

**Molecular Neurobiology and Physiology**

Code: 42890  
ECTS Credits: 9

Degree	Type	Year	Semester
4313792 Neurosciences	OB	0	1
4313794 Biochemistry, Molecular Biology and Biomedicine	OT	0	1

**Contact**

Name: Alfredo Jesús Miñano Molina  
Email: Alfredo.Minano@uab.cat

**Use of languages**

Principal working language: spanish (spa)

**Teachers**

Antonio Armario García  
Victoria Clos Guillén  
Marcel Jiménez Farrerons  
Xavier Navarro Acebes  
José Rodríguez Álvarez  
Jordi Ortiz de Pablo  
Carlos Alberto Saura Antolin  
Guillermo García Alias  
Roser Masgrau Juanola  
Francesc Jiménez Altayo  
Ruben Lopez Vales

**External teachers**

Bryen A. Jordan  
Julio Morán Andrade

**Prerequisites**

Good level of English. Part of the classes and some of the materials will be given in English, so good level of this language is mandatory

In case any of the students does not speak Catalan, classes will be given in Spanish and/or English, so knowledge of Spanish is also mandatory.

Students with a degree in the biosciences field or similar (Biology, biochemistry, biotechnology, microbiology, genetics, biomedical sciences, medicine, veterinary, pharmacy, psychology...)

Knowledge about neuroanatomy is highly recommended. Background in biochemistry and physiology is expected.

## Objectives and Contextualisation

The main goal of the module is to learn the chemical, cellular and functional characteristics of the central and peripheral nervous system in order to reach a basic knowledge of Neurosciences, to be able to understand any field in neurosciences and the bases of the pathologies of the nervous system.

## Skills

### Neurosciences

- Analyze the performance of the motor, sensory and autonomic systems and the brain integrative functions, and know the experimental techniques used to study.
- Continue the learning process, to a large extent autonomously
- Explain how the intermediary metabolism of the nervous system, chemical processes and pharmacology transmission based receptors, transporters and enzymes of the metabolism of neurotransmitters or their transduction mechanisms work.
- Explain the basis of treatments for pathologies of the nervous system.
- Use acquired knowledge as a basis for originality in the application of ideas, often in a research context.

### Biochemistry, Molecular Biology and Biomedicine

- Analyse and correctly interpret the molecular mechanisms operating in living beings and identify their applications.
- Analyse and explain normal morphology and physiological processes and their alterations at the molecular level using the scientific method.
- Continue the learning process, to a large extent autonomously.
- Develop critical reasoning within the subject area and in relation to the scientific or business context.
- Use acquired knowledge as a basis for originality in the application of ideas, often in a research context.
- Use and manage bibliography and IT resources related to biochemistry, molecular biology or biomedicine.

## Learning outcomes

1. Continue the learning process, to a large extent autonomously
2. Continue the learning process, to a large extent autonomously.
3. Describe the processes of synthesis and inactivation of neurotransmitters.
4. Describe the working and the regulation of motor circuits, circuits of the autonomous nervous system and sensorial circuits.
5. Develop critical reasoning within the subject area and in relation to the scientific or business context.
6. Distinguish the mechanisms of action of drugs that modulate the action of neurotransmitters.
7. Evaluate and implement improvements or changes, either in methods or parameters, in the clinical laboratory.
8. Explain electric phenomena in neurons, in molecular and ionic terms.
9. Explain the mechanism of action of drugs that are useful in the treatment of neurodegenerative processes.
10. Identify and describe the working of brain integration functions.
11. Recognise and explain the characteristics and special requirements of biochemical and genetic analyses in clinical laboratories
12. Use acquired knowledge as a basis for originality in the application of ideas, often in a research context.
13. Use and manage bibliography and IT resources related to biochemistry, molecular biology or biomedicine.

## Content

## PROGRAM OF THE SUBJECT

### **Molecular and Physiological Neurobiology (Module 2)**

#### **“ Generalities on neurotransmission and receptor pharmacology (Dr Ortiz). 2h**

General characteristics of synapse and chemical neurotransmission

General concepts on receptor pharmacology: Specificity and multiplicity of neurotransmitter action

Agonists and antagonists

Interaction ligand-receptor and associated responses: affinity and EC50

#### **“ Signal transduction mechanisms (Dra Masgrau). 4h**

Receptors directly/indirectly linked to ionic channels

Structure and pharmacological sites of action

Receptors linked to G proteins

Receptors with tyrosine kinase activity

#### **“ Excitatory and inhibitory aminoacid neurotransmission (Dr Miñano). 4h**

Metabolism of glutamate and other excitatory amino acids

Pharmacology of glutamate receptors

Ionotropic and metabotropic receptors

GABA metabolism, GABA receptors pharmacology

Glycine receptors

#### **“ Serotonergic neurotransmission (Dr Jiménez Altaya). 1'5h**

Metabolism of serotonin

Pharmacology of serotonin receptors

Monoaminergic hypothesis of depression

#### **“ Noradrenergic neurotransmission (Dr Jiménez Altaya). 1'5h**

#### **“ Dopaminergic neurotransmission (Dra Clos). 1'5h**

#### **“ Cholinergic neurotransmission (Dra Clos). 1'5h**

Metabolism of acetylcholine

Functional aspects of cholinergic neurotransmission

Pharmacology of cholinergic receptors

#### **“ Histaminergic neurotransmission (Dr Ortiz). 2h**

Metabolism of histamine

Pharmacology of histamine receptors

“ **Purinergic neurotransmission (Dr Saura). 2h**

Metabolism of adenosine and purine nucleotides

Pharmacology of purinergic receptors

“ **Neuropeptides (Dr Armario). 2h**

“ **REDOX regulation in CNS (Dr Morán, external professor - UNAM, Mexico). 2h**

Effect of Reactive Oxygen Species (ROS) on CNS

ROS as regulators of physiologic processes as synaptic plasticity

Mechanisms of action of ROS in CNS

Signaling pathways involved in ROS action

“ **Synaptic function and dysfunction in Neurological Diseases (Dr Jordan, external professor - Albert Einstein College of Medicine, NY, US). 2h**

“ **Electrical phenomena of neurons (Dr Jiménez Farrerons). 2h**

Ionic transport across cell membrane

Active transport, Ionic channels, transmembrane resting potential

Action potential: generation and propagation

Production of pulse trains. Stimulus / frequency relation

“ **Somatosensory systems (Dr López Vales). 4h**

Introduction to sensory physiology

Sensory receptors

Sensory pathways coding

Central integration and sensory information transduction

Somatic sensitivity to touch, kinesthesia, thermal, pain, and visceral

“ **Motor systems (Dr García-Alias). 6h**

Excitation and muscle contraction

Functional structure of striatal muscle fibers

Electrical phenomena. Neuro-muscular transmission

Mechanisms of muscle contraction in striatal and smooth fibers

Segmentary control of movement and posture

Motor Unit

Segmentary reflex

Gamma-motor system

Propiospinal control circuits

Suprasegmentary control of movement and posture

Motor cerebral cortex

Basal ganglia

Motor centers of brainstem

Cerebellum

**“ Autonomic nervous system (Dr Navarro). 3h**

Efferent systems

Hypothalamus. Functional organization and multi-systemic control

Limbic system and cerebral cortex

Autonomic regulation of visceral functions

**“ Special Senses (Dr Navarro). 3h**

Taste sensitivity: Receptors, sensations, pathways and central connections

Olfactory sensitivity: Receptors, sensations, pathways and central connections

Hearing sensitivity

Vestibular sensitivity

Optic sensitivity

**“ Integrative functions in the brain (Dr Navarro). 1h**

Electrical brain activity

Biological rhythms

Functional organization of neocortex

Language

**“ Practical sessions.**

Nerve conduction and channels (Dr Jiménez Farrerons). 2h

Electromyography (Dr Navarro). 2h

**“ Integrative Seminars.**

Dr José Rodríguez-Álvarez 2h (half group)

Dr Alfredo J. Miñano 2h (half group)

Dr Julio Morán (External professor - UNAM, Mexico) 4h (half group)

Dra Roser Masgrau 4h (half group)

Dr Guillermo García-Alías 8h (half group)

Dr Marcel Jiménez 2h

## Methodology

Combination of theoretical lectures and working with scientific articles where the more relevant themes will be exposed. It is assumed that the student will complement these sessions with reading of papers and books. Autonomous study is required for the student to reach the knowledge required to pass the module.

Laboratory practices will be done where the student will learn through the practice of some of the theoretical concepts. These practical sessions will be evaluated by means of a group work or a short evaluation at the end of the session.

Integrative seminars will be performed where the students have to prepare some articles that will be discussed in a seminar class. To understand the articles, students must integrate the knowledge of the program and its application on research.

## Activities

Title	Hours	ECTS	Learning outcomes
<b>Type: Directed</b>			
Integrative seminars	11	0.44	
Laboratory practicals	4	0.16	
Theoretical classes	46	1.84	
<b>Type: Autonomous</b>			
Autonomous study	104	4.16	
Integrative seminars preparation	40	1.6	
Work preparation	15	0.6	

## Evaluation

To pass the module, students must get a minimum mark of 5 (to 10). Two written exams will amount 35% each of this mark (students need a minimum of 4 in each exam to average). The remaining 30% of the mark will be evaluated in the practical sessions (through a group work or a short evaluation at the end of the practical session) and in the integrative seminars (through the participation of the students and a short evaluation at the end of each session). The students that have been presented to the two partial exams (set of evidences greater than 2/3 of the continuous evaluation) can only be presented for recovery. Thus, the student will be graded as "No Avaluable" if the weighthin of all conducted evaluation activities is less than 67% of the final score".

**Important:** If plagiarism is detected in any of the works submitted, the student may fail the whole module.

## Evaluation activities

Title	Weighting	Hours	ECTS	Learning outcomes
Evaluation of Integrative seminars	15	0.8	0.03	4, 3, 7, 5, 6, 11, 8, 2, 1, 12, 13
Evaluation of Practical sessions	15	0.2	0.01	8, 2, 1, 12, 13

Written exam 1st Part	35	2	0.08	4, 3, 7, 6, 11, 9, 8, 10, 12
Written exam 2nd Part	35	2	0.08	4, 3, 7, 6, 11, 9, 8, 10, 12

## Bibliography

- Kandel E. Principles of neural science. Fifth edition, McGraw Hill, 2012.
- Purves D. Neurociencia, Panamericana, 2006.
- Waxman S. Molecular neurology. Academic Press 2007.
- Cooper JR. The Biochemical Basis of Neuropharmacology, 8<sup>th</sup> ed. Oxford Univ Press, 2002.
- Pratt WB, P Taylor. Principles of Drug Action. Churchill Livingstone, New York 1990.
- Siegel GJ. Basic Neurochemistry, 7<sup>th</sup> ed. Academic Press, 2006.
- Carpenter RHS. Neurophysiology. Ed Arnold, London, 2003.
- Cardinali. Neurociencia: sus fundamentos. Ed Panamericana, Buenos Aires, 2007
- Matthews GG. Neurobiology. Ed Blackwell Science, 2001.
- Squire LR et al. Fundamental Neuroscience. Ed Academic Press, Amsterdam, 2008.