# Testi del Syllabus

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<th>Resp. Did.</th>
<th>BATTAGLINI PIERO PAOLO</th>
<th>Matricola: 003861</th>
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<td>Docenti</td>
<td>BALLERINI LAURA, 2 CFU</td>
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<td>BATTAGLINI PIERO PAOLO, 3 CFU</td>
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<td>TORRE VINCENT, 2 CFU</td>
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<td>898SM - NEUROFISIOLOGIA INTEGRATIVA</td>
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## Lingua insegnamento

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<th>Inglese</th>
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## Contenuti (Dipl.Sup.)

The course is organized in three independent modules, given by three different teachers, each of them expert in the particular one. The program is aimed at providing wide information on the more actual approaches to study the activity of the living brain and on fundamental aspects of neuronal integration, from the integrative processes which are carried on by neuronal membranes to neuronal networks, to sensory-motor integration and movement production.

Main topics which will be presented.

**Part 1:** Basic properties of maging brain activity. Analog to digital conversion. Basic properties of optical trapping and manipulation. Introduction to mechanobiology and mechanosensitivity of cells and neurons.

**Part 2:** M membrane biophysics and cell excitability. Brain waves generation and oscillatory mechanisms. Thalamo-cortical rhythms, spindle waves and delta waves. Role of particular membrane properties, such as voltage dependent ion channels, or synaptic properties. Role of voltage dependent ion channels. Thalamo-cortical rhythm.

**Part 3:** General organization of the spinal cord and spinal reflexes. Brainstem reflexes and function of the superior colliculus. Somaesthesia: coding of sensory information; physiological basis of perception. General organization of the cerebral cortex; primary and associative areas. General organization of motor systems.

## Testi di riferimento

Kandel, Principles of Neuronal Science, Mc Graw-Hill

Hille “Ionic channels of excitable membranes” Sinauer ass.editors [second or third edition]. In particular from chapter 1 to 5.

Obiettivi formativi

The course aims to ensure that students acquire:

1) Knowledge and understanding, possessing a thorough knowledge of the fundamental principles underlying the different, but fundamental, aspects of neuronal integration at several levels of the central nervous system. These will comprise different aspects, from the integrative processes which are carried on by neuronal membranes to neuronal networks, main aspect of sensory-motor integration, such as reflex and voluntary movement, till to the more actual approaches to study the activity of the living brain.

2) Applying knowledge and understanding, acquiring the theoretical basis for understanding the most basic procedures related to the acquisition of the most sophisticated biological information from a living brain.

3) Making judgment, acquiring a correct vision of the functioning of the nervous system, with particular emphasis on the basic processes of integration, both at cellular and systemic level.

4) Communication skills, getting used to the exhibition, in the classroom, of the concepts requested by the teacher, in a stimulated and interactive teaching environment. Students will always be urged to keep in mind the need for scientifically rigorous exposure and communication with colleagues and the general public. They will be stimulated to express themselves in a correct and essential language.

5) Learning skills. At the end of the course the students will possess knowledge and critical reading abilities to continue their training independently, adapting themselves to new knowledge and technologies in the understanding of the integrative processes acting in the brain.

Prerequisiti

Basic knowledge of physics, chemistry and elementary mathematics.
Good knowledge of neuroanatomy
Knowledge in cell physiology
Good knowledge of basic neurobiology

Metodi didattici

Lectures

Modalità di verifica dell'apprendimento

Students are required to take a final written examination (parts 1 and 2) and an oral one (part 3). The written examination consists in a multiple choices test (true/false) and 2 open questions on the topic of the courses. The oral examination consists in a discussion of 20-30 min, during which the student is invited to describe and comment on topics covered in the course.

Programma esteso

The course is organized in three independent modules, given by three different teachers, each of them expert in the particular topic. The program is aimed at providing wide information on fundamental aspects of neuronal integration at several levels in the central nervous system, from the integrative processes which are carried on by neuronal membranes to neuronal networks, to sensory-motor integration and movement production, till to the more actual approaches to study the activity of the living brain.


Part 2: The main aim of these Lectures is to provide fundamentals in membrane biophysics and in the mechanisms characterizing cell excitability; to translate single cell knowledge towards rules governing small networks behavior in more complex systems. The focus will be on brain waves generation and neuronal mechanisms sustaining such
The course is organized in three independent modules, given by three different teachers, each of them expert in the particular one. The program is aimed at providing wide information on the more actual approaches to study the activity of the living brain and on fundamental aspects of neuronal integration, from the integrative processes which are carried on by neuronal membranes to neuronal networks, to sensory-motor integration and movement production. Main topics which will be presented.


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The presentation of the lectures and a collection of papers are provided

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1) Knowledge and understanding, possessing a thorough knowledge of the fundamental principles underlying the different, but fundamental, aspects of neuronal integration at several levels of the central nervous system. These will comprise different aspects, from the integrative processes which are carried on by neuronal membranes to neuronal networks, main aspect of sensory-motor integration, such as reflex and voluntary movement, till to the more actual approaches to study the activity of the living brain.
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3) Making judgment, acquiring a correct vision of the functioning of the nervous system, with particular emphasis on the basic processes of integration, both at cellular and systemic level.
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Lectures

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Part 1: Basic properties of Imaging: spatial and temporal resolution. Number of pixels in a CCD camera and physical properties of pixels in high performance CCD cameras. A/D processing at 8, 12 and 16 bits and its implication for the detection of fluorescence signals (DF/F). Acquisition rates for different biological phenomena. Basic properties of optical trapping and manipulation. Introduction to mechanobiology: forces
exerted by filopodia, lamellipodia and neurons. Introduction to mechanosensitivity of cells and neurons.

Part 2: The main aim of these Lectures is to provide fundamentals in membrane biophysics and in the mechanisms characterizing cell excitability; to translate single cell knowledge towards rules governing small networks behavior in more complex systems. The focus will be on brain waves generation and neuronal mechanisms sustaining such activities, from neuronal membrane to neuronal networks. Oscillatory mechanisms: cellular and network analysis of oscillatory neural systems. Thalamo-cortical rhythms, spindle waves and delta waves, contribution of thalamic neuron properties and circuits. Recent published experimental evidences will be presented within the framework of theoretical concepts sustaining brain waves mechanisms. At a cellular level experimental evidence supporting the role of particular membrane properties, such as voltage dependent ion channels, or synaptic properties, such as microcircuit organization enabling oscillating activities in cortical networks reflected in EEG activities will be addressed and presented. In particular the following systems will be addressed: Oscillatory mechanisms: cellular and synaptic contributions (network driven rhythmicity vs pacemaker driven one). Voltage dependent ion channels: calcium channels (HVA and LVA) with particular attention to It; IKCa; ICAN; Ih; IIR; IAHP (BK and SK) and others Thalamo-cortical rhythm.