Testi del Syllabus

Resp. Did.	**BATTAGLINI PIERO PAOLO**	**Matricola: 003861**

Docenti	**BALLERINI LAURA, 2 CFU** **BATTAGLINI PIERO PAOLO, 3 CFU** **CELLOT GIADA, 2 CFU**

Anno offerta:	**2021/2022**
Insegnamento:	**898SM - NEUROFISIOLOGIA INTEGRATIVA**
Corso di studio:	**SM54 - NEUROSCIENZE**
Anno regolamento:	**2021**
CFU:	**7**
Settore:	**BIO/09**
Tipo Attività:	**B - Caratterizzante**
Anno corso:	**1**
Periodo:	**Secondo Semestre**
Sede:	**TRIESTE**

Testi in italiano

Lingua insegnamento	Inglese
Contenuti (Dipl.Sup.)	The course is organized in different independent modules and three teachers contribute to them with specific competences. 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 1a: 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 1b: Long term plasticity (LTP): from Hebb’s postulate to eelectropysiological and behavioral evidence. NMDA receptor- dependent LTP. Spike timing dependent plasticity. Anti-Hebbian LTP. Functional implications of hippocampal synaptic plasticity: memory and learning. Plastic changes in the amygdala circuitry. An example of associative learning: the fear conditioning paradigm. Cellular mechanism underlying fear extinction. Part 2: 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. Other reviews and papers: Annu. Rev. Neurosci. 1997. 20:185–215. J. Physiol. 1995;483;641-663. J. Physiol. 1993;468;669-691. J. Physiol. 1990;431;291-318 Physiol Rev 89: 847–885, 2009; Neuron, Vol. 20, 553–563, March, 1998. Neuron, Vol. 21, 9–12, July, 1998. Annu Rev. Phyiol. 1996 58:299-327. PNAS 2004 vol. 101 no. 52 18195–18199. The Journal of Neuroscience, 1993, 13(8): 3284-3299. Cell Calcium 40 (2006) 97–114. Trends in Neurosciences, 2013, Vol. 36, No. 12 pp 738. Additional Selected scientific papers or other didactical material could be provided. The presentation of the lectures and a collection of papers are provided
Obiettivi formativi	The course aims to ensure that students acquire: 1) Knowledge and undertanding, 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 nervosus system, with particular enphasys 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 posses 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	Lezioni Frontali. Eventuali cambiamenti alle modalità descritte, che si rendessero necessari per garantire l'applicazione dei protocolli di sicurezza legati all'emergenza COVID19, saranno comunicati nel sito web di Dipartimento, del Corso di Studio e dell'insegnamento.
Altre informazioni	Any necessary change in the course modalities due to COVID19 emergency will be published at the Department, Master Programme and Course websites.
Modalità di verifica dell'apprendimento	Students are required to take a final written examination (part 1 a and 1 b) and an oral one (part 2). The written examination consists in a multiple choices test (true/false). 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	Part 1a: 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.
Part 1b: The focus of these lectures is to explore the long term plasticity (LTP), from the theory (Hebb's postulate) to the experimental strategies that can be used for its investigation, including electrophysiology and behavioral analysis. In detail, some forms of plasticity will be described: the NMDA receptor- dependent LTP (with its properties and mechanisms: input specificity, associativity and cooperativity), the spike timing dependent plasticity and the anti-Hebbian LTP. The functional implications of hippocampal synaptic plasticity, that are memory and learning, will be presented. The second part of the lectures will regard the amygdala, the brain structure involved in emotion processing. Plastic changes in the amygdala circuitry are the neuronal substrate for an example of associative learning, that is the fear conditioning. Finally, we will explore the cellular mechanisms underlying fear extinction.

Part 2: Spinal reflexes: monosynaptic reflex and general organization of the spinal cord. Brainstem reflexes: vestibular reflexes, orienting reflex. Stability of visual perception. Somaesthesia: overview of sensory modalities and receptors, sensory transduction, cutaneous mechanoceptors, receptive field, coding of stimulus intensity and duration, tactile acuity, lemniscal and spino-thalamic pathways; primary sensory area, coding of stimulus location and modality. Cerebral cortex: functional subdivisions, Brodman's areas, cortical columns, maturation of the cerebral cortex, cortical plasticity, primary and association areas. Voluntary movement: kinds of movement and their control, motor equivalence, overall organization of the motor systems, pyramidal tract, primary motor cortex, premotor areas, working memory, mirror neurons, functional streams, action and perception, timing for motor production. Basal ganglia and cerebellum: relation of basal ganglia with the cerebral cortex, direct and indirect pathways, disorders of the basal ganglia, functional organization of the cerebellum, input and output pathways, disorders of the cerebellum. Pain: peripheral mechanisms, central pathways and cortical localization. Central control of pain.

Testi in inglese

	English
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LTP. Spike timing dependent plasticity. Anti-Hebbian LTP. Functional implications of hippocampal synaptic plasticity: memory and learning. Plastic changes in the amygdala circuitry. An example of associative learning: the fear conditioning paradigm. Cellular mechanism underlying fear extinction.

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3) Making judgment, acquiring a correct vision of the functioning of the nervosus system, with particular enphasys 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 posses 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.

Basic knowledge of physics, chemistry and elementary mathematics.

Good knowledge of neuroanatomy

Knowledge in cell physiology

Good knowledge of basic neurobiology

Frontal lectures.

Any change to the methods described, which become necessary to ensure the application of the safety protocols related to the COVID19 emergency, will be communicated on the web sites of the Department and of the Study Program.

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