PsGeneral information		
Academic subject	**NEUROBIOLOGY**	
Degree course	Master's Degree in Biomedical Sciences (LM/6) - Diagnostic curriculum	
Academic Year	Second	
European Credit Transfer and Accumulation System (ECTS)	4	
Language	Italian	
Academic calendar (starting and ending date)	Second semester march 1, 2022 – june 10, 2022	
Attendance	Mandatory attendance	

Professor/ Lecturer	
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Virtual headquarters	
Tutoring (time and day)	From Monday to Friday by previous e-mail appointment

Syllabus	
Learning Objectives	The course aims to provide in-depth knowledge of the physiological and functional aspects of the central and peripheral nervous system, of the cellular and molecular mechanisms underlying cognitive processes and behavioral responses, with particular reference to the conditions that cause neurological diseases and disorders. affecting the nervous system.
Course prerequisites	Basic knowledge of Physics, General and Organic Chemistry, Biochemistry, Human Anatomy and General Physiology.
Contents	• **Signal transmission in neurons** – Conduction of neuroelectric signals and related neurological alterations (multiple sclerosis). – Synaptic transmission and neurological alterations dependent on synaptic mechanisms (myasthenia gravis, botulism, epilepsy, mental and mood disorders, alterations of the dendritic spines and mental retardation). • **Development of the nervous system** – Embryogenesis of the SN and neural plaque; development of the neural tube; migration, induction and differentiation of embryonic nerve cells. – Neuronal growth and migration; growth cone, adhesion, orientation factors; Nervous tissue reactions to injuries: degeneration and regeneration; Development and architecture of the cerebral cortex; Localization and roles of the sensory, associative, motor cortical areas. – Folate deficiency and myelomeningocele. – Structure of the neocortex; functional relationships between cortical areas; neocortical circuits, laminar stratification. – Sensory, associative and motor areas; Roles and functional relationships; Higher cortical functions; Electroencephalogram. – Formation, maturation, selection and stabilization of synaptic contacts; Neurotrophic factors (NGF) and neuronal survival; Principle of cooperation and neuronal survival; Role of sensory experiences and sensory deprivation on the cortical structure (experiments by Hubel & Wiesel); The critical periods of

development and regulatory molecules. Effects of training on the cortical structure.
- Sexual dimorphism; mechanisms of somatic and cerebral sexual differentiation and control factors.

- **Sensory perception**
  - Psychophysics of sensory perception; sensation and perception.
  - General properties of the sense organs and receptors; characteristics of sensory perception and encoding of sensory information (modality, location, intensity, duration); classification of receptors.
  - Central processing of somatic perception, organization of somatosensory pathways and primary and higher order somatic cortical areas; functional modifications of somestic areas; Synesthesia.
  - Visual system: optical properties of the eye; accommodation and pupillary reflex; visual defects; photoreceptors and phototransduction mechanisms; cortical projections and role of the visual cortex; retinopathies, glaucoma.
  - Auditory system: sound wave transduction; frequency and intensity decoding; auditory cortex; perception and production of language; aphasia.
- **Cognitive functions, learning, memory**
  - Role of learning and memory; brain structures involved; construction and stabilization of mnemonic contents.
  - Forms of associative and associative learning. Cellular and molecular mechanisms of short- and long-term synaptic sensitization; cellular mechanisms of classical conditioning. The time factor and the coincidence detector. Cellular mechanisms of early and late long-term potentiation in hippocampal neurons; role of glutamate receptors. Experiments with NMDA mutant animals.
  - Mirror neurons: function in the learning of motor activities and in the interpretation of intentions; role in autism.
  - Amyloidosis, Alzheimer's disease, Creutzfeldt-Jakob disease.
- **Motor control**
  - Motor modes and functional and hierarchical organization of the structures involved.
  - Spinal movement control; muscle receptors, motor units; and recruitment; spinal motor nuclei; Motor neuron disease.
  - Encephalic trunk; posture; postural reflexes; muscle tone; postural tone; gamma-motor control on the antigravity musculature. Vestibular system. Menière's disease.
  - Voluntary movement: role of the prefrontal, supplementary motor, premotor, primary motor areas. Apraxia.
  - Cerebellum: structure and functional organization; role in voluntary movement programming, execution control and vestibular function. Cerebellar ataxia.
  - Basal ganglia: functional organization and role in facilitating and inhibiting voluntary movement; Parkinson's disease (hypokinesia); Huntingdon's disease (hyperkinesis), Tourette's syndrome.
- **Motivation and control of visceral functions**
  - Evolutionary models of motivation, genotype and phenotype adaptation; evolution of the central nervous system.
  - Control of direct and indirect responses and structures involved:

	Autonomous Nervous System, Nucleus of the solitary tract, Adrenal glands, Diffuse modulatory systems. – Hypothalamic centers for controlling motivation and interactions with the visceral nervous system and with the endocrine system. – The dopaminergic and serotonergic reward system. Drug addiction. – Circadian biological rhythms, variable physiological parameters, chronobiology. – Sleep: characteristics and functions; photo synchronization structures; stages and stages of sleep; sleep disorders; effects of deprivation, jet lag. • **Senescence and neurodegenerative diseases** – Cell aging processes; Senile dementia.
Books and bibliography	A. Teaching materials distributed during the course B. "NEUROSCIENZE" di D. Purves et al. – 5a edizione; Ed. Zanichelli C. "PRINCIPI DI NEUROSCIENZE" di E. Kandel et al.; 3a edizione; Editrice Ambrosiana CEA D. "FISIOLOGIA dalle molecole ai sistemi integrati" di E. Carbone et al. – 2nd ed. - Ed. EdiSES E. Articles from scientific journals proposed during the course.
Additional materials	

Work schedule			
Total	Lectures	Hands on (Laboratory, working groups, seminars, field trips)	Out-of-class study hours/ Self-study hours
Hours			
32	32	0	68
ECTS			
4	4	0	

Teaching strategy	The teaching modality will be that of "blended learning": mixed frontal and remote teaching at the same time.
Expected learning outcomes	
Knowledge and understanding on:	• Physiological and functional aspects of the central, peripheral and vegetative nervous system, of the cellular and molecular mechanisms underlying cognitive processes, behavioral responses and homeostasis control. • Neurological diseases and disorders affecting the central and peripheral nervous system and of molecular etiology. • Advanced methodologies for diagnostics and biomedical research.
Applying knowledge and understanding on:	• Critically analyze the functions of the nervous system and the role of the various neuronal, glial and nervous structures • Correlate the cellular and molecular mechanisms and their alterations in the central and peripheral nervous system to the dysfunctions that affect it.
Soft skills	• *Making informed judgments and choices* Developed through lectures and in-depth study of scientific texts and articles, it must lead the student to be able to evaluate the role of structures, connections and cells of the central and peripheral nervous system in cognitive processes, in behavioural responses and in the control of homeostasis. The student must be able to understand, analyze and evaluate the scientific

	literature relating to neurophysiology. • *Communicating knowledge and understanding* Developed through comparison during lessons, it must lead the student to be able to describe the knowledge relating to the functioning of the human nervous system with simplicity and effectiveness. • *Capacities to continue learning* Developed through the study and deepening of the bibliography, in order to perfect the learning ability from highly complex technical-scientific texts, monographs, scientific periodicals, regarding neurophysiology.

Assessment and feedback	
Methods of assessment	Ongoing oral assessment - Oral exam
Evaluation criteria	• *Knowledge and understanding* Correctly identify the specific problems proposed and capacity to organize knowledge. • *Applying knowledge and understanding* Knowledge and understanding adequately related to the teaching contents. • *Autonomy of judgment* Develop a critical and functional reasoning and to argue on specific proposed problems. • *Communicating knowledge and understanding* Report, in a clear way and using an adequate vocabulary, the contents of the course and other acquired knowledge and to argue on specific problems proposed. • *Communication skills* Effectiveness in answering questions
Criteria for assessment and attribution of the final mark	The final grade is awarded out of thirty. The exam is passed when the grade is greater than or equal to 18.
Additional information	