ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

93001326 - NeuroprostÉtica

DEGREE PROGRAMME

09BQ - Master In Science In Neurotechnology

ACADEMIC YEAR & SEMESTER

2024/25 - Semester 2

Index

Learning guide

1. Description

1.1. Subject details

Name of the subject	93001326 - Neuroprostética
No of credits	6 ECTS
Type	Compulsory
Academic year ot the programme	First year
Semester of tuition	Semester 2
Tuition period	February-June
Tuition languages	English
Degree programme	09BQ - Master In Science In Neurotechnology
Centre	09 - Escuela Tecnica Superior De Ingenieros De Telecomunicacion
Academic year	2024-25

2. Faculty

2.1. Faculty members with subject teaching role

Name and surname	Office/Room	Email	Tutoring hours *
Alvaro Gutierrez Martin (Subject coordinator)		a.gutierrez@upm.es	- -
Blanca Larraga Garcia		blanca.larraga@upm.es	Sin horario.
Georgios Kontaxakis Antoniadis		g.kontaxakis@upm.es	Sin horario.
Juan Jose Gomez Valverde		juanjo.gomez@upm.es	Sin horario.

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

3. Prior knowledge recommended to take the subject

3.1. Recommended (passed) subjects

- Neurodevices

- Neurosignals And Neuroimaging

3.2. Other recommended learning outcomes

The subject - other recommended learning outcomes, are not defined.

4. Skills and learning outcomes *

4.1. Skills to be learned

C3 - Concebir, desarrollar y validar nuevos neurodispositivos y neuroprótesis que puedan aumentar la calidad de vida de las personas, y realizar, en contextos académicos y profesionales, innovaciones o avances tecnológicos que puedan hacer avanzar el estado del arte en áreas relacionadas con la neurotecnología. Competencias

C4 - Resolver problemas de neurodispositivos, neuroseñales e inteligencia artificial, integrando conocimiento en aspectos nuevos o escasamente definidos y en entornos multidisciplinares. Competencias

C5 - Aplicar metodologías, procedimientos, herramientas y normas del estado del arte para la creación de nuevos componentes tecnológicos, y construir nuevas hipótesis y modelos, evaluarlos y aplicarlos a la resolución de problemas en el área de la neurotecnología. Competencias

K4 - Comprender los conceptos y técnicas avanzadas de la electrónica, de la instrumentación biomédica y de los biomateriales en la neuroingeniería. Conocimientos.

K5 - Comprender los principales conceptos avanzados sobre prótesis neurosensoriales y motoras, incluyendo los tipos de prótesis disponibles y los principios básicos de su funcionamiento. Conocimientos

K6 - Conocer los métodos de estimulación neuronal y neuromodulación, y entender los principales conceptos avanzados de las interfaces cerebro-ordenador y cerebro-cerebro, y sus relaciones con las prótesis neurosensoriales y motoras. Conocimientos

S1 - Aplicar técnicas de neurotecnología adecuadas (neurodispositivos, neuroprótesis, procesamiento de neuroseñales, inteligencia artificial) ante problemas mixtos tecnológicos y clínicos y entender los desafíos y oportunidades asociados con su aplicación en este campo.Habilidades

S3 - Seleccionar y aplicar técnicas avanzadas para el procesamiento de señales neuroelectrofisiológicas e imágenes cerebrales para diseño, implementación y evaluación de interfaces cerebro-máquina, y dispositivos de neurorehabilitación que permitan diagnosticar y tratar enfermedades neurológicas y neuropsiquiátricas. Habilidades

S4 - Comunicar trabajos y conclusiones a comunidades de iguales o a públicos generales de una manera razonada, clara y sin ambigüedades, elaborar artículos o memorias técnicas, y transmitir de un modo claro los avances científicos y tecnológicos o de la innovación más avanzada a audiencias especializadas y no especializadas. Habilidades

S5 - Utilizar las tecnologías de la información y la comunicación para la búsqueda de información y datos bibliográficos, y para la adquisición de nuevo conocimiento para la formación permanente y el trabajo autónomo.Habilidades

4.2. Learning outcomes

RA3 - S4

* 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.

5. Brief description of the subject and syllabus

5.1. Brief description of the subject

The neuroprosthesis course is an intensive, hands-on program designed to immerse students in the practical aspects of prosthetic devices.

The course emphasizes real-world application, with students spending the majority of their time in labs.

Participants will engage in collaborative projects, from initial concept through to prototype development and testing, gaining valuable experience in technical considerations of neuroprosthetic engineering.

5.2. Syllabus

1. Introduction
2. Implants and electronic organs
   - 2.1. Auditive implants
   - 2.2. Visual implants
   - 2.3. Electronic noise
   - 2.4. Electronic tongue
   - 2.5. Somatosensorial implants
3. Limb prosthesis
   - 3.1. Kinematics
   - 3.2. Trajectories
   - 3.3. Haptic systems
   - 3.4. Neural stimulation and modulation
4. Practice

6. Schedule

6.1. Subject schedule*

Week	Type 1 activities	Type 2 activities	Distant / On-line	Assessment activities
1	**Introduction** Duration: 02:00 **Implants and electronic organs** Duration: 02:00			
2	**Implants and electronic organs** Duration: 02:00 **Limb prosthesis** Duration: 02:00			
3	**Implants and electronic organs** Duration: 02:00	**Practice** Duration: 02:00		
4	**Implants and electronic organs** Duration: 02:00	**Practice** Duration: 02:00		
5	**Implants and electronic organs** Duration: 02:00	**Practice** Duration: 02:00		
6	**Implants and electronic organs** Duration: 02:00 **Limb prosthesis** Duration: 02:00			
7	**Limb prosthesis** Duration: 02:00	**Evaluation** Duration: 02:00		**Evaluation** Progressive assessment Presential Duration: 02:00
8		**Practice** Duration: 04:00		
9		**Practice** Duration: 04:00		

10		**Practice** Duration: 04:00		
11		**Practice** Duration: 04:00		
12		**Practice** Duration: 04:00		
13		**Practice** Duration: 04:00		
14				**Evaluation** Progressive assessment Presential Duration: 04:00
15				
16				
17				**Evaluation** Global examination Presential Duration: 02:00 **Evaluation** Global examination Presential Duration: 02:00

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.

7. Activities and assessment criteria

7.1. Assessment activities

7.1.1. Assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
7	Evaluation		Face-to-face	02:00	20%	5 / 10	C5 K4 K5
14	Evaluation		Face-to-face	04:00	80%	5 / 10	C3 C4 C5 S1 S3 S4 S5 K4 K5 K6

7.1.2. Global examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
17	Evaluation		Face-to-face	02:00	20%	5 / 10	
17	Evaluation		Face-to-face	02:00	80%	5 / 10	C3 C4 C5 S1 S3 S4 S5 K4 K5 K6

7.1.3. Referred (re-sit) examination

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
EValuation		Face-to-face	02:00	20%	5 / 10	C5 K4 K5
Evaluation		Face-to-face	02:00	80%	5 / 10	C3 C4 C5 S1 S3 S4 S5 K4 K5 K6

7.2. Assessment criteria

Evaluation will assess if students have acquired all the competences of the subject. The students will pass the course when a grade greater than or equal to 5 points out of a total of 10 is obtained. The final grade will be obtained by adding the grades and percentages corresponding to the different evaluation activities, as shown in the corresponding section of this document. Deliveries must be the result of work in assigned groups during the course. Copying, plagiarism or any other show of deception in the work delivered will mean the failure of said part and the regulations of UPM evaluation for the corresponding academic year. The evaluation will check whether the students have acquired the skills of the subject. Therefore, the evaluation by global test will use the same types of evaluation techniques that are used in the evaluation progressive, although the evaluation activities by final test focus on the dates and times of final evaluation approved by the School Board for the current course and semester.

8. Teaching resources

8.1. Teaching resources for the subject

Name	Type	Notes
Neuroscience - D Purves et al. OUP Higher Education Division (6th edition). 2017. ISBN: 9781605358413	Bibliography	
M. Spong and M. Vidyasagar. Robot Dynamics And Control. 1989. John Wiley Sons.	Bibliography	
J.J. Craig. Introduction to Robotics. Mechanics And Control. 1986. Addison-Wesley Publishing Company, Inc.	Bibliography	