



POLITÉCNICA

INTERNATIONAL  
CAMPUS OF  
EXCELLENCE

COORDINATION PROCESS OF  
LEARNING ACTIVITIES  
PR/CL/001



E.T.S. de Ingenieros de  
Telecomunicacion

# ANX-PR/CL/001-01

## LEARNING GUIDE

**SUBJECT**

**93000844 - Ingeniería Neurosensorial**

**DEGREE PROGRAMME**

09AQ - Master Universitario En Ingeniería De Telecomunicacion

**ACADEMIC YEAR & SEMESTER**

2025/26 - Semester 1

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## 1. Description

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### 1.1. Subject details

<b>Name of the subject</b>	93000844 - Ingenieria Neurosensorial
<b>No of credits</b>	6 ECTS
<b>Type</b>	Optional/elective
<b>Academic year of the programme</b>	Second year
<b>Semester of tuition</b>	Semester 3
<b>Tuition period</b>	September-January
<b>Tuition languages</b>	English
<b>Degree programme</b>	09AQ - Master Universitario en Ingenieria de Telecomunicacion
<b>Centre</b>	09 - E.T.S. De Ingenieros De Telecomunicacion
<b>Academic year</b>	2025-26

## 2. Faculty

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### 2.1. Faculty members with subject teaching role

<b>Name and surname</b>	<b>Office/Room</b>	<b>Email</b>	<b>Tutoring hours *</b>
Andres De Santos Lleo (Subject coordinator)	C-227	andres.santos@upm.es	Sin horario. Contact by email
Ricardo De Cordoba Herralde	B-108	ricardo.cordoba@upm.es	Sin horario. Contact by email
Juan Jose Gomez Valverde	C-230	juanjo.gomez@upm.es	Sin horario. Contact by email

\* The tutoring schedule is indicative and subject to possible changes. Please check tutoring times with the faculty member in charge.

## 3. Skills and learning outcomes \*

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### 3.1. Skills to be learned

CE15 - Capacidad para la integración de tecnologías y sistemas propios de la Ingeniería de Telecomunicación, con carácter generalista, y en contextos más amplios y multidisciplinares como por ejemplo en bioingeniería, conversión fotovoltaica, nanotecnología, telemedicina.

CG4 - Que los estudiantes sepan comunicar sus conclusiones y los conocimientos y razones últimas que las sustentan a públicos especializados y no especializados de un modo claro y sin ambigüedades.

CG5 - Que los estudiantes posean las habilidades de aprendizaje que les permitan continuar estudiando de un modo que habrá de ser en gran medida autodirigido o autónomo.

CT1 - Capacidad para comprender los contenidos de clases magistrales, conferencias y seminarios en lengua inglesa.

CT4 - Capacidad para trabajar de forma efectiva como individuo, organizando y planificando su propio trabajo, de forma independiente o como miembro de un equipo.

CT5 - Capacidad para gestionar la información, identificando las fuentes necesarias, los principales tipos de documentos técnicos y científicos, de una manera adecuada y eficiente.

### 3.2. Learning outcomes

RA62 - Conocer el funcionamiento básico de los órganos sensoriales del cuerpo humano y saber analizar el funcionamiento y las posibilidades de prótesis y ayudas para discapacitados

RA26 - Capacidad para abordar la gestión de proyectos de ingeniería como un problema ético y sistémico, de tecnología, gestión y factor humano. (CG3, CT5, CT6, CE6, CE7, CE8, CE9)

RA63 - Comprender el funcionamiento, las características principales y aplicaciones de las interfaces sensoriales basadas en habla (síntesis y reconocimiento), multisensoriales y de realidad virtual

RA10 - Saber realizar una presentación de carácter técnico, ante una audiencia de pares, que describa el trabajo realizado y sus resultados, de forma clara y bien estructurada, en el tiempo establecido, y usando un lenguaje preciso

RA60 - Capacidad para entender los fundamentos del procesamiento de información en el sistema nervioso

RA9 - Saber redactar informes técnicos sobre trabajos realizados, con una estructura, contenidos y lenguaje del nivel adecuado a un trabajo de ingeniería

RA61 - Capacidad para entender el funcionamiento básico de sistemas que interactúan directamente con el sistema nervioso como interfaces cerebro-ordenador o neuroprótesis

\* The Learning Guides should reflect the Skills and Learning Outcomes in the same way as indicated in the Degree Verification Memory. For this reason, they have not been translated into English and appear in Spanish.

## 4. Brief description of the subject and syllabus

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### 4.1. Brief description of the subject

This course focuses on electronic systems that interact with the human body, particularly the nervous system and sensory organs.

This includes assistive technology for people with disabilities and communication systems that use speech and brain-computer interfaces.

Examples of artificial systems that emulate biological ones and advanced multisensory interfaces will also be covered.

### 4.2. Syllabus

1. Introduction
2. The nervous system
  - 2.1. Information processing in the nervous system
  - 2.2. Functional electrical stimulation and neuroprosthesis
  - 2.3. Brain-computer interfaces
  - 2.4. Introduction to nervous system modeling - Neural networks
3. Sensory systems: physiology, aids for the disabled, artificial systems
  - 3.1. Vision
  - 3.2. Hearing
  - 3.3. Touch, pain and temperature
  - 3.4. Smell and taste

#### 4. Multisensory user interfaces

- 4.1. Speech synthesis and recognition
- 4.2. Alternative and augmentative communication
- 4.3. Virtual reality

## 5. Schedule

### 5.1. Subject schedule\*

Week	Type 1 activities	Type 2 activities	Distant / On-line	Assessment activities
1	<b>Module 1</b> Duration: 01:00 Lecture  <b>Module 2.1</b> Duration: 02:00 Lecture			
2	<b>Module 2.2</b> Duration: 03:00 Lecture			
3	<b>Module 2.3</b> Duration: 03:00 Lecture			<b>Participation and exercises</b> Individual work Progressive assessment Presential Duration: 00:00
4	<b>Module 3.1</b> Duration: 03:00 Lecture			
5	<b>Module 3.1</b> Duration: 03:00 Lecture			
6	<b>1st partial exam</b> Duration: 03:00 Additional activities			<b>1st partial exam</b> Written test Progressive assessment Presential Duration: 00:00
7	<b>Module 2.4</b> Duration: 02:00 Lecture  <b>Module 3.2</b> Duration: 01:00 Lecture			
8	<b>Module 3.2</b> Duration: 03:00 Lecture			
9	<b>Module 4.1</b> Duration: 03:00 Lecture			
10	<b>Modules 4.2</b> Duration: 03:00 Lecture			

11	<b>Module 3.3</b> Duration: 02:00 Lecture  <b>Module 4.3</b> Duration: 01:00 Lecture			<b>Participation and exercises</b> Individual work Progressive assessment Presential Duration: 00:00
12	<b>2nd partial exam</b> Duration: 03:00 Additional activities			<b>2nd partial exam</b> Written test Progressive assessment Presential Duration: 00:00
13		<b>Teamwork presentations</b> Duration: 03:00 Additional activities		<b>Teamwork</b> Group presentation Progressive assessment and Global Examination Presential Duration: 00:00
14		<b>Teamwork presentations</b> Duration: 03:00 Additional activities		<b>Teamwork</b> Group presentation Progressive assessment and Global Examination Presential Duration: 00:00
15				
16				
17				<b>Final exam</b> Written test Global examination Presential Duration: 03:00

Depending on the programme study plan, total values will be calculated according to the ECTS credit unit as 26/27 hours of student face-to-face contact and independent study time.

## 6. Activities and assessment criteria

### 6.1. Assessment activities

#### 6.1.1. Assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
3	Participation and exercises	Individual work	Face-to-face	00:00	5%	0 / 10	CE15
6	1st partial exam	Written test	Face-to-face	00:00	35%	0 / 10	CT5 CT1 CE15
11	Participation and exercises	Individual work	Face-to-face	00:00	5%	0 / 10	CE15
12	2nd partial exam	Written test	Face-to-face	00:00	35%	0 / 10	CT5 CT1 CE15
13	Teamwork	Group presentation	Face-to-face	00:00	20%	2 / 10	CT4 CG4 CT5 CE15 CG5
14	Teamwork	Group presentation	Face-to-face	00:00	%	/ 10	

#### 6.1.2. Global examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
13	Teamwork	Group presentation	Face-to-face	00:00	20%	2 / 10	CT4 CG4 CT5 CE15 CG5
14	Teamwork	Group presentation	Face-to-face	00:00	%	/ 10	
17	Final exam	Written test	Face-to-face	03:00	80%	5 / 10	CT5 CT1 CE15

#### 6.1.3. Referred (re-sit) examination

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
Teamwork	Group work	Face-to-face	03:00	20%	2 / 10	CG5 CT4 CE15 CG4 CT5
Final exam	Written test	Face-to-face	04:00	80%	5 / 10	CE15 CT5 CT1

## 6.2. Assessment criteria

The course will be passed if a grade of at least 5 out of a total of 10 points is obtained, provided that the minimum grade is achieved in activities with a required minimum. If this minimum is not achieved, the grade cannot be higher than 4.5.

The evaluation assesses whether the students have acquired all the course competencies. The global and extraordinary evaluations will use the same evaluation techniques as the progressive evaluation and will take place on the dates and times approved by the School Council (Junta de Escuela) for the current academic year. However, activities that assess learning outcomes that cannot be evaluated through a final exam will take place throughout the semester.

Specifically, the evaluation will include a written group work and an oral presentation of the work. This activity is mandatory and non-recoverable, since the work must be presented publicly to all the students, and everyone must participate in the subsequent debate (competence CG4). After each group's oral presentation, a debate will be initiated, during which students must demonstrate their understanding of all aspects of the work presented. This activity will take place during weeks 13 and 14, depending on the number of presentations. The exact dates of the presentations will be announced at least 14 days in advance.

### Progressive evaluation:

This is the recommended method. It includes:

- Participation and exercises during the classes (10%)
- First partial exam (35%)
- Second partial exam (35%)

- Teamwork: Written text and oral presentation of a case study selected by teams of two students (20%)

### **Global exam**

To take the final exam, students must have previously presented the written and oral teamwork assignments with the same rules and dates as the progressive evaluation.

The global exam will cover the entire course syllabus. Students must submit a written request to take the exam at least two weeks before the scheduled date.

### **Extraordinary (re-sit) assessment**

To take the final exam, students must have previously presented the written and oral teamwork assignments with the same rules and dates as the progressive evaluation.

This exam will cover the entire course syllabus.

## 7. Teaching resources

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### 7.1. Teaching resources for the subject

Name	Type	Notes
Neuroscience. Exploring the brain	Bibliography	M. Bear, B. Connors, M. Paradiso. Neuroscience. Exploring the brain. Lippincott Williams & Wilkins. (3rd ed.). 2006. ISBN: 978-0781760034
Slides used in the classes	Web resource	Available in moodle
Neural engineering	Bibliography	Supplementary material  B. He. Neural Engineering (2nd ed.). Springer- Verlag. 2013. ISBN: 978-1461452263
Neuroscience	Bibliography	Supplementary material  D. Purves et al. Neuroscience. Palgrave Macmillan (5th ed.). 2012. ISBN: 978-0878939671

## 8. Other information

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### 8.1. Other information about the subject

This course is related to United Nations' Sustainable Development Goals, in particular goal SDG3: Ensure healthy lives and promote well-being for all at all ages; goal SDG4: Quality education, and goal SDG9: industry, innovation & infrastructure