

Degree programme	Type	Course
Biomedical Sciences	OP	4

Contact lecturer

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Group languages

You can consult this information at the [end](#) of the document.

Prerequisites

There is no official requirements, but it is recommended that students have completed most of the subjects of the first three courses of the Biomedical Sciences or Biochemistry Degrees.

Objectives

In the context of Molecular Physiology, the *Neurochemistry* course is designed to understand the bases of the central and peripheral nervous system function under physiological and pathological conditions. This course includes the study of different cell types and regions involved in the function of the adult brain. The subject emphasizes the teaching of biochemical and cellular processes involved in the function and relationships of different regions in the brain. A central point of the agenda is the knowledge of the different types and steps of neurotransmission, as well as the molecular mechanisms regulating the release of neurotransmitters and their postsynaptic action (neuronal plasticity and gene expression). It focuses in molecular processes involved in metabolism, regulation and release of the main neurotransmitters (glutamate, GABA, acetylcholine, catecholamines, serotonin, neuropeptides and others), together with their mechanisms of action in the postsynaptic cell. Finally, we will study the biochemical and pathophysiological mechanisms involved in several brain diseases such as mental disorders and neurodegenerative diseases. The final objective is to examine the biochemical and molecular aspects of brain function in physiological and pathological conditions so that the student can develop critical reasoning about the function and dysfunction of the nervous system.

The specific educative aims of this course are:

1. To understand the anatomical organization of the nervous system.

2. To understand the cellular organization of the nervous system.
3. To acquire a global view of the cellular mechanisms involved in differentiation and function of cells in the nervous system.
4. To know the structure, function and relevance of the barriers present in the nervous system.
5. To understand the importance of cellular compartmentalization in the context of the metabolism of nervous system.
6. To understand the molecular and electrical fundamentals responsible for the transmission of nerve impulses.
7. To know the molecular events at synapses and neurotransmitter storage, release and inactivation.
8. To know the molecular structure and function of ion channels and membrane receptors for neurotransmitters.
9. To know the basis of the metabolism and action of the main neurotransmitters.
10. To understand the biochemical mechanisms involved in some diseases of the nervous system.
11. To develop critical reasoning to deepen into scientific issues related to biochemistry of the nervous system.

Learning outcomes

1. Work as part of a group with members of other professions, understanding their viewpoint and establishing a constructive collaboration.
2. Understand the basic mechanisms of cell and tissue physiology.
3. Analyse and identify the functional alterations, at the level of the nervous system, nerve cells and neurotransmitters, that are caused by various types of pathologies.
4. Correctly use the terminology of neuroscience and its text and reference books.
5. Describe the principal experimental techniques in neuroscience and their use in basic and applied research.
6. Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
7. Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
8. Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
9. Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
10. Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.
11. Make changes to methods and processes in the area of knowledge in order to provide innovative responses to society's needs and demands.
12. Take account of social, economic and environmental impacts when operating within one's own area of knowledge.
13. Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
14. Take sex- or gender-based inequalities into consideration when operating within one's own area of knowledge.

Contents

CONTENTS OF THE COURSE

CHAPTER I: BASIC FUNDAMENTS OF THE NERVOUS SYSTEM

1. ANATOMICAL AND CELLULAR ORGANIZATION OF THE NERVOUS SYSTEM. Organization of the central and peripheral nervous system. Molecular, morphological and functional features of the cell types of the nervous system: neurons and glial cells.

2. BARRIERS AND FLUIDS OF THE NERVOUS SYSTEM. Blood-brain barrier and Blood-CSF Barrier. Cerebrospinal fluid.

3. HOMEOSTASIS OF THE NERVOUS SYSTEM. Neurovascular coupling. Cellular compartmentalization and metabolism.

CHAPTER II: MECHANISMS OF NEUROTRANSMISSION

4. NEUROTRANSMISSION IN THE NERVOUS SYSTEM. Types of neurotransmission: chemical and electrical synapses. Structure and function of synapses. Calcium-dependent and -independent neurotransmitter release. Structure and cycle of synaptic vesicles. Structure and function of neurotransmitter receptors: ionotropic and G protein-coupled receptors and effectors. Desensitization of neurotransmitter receptors. Molecular mechanisms of synaptic plasticity

CHAPTER III: BASIS OF THE NEURONAL EXCITABILITY

5. BIOCHEMICAL AND ELECTRICAL BASES OF NEURONAL EXCITABILITY. Electric transmission signal. Resting potential. Action potential. Function and structure of ion channels. Local potential and neuronal integration.

CHAPTER IV: MAIN NEUROTRANSMITTERS

6. TYPES OF NEUROTRANSMITTERS. Neurotransmitter systems: glutamate, GABA, acetylcholine, catecholamines, serotonin, histamine, neuropeptides and others. General principles: neurotransmitter metabolism, storage, inactivation, receptors and brain pathologies associated with neurotransmitter systems.

CHAPTER V: NEUROCHEMICAL AND PATHOLOGICAL MECHANISMS OF NEURODEGENERATIVE DISEASES

7. BIOCHEMICAL AND PATHOLOGICAL ASPECTS OF NEURODEGENERATIVE DISEASES. Alzheimer's disease. Parkinson's disease. Huntington's disease. Amyotrophic lateral sclerosis.

Learning activities and methodology

Title	Hours	ECTS	Learning outcomes
Report lab practices and oral presentation	6	0.24	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13
Master classes	31	1.24	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14
Tutorials	5	0.2	1, 2, 3, 4, 5, 9, 12, 13, 14
Self-learned exercises	4	0.16	1, 2, 3, 4, 5, 7, 8, 9
Laboratory practices	12	0.48	1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 13
Seminar/Oral presentation	7	0.28	1, 2, 3, 4, 5, 7, 8, 9, 10, 11
Personal study	72	2.88	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14
Preparation commented exercises	6	0.24	1, 2, 3, 4, 5

The TEACHING METHODOLOGY consists of: 1) Master classes that include both theoretical content and research seminars; 2) Commented self-learned exercises; 3) Seminars; and 4) Laboratory practices.

1. Master classes will be taught in the form of lectures to the full group, in which the Professor will also comment on the material available for other activities, including materials for self-learning. Research seminars will be in English by professors experts in different neuroscience research-specific subjects. Teaching material for the different activities will be provided basically through the UAB Virtual Campus. The teaching of the theoretical classes will be in person, and only in exceptionally occasions could be changed via Teams.

2. Self-learned exercises. At the end of each chapter, the students will solve some theoretical-practical cases, called "Self-learned exercises", which will be written in English and delivered to the teacher in advance, via Virtual Campus, and will be discussed in class in English with classmates tutored by the teacher.

3. Seminars/Oral Presentations consist of an oral presentation by the students in group about the content of the laboratory practices and/or theoretical and practical cases related to the nervous system.

4. Laboratory practices consist in the design and performance of an experimental procedure about a scientific question related to the nervous system. Students will do the practical part in the lab supervised directly by a teacher and at the end they will write a report. Additionally, students will be able to have specific tutorials. Laboratory practices are mandatory to get examined and pass the course. The laboratory practices will be carried out partially in ATTENDANCE BASIS (Schedule:15:00-19:00h) in reduced groups in the laboratories of the Biochemistry Unit of the Dept. of Biochemistry and Molecular Biology of the School of Medicine (Medicine Building, Tower M2) and partially NON-ATTENDANCE of personal work related to the experimental practice (bibliographic search, preparation of results, writing report, etc ...).

Use of Artificial Intelligence (AI): For this subject, the use of AI is allowed exclusively for support tasks, such as bibliographic or information search, text correction or language translation. The student will have to clearly identify which parts have been generated through this technology, specify the used tools and include a critical discussion about how these tools have affected the process and final result of the activity. The absence of transparency in the use of AI in the assessable activities will be considered a lack of academic honesty and may involve a partial or total penalty in the mark of the corresponding activity, or bigger sanctions in case of greater severity.

Annotation: within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continuous assessment activities

Title	Weight	Hours	ECTS	Learning outcomes
Commented exercises	20 % of the final score	2	0.08	1, 2, 3, 4, 5, 6, 7, 9, 10
Final Exam	50 % of the final score	3	0.12	1, 2, 3, 4, 5, 6, 7, 10, 11, 12, 13, 14
Seminars	15% final score	1	0.04	1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 14
Laboratory Practices	15 % of the final score	1	0.04	1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 12, 13, 14

The knowledge acquired will be evaluated in different tests in a continuous way, except for students who chose the unique evaluation at the beginning of the course. At the end of all theoretical classes the student will be examined in a mandatory final exam consisting of a written test of 10 short questions about all the subject matter of the course. The final written exam will mean 50% (100% for unique evaluation) of the mark of the subject; the rest will be given by the activities that would have been continuously performed throughout the course (see below). The final exam is compulsory and only students that fail can attend the recovery exam, keeping notes of the activities carried out throughout the course. The recovery exam will never be for a note to go up. The \"non-evaluable\" will reflect non-attendance to the final compulsory exam.

Format of the evaluations:

Unique evaluation:

- Final written exam: Students are not obligated to perform the laboratory practices, the commented exercises and seminars/oral seminars, and their evaluation will consist of a final written exam performed in the same moment and day of the exam of continuous evaluation, and if failed (mark under 5.0) will have the opportunity for a recovery exam.

Calculation of the final grade: 100% of the written final test. The revision of the final grade will follow the same procedure than that for the written exam in the continuous evaluation.

Continuous evaluation:

- Final written exam:

The obligatory written exam will consist of 10 short questions that the students will have to answer individually in approximately ½ page each one. In this test it can be asked about any part of the subject that has been explicitly given or related to the theoretical classes, exercises commented, practices or seminars. The mark of the written exam will account for 50% of the final mark. Students repeating the course will be able to keep the marks from other continuous evaluation activities and go only for the final exam; in case of willing to repeat the continuous evaluation activities, there will prevail the present course marks. The revision of the exam's mark will be performed by visualization of the written exam in person in a scheduled visit with the coordinator.

- Self-learning exercises:

Exercises that will be carried out by the students and commented in tutored self-study classes. The assessment will be done through tests written in English that aim to reflect the achievement of competences, as well as the knowledge of concepts explained in the theoretical classes. Each exercise will have a score of 1 to 10. The overall grade for these exercises will count 20% in the final grade.

- Laboratory practices:

Laboratory practices are mandatory. The evaluation of the practices will include the realization of the practice of laboratory using experimental methodology and the written report of the obtained results (NO PRESENCIAL). The practical note will correspond to 15% of the final grade of the subject. The students will obtain the \"Non-Valuable\" qualification when the absence exceeds 20% of the programmed sessions or a score 0 in this activity.

- Seminars/Oral Presentations:

Each group of students will present orally (PRESENCIAL) to the rest of the students and professors the results obtained in the laboratory practices or clinical or scientific cases that they have done. Students and teachers will be able to ask questions and the latter will evaluate the presentation of each student individually. The note of the seminar will correspond to 15% of the final grade.

Requisites to pass: In order to pass the subject, the final grade of the course has to be equal to or greater than 5 out of 10. It will also be essential to obtain at least 4.5 out of 10 points in the final written exam to be able to count with the continuous evaluation activities marks. If a minimum of 4.5 score out of 10 is not achieved in the final exam of the continuous evaluation, it will prevail the exam's mark as final mark.

Calculation of the final score: The final grade for the course will be calculated as follows: the grade for the final written exam will be 50% of the final grade for the course, while the grade for the continuous assessment exercises (commented exercises, laboratory practices and seminars) will represent 50% of the final grade for the course.

The commission of any irregularity in an assessment activity (academic fraud, plagiarism, or improper use of AI, unless such use is expressly authorized in the course guide) that could lead to a significant change in the grade will result in that activity being graded with a 0. If the course guide specifies that passing the subject requires obtaining a minimum mark in this assessment activity, or if multiple irregularities occur in the assessment activities of the same subject, the final grade for the subject will be 0. In addition, disciplinary proceedings may be initiated against any student who commits any of these irregularities.

Recovery exam:

The only activity with recovery is the written exam, while self-learning exercises, laboratory practices or seminars are not subjected to recovery within the same academic course. Students that do not pass the minimum score (total score of 5 and 4.5 score in the written exam) may voluntarily assist to a recovery test, the grade from which will replace the one obtained from the final written exam. The only recoverable assessment activity is the written exam, while the exercises, laboratory practices and seminars are NOT recoverable. The final grade for the course will be calculated as detailed in the previous section Calculation of the final grade. The recovery exam will give no the right to an Honors degree.

To participate in the recovery, students must have been previously evaluated in a set of activities, the weight of which is equivalent to a minimum of two thirds of the total grade for the subject or module. Therefore, students will obtain the qualification of \"Not Valuable\" when the evaluation activities carried out have a weighting of less than 67% in the final qualification.

Bibliography

To check disponibility of electronic documents, book and scientific journals at UAB library see:
<https://ddd.uab.cat/>

BOOKS

BASIC NEUROCHEMISTRY: Molecular, Cellular and Medical Aspects (Seven edition) 2005. Scott Brady; George Siegel; R. Wayne Albers; Donald Price.

NEUROSCIENCE (5th edition) 2012. D Purves, GJ Augustine, D Fitzpatrick, WC Hall, AS LaMantia, LE White. Sinauer Associates, Inc.

FUNDAMENTAL NEUROSCIENCE (4th Edition) (2013). Squire, LR, Berg, D., Bloom, F., du Lac, S., Gosh, A. and Spitzer, N. Academic Press, Elsevier Science.

MOLECULAR NEUROPHARMACOLOGY (2nd edition) 2009. EJ Nestler, SE. Hyman, RC. Malenka. McGraw-Hill Medical.

PRINCIPIOS DE NEUROCIENCIA (2001) (4ª edició). E.R. Kandel, J.H. Schwartz & T.M. Jessell. McGraw-Hill Interamericana

CELLULAR AND MOLECULAR NEUROPHYSIOLOGY (2015) (4a Edició). C. Hammond. Academic Press

<https://www.sciencedirect.com/book/9780123970329/cellular-and-molecular-neurophysiology>

ELECTRONIC RESOURCES: Real/animated videos

JoVe

<https://www.jove.com>

<https://www.jove.com/education/5/neuroscience>

<https://www.jove.com/research/journal/neuroscience>

Software

Microsoft Word, Excel

Course groups and languages

The information provided is provisional until November 30. After this date, you will be able to consult the language of each group through this [link](#). To access the information, you will need to enter the course CODE