

# Neurosensorial and Bioinstrumentation Engineering



Departamento de  
Ingeniería  
Electrónica

Universidad Politécnica de Madrid

Máster Oficial en Ingeniería  
de Sistemas Electrónicos

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## Neurosensorial and Bioinstrumentation Engineering (INSB 2)

*Number of credits: 4.*

*Semester: 2*

*Type: optional*



## Objectives

The main objective of the course is the study of the nervous system and sensory systems with a view to simulation and their integration into electronic systems, including some applications of sensor-neural engineering such as prostheses and multisensory interfaces. Bio-inspired systems will be studied, such as artificial systems that emulate or imitate some of the capabilities of living beings.

Moreover, some systems of biological monitoring will also be studied, with the primary aim of helping in the medical diagnosis of certain pathologies. Basically, it will be based on two of the most important systems, such as the heart and brain, though many of the techniques will be applied to other organs as well. The main skills are:

1. Explain the basic processes involved in biological sensory systems and engines.
2. Critically expose the existing technological alternatives to replace the motor or sensory capabilities of humans in the case of people with disabilities.
3. Analyze natural processes or structures that can be played in bio-inspired systems.
4. Apply some of the existing tools for the analysis of basic biological functions, especially those based on biomedical signals and images.

## Program

I. Presentation and course objectives

II. The nervous system and the brain

III. The hearing system

III.1. Physiology and function

III.2 Sound perception and speech

III.3. Prostheses and implants

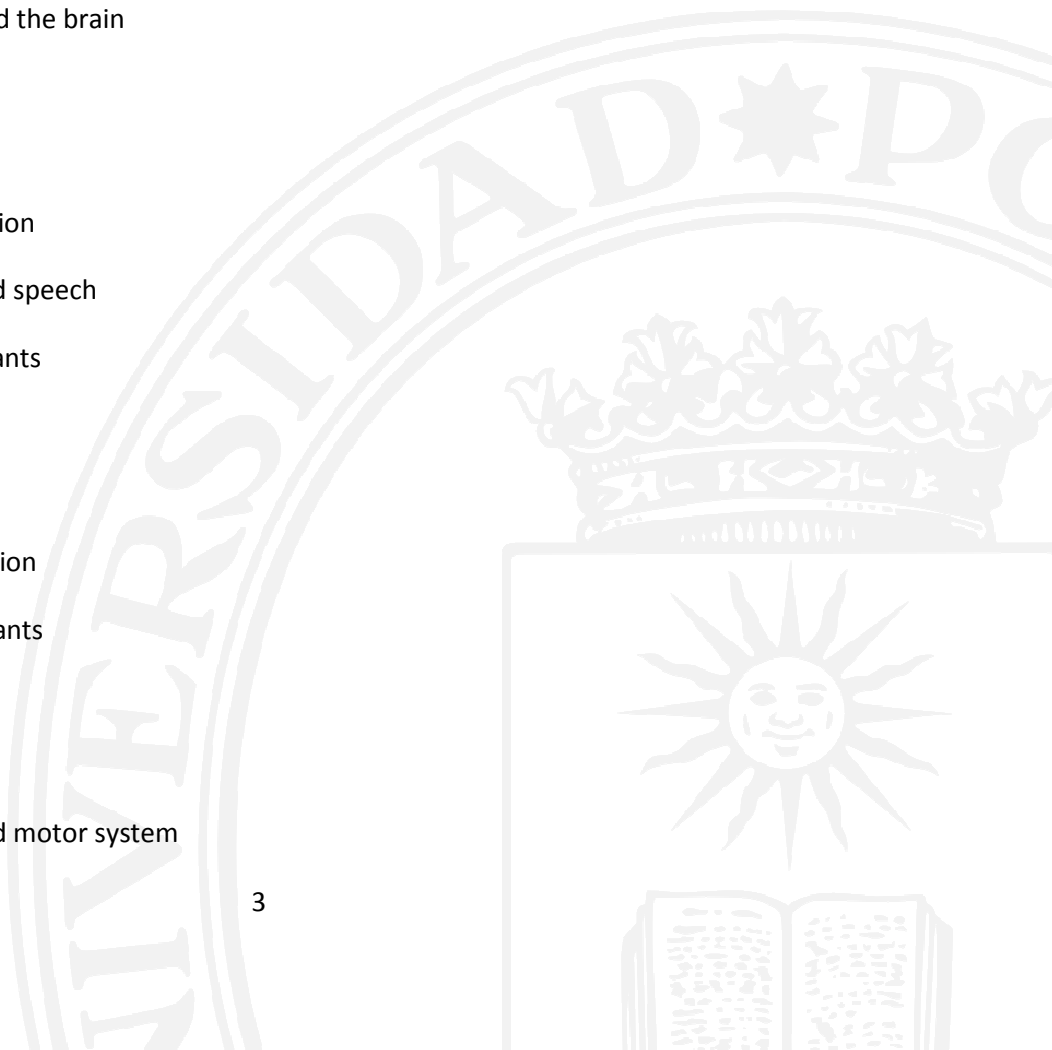
IV. The visual system

IV.1. Physiology and function

IV.2. Prostheses and implants

IV.3. Artificial vision

V. The somatosensory and motor system



V.1. Physiology and function.

V.2. Functional Electrical Stimulation

V.3. Bio-inspired systems

VI. Smell and taste system

VI.1. Physiology and function

VI.2 Smell and artificial taste

VII. Speech production and alternative / augmentative communication

VIII. Multisensory interfaces and artificial reality

IX. Non-invasive biological monitoring I

IX.1. Cardiovascular activity

IX.2 Acquisition and signal processing and cardiac imaging

X. Non-invasive biological monitoring II

X.1. Brain activity

X.2 Acquisition and signal processing and brain imaging

Final work: draw up a written report by the students on an optional subject, together with its oral presentation in class

### **Bibliography**

- M. Bear, B. Connors, M. Paradiso. Neurociencia. Explorando el cerebro. Lippincott Williams & Wilkins. (3a ed.). 2009. ISBN: 978-8496921092

- Slides, available at Moodle.

Complementary:

- B. He. Neural Engineering (2nd ed.). Springer-Verlag. 2013. ISBN: 978-1461452263

- D. Purves et al. Neuroscience. Palgrave Macmillan (5th ed.). 2012. ISBN: 978-0878939671  
(Versión en español de Editorial Médica Panamericana 2010)

## Teachers

Coordinator: Andrés Santos Lleó  
Teachers: Andrés Santos Lleó  
Ricardo de Córdoba Herralde

## Teaching Methodology

- Evaluation

Class attendance is mandatory, minimum attendance 75% of the sessions.

- Continuous evaluation

Continuous assessment is performed, which may include delivery of brief personal work and individual and team work.

- Final evaluation

The final test is an examination of short questions without books or notes.

- Elaboration and presentation of work

Must be submitted in writing and orally present a paper on the topic of the subject.

## Evaluation

The evaluation of the course will be based on the following parameters:

- Participation in forums and activities in class and in moodle (5%).
- Proposed work, individual work and group (20%).
- Final test (75%).

Note the importance of continuous monitoring of the subject, as well as take advantage of forums, hours of tutoring and classroom to see the student progress.

## Contact

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Moodle:

<http://moodle.upm.es/titulaciones/oficiales/course/view.php?id=691>

