

MEDTEC SCHOOL

Course: Neurosciences and mental health

Year (1st-2nd-3rd-4th-5th-6th): 5 th

Period (1st-2nd semester – annual): 1 st semester

Credits: 9

Objectives

Knowledge in Clinical Neuroscience is expanding rapidly. This interdisciplinary course will bridge different subspecialties into an integrated and comprehensive program. By completion of the program, students will have adequate knowledge of the main neurological and psychiatric diseases, their pathophysiology and treatment. Furthermore, the technological applications in neuroscience are now established standard of care (e.g. deep brain stimulation) and in rapid evolution (e.g. brain-computer interface), thus representing an ideal synthesis between medicine and engineering.

The Neurology module is divided into three comprehensive parts. The first part introduces students to clinical neuroanatomy and neurological semiotics, providing essential tools for mastering neurological localization in diagnosis and interpreting historical medical data to formulate reasoned etiological diagnostic hypotheses. The second part covers the major neurological disorders that are commonly encountered in clinical practice. It discusses their etiopathogenesis, clinical presentation, diagnostic modalities, differential diagnosis, and therapeutic approaches. The final part aims to equip students with practical skills for addressing the main neurological symptoms seen in clinical settings. It includes detailed discussions on differential diagnoses, diagnostic algorithms, and strategic diagnostic approaches, along with practical therapeutic insights. Moreover, this part features interactive lessons where students are encouraged to engage in logical reasoning and formulate diagnostic hypotheses based on discussed neurological clinical cases. The approach is symptom-based and patient-centered. Whenever possible, a deeper dive into the application of technology will be presented.

The Neuroradiology module reviews the role diagnostic and interventional radiology applied to neurological diseases. This module instructs on some of the basic aspects of neurologic imaging, including anatomy of the brain and spinal cord as shown by CT and MRI, and diagnosis of diseases and abnormalities of the central nervous system.

The Neurosurgery module provides an overview of the surgical management of brain and spine neurological diseases. It integrates with diagnostic procedures and technological advancements with a special focus on intraoperative devices

The Mental Health module will let students become aware of the many interactions between mental and medical disorders and learn how to differentiate normality from pathology in mental health, to recognize the organizing principles of each mental disorders with their key psychopathological features and neuroscientific basis, make a differential diagnosis, choose among treatment options and understand the many links between mental and somatic disorder, all in the light of personalized medicine approach.

Prerequisites

The course is dedicated to 5th year medical students who already master the fundamental knowledge required to approach the integrated field of Clinical Neuroscience. This includes the neuroanatomy and neurophysiology teaching. Neuroanatomy (1st year) frontal lessons have been given by the same teachers as per neurosurgery in this course

CONTENT

"The ghost in the machine" (Absinta) (2 hours)

Introduction by Prof. Fasano; presentation of the course by all the teachers.

Learning goals: to understand the relationship between clinical neurology and internal medicine; to understand the relationship between neurology, psychiatry and neuroscience; to understand the clinical methodology in neurology; to describe the initial clinical approach to the patient with neurological problems; to describe the main categories of neurological diseases and their frequency; to understand how technology is shaping the future of neuroscience (from 'the ghost in the machine' to 'the machine in the ghost').

The blueprint of the nervous system part 1: cranial nerves (Nobile-Orazio) (2 hours)

Learning goals: to describe the symptoms due to impairment of cranial nerve; to learn the neurological examination of patients with cranial nerve impairment; to learn the main diseases causing cranial nerve impairment.

The blueprint of the nervous system part 2: motor and sensory (Nobile-Orazio) (2 hours)

Learning goals: to describe the symptoms of motor and sensory pathways impairment; to describe the clinical assessment of motor impairment; to describe the clinical assessment of sensory impairment; to describe the symptoms due to cerebellar dysfunction; to describe the symptoms due to meningeal involvement; to describe the clinical assessment of cerebellar dysfunction and meningeal involvement.

"Locked-in" a small space: the brainstem (Liberatore) (2 hours)

Learning goals: to revise the macroscopic features of the brainstem; to describe the clinical presentation of a patient with persistent loss of consciousness; to explain the neurological mechanisms underlying coma; to differentiate between various coma states; to assess patients using standardized coma scales; to discuss clinical approaches to diagnosis and management.

"Messages interrupted": neurological syndromes (Doneddu) (2 hours)

Learning goals: to understand transient and permanent neurological syndromes; to understand the anatomical-clinical syndromes of the brain; to understand the anatomical-clinical syndromes of the spinal cord and the peripheral nervous system.

"Out of sync 1": the slow and trembling patient (Parkinson's disease and parkinsonian syndromes) (Fasano) (2 hours)

Learning goals: to recognize the clinical presentations of parkinsonian syndromes; to learn diagnostic criteria for Parkinson's disease and other parkinsonian syndromes; to review the different causes of parkinsonian syndromes; to learn how to manage a patient with Parkinson's disease.

"Out of sync 2": the patient with abnormal movement and incoordination (Fasano) (2 hours)

Learning goals: to describe the different hyperkinetic movement disorders; to learn how to diagnose a patient with hyperkinetic movement disorder; to learn how to manage patients with hyperkinetic movement disorders; to describe ataxias; to learn how to diagnose a patient with cerebellar ataxia.

"Out of sync 3": Advanced surgical therapies in movement disorders (Fasano, Pessina, Riva) (2 hours)

Learning goals: to learn about current surgeries for Parkinson's disease and movement disorders: indications, procedures, complications.

"Electric storms": the patient with acute loss of consciousness and jerking (epilepsy) (Nobile-Orazio) (2 hours)

Learning goals: to describe the clinical presentation of a patient with acute loss of consciousness; to describe the main causes of acute loss of consciousness; to recognize the main seizure types, to learn what are the main forms and causes of epilepsy; to learn how to treat patients with epilepsy; to learn how to manage and treat patients with syncope.

Priority Presenting Problems Portfolio: Seizure, Loss of Consciousness

"Brain blackout": the patient with acute loss of consciousness (syncope) (Doneddu) (2 hour)

Learning goals: to describe the clinical presentation of a patient with fainting and loss of

consciousness; to describe the main causes of fainting and loss of consciousness; to learn what is the assessment of fainting and loss of consciousness; to learn how to treat patients with fainting and loss of consciousness; to learn how to manage and treat patients with fainting and loss of consciousness.

“The dreaming brain”: the patient with sleep disorders (Absinta) (2 hours)

Learning goals: to describe the physiology of sleep and the main pathological conditions that alter the physiology of sleep; to learn how to identify these conditions based on medical history, physical examination, and second-level diagnostic tests. To learn the management and therapeutic strategies for treating sleep-related disorders; to learn how handle these complex conditions in clinical settings.

“Cognitive drift”: the patient with loss of memory and cognitive impairment (Fasano) (2 hours)

Learning goals: to describe the varied clinical presentations of a patient with cognitive impairment; to learn how to investigate a patient with cognitive impairment; to learn how to distinguish age-related cognitive decay from dementia; to review the different causes of dementia; to learn how to manage a patient with dementia.

“The clouded mind”: the patient with confusion and delirium (Doneddu) (2 hours)

Learning goals: to describe the clinical presentation of a patient with confusion and delirium; to learn what how to assess a patient with confusion and delirium; to describe the main causes of confusion and delirium; to learn how to treat patients with delirium.

Priority Presenting Problems Portfolio: Altered Mental Status, Substance Abuse

“Snapshots 1”: Introduction to Neuroimaging: basic tips on how to read a brain CT and MRI (Politi) (2 hours)

Learning goals: to recognize the main imaging features of brain CT; to recognize the main imaging features of brain MRI.

“Breaking the flow 1”: the patient with acute onset of neurological signs (stroke) (Pensato) (2 hours)

Learning goals: to describe the different clinical presentations of a patient with stroke; to review the main stroke syndromes; to recognize transient ischemic attacks; to describe the main causes leading to stroke.

Priority Presenting Problems Portfolio: Stroke

“Breaking the flow 2”: stroke management (Pensato) (2 hours)

Learning goals: to describe the principal complication of stroke; to describe the prognosis of a patients with stroke; to describe the therapeutic approach to a patient with stroke; to describe the therapy in the acute phase of stroke; to describe the secondary prevention o stroke

“Breaking the flow 3”: Imaging and endovascular treatment of ischemic stroke (Politi) (2 hours)

Learning goals: to learn to recognize an acute ischemic stroke on CT and MRI images; to learn timing and indication of the different neuroimaging modalities in the management of a patient with acute ischemic stroke; to gain familiarity with CT angiography. To learn to recognize normal vasculature and vessel occlusions; Understand the differences between cytotoxic and vasogenic edema; Understand the fundamentals of endovascular thrombectomy; to learn how to depict brain chronic ischemic lesions on CT and MRI.

“Wired painfully”: the patient with pain in the head (Absinta) (2 hours)

Learning goals: to describe the clinical presentation of a patient with pain in the head; to learn what are the main causes of headache; to learn how to diagnose different types of headaches; to learn how to treat patients with headache.

Priority Presenting Problems Portfolio: Headache

Collaborative learning: Headache (Politi, Lalli, Pessina, Riva) (2 hours)

Learning goals: to describe the possible neuroanatomical sources of pain in the head region; to understand the role of the trigeminal ganglion and the trigeminovascular system in the pathogenesis of migraine; to learn how to treat patients with headache

Priority Presenting Problems Portfolio: Headache

“Drowning brain”: the patient with hydrocephalus (Lalli, Fasano, Pessina, Riva) (2 hours)

Learning goals: to describe the clinical presentation of a patient with hydrocephalus and learn the differential diagnosis with other dementia patients; to learn the diagnostic workout; to learn the surgical indications in these patients; to learn which are the main causes of hydrocephalus; to learn the different surgical approaches; to learn the clinical outcomes of surgery.

“Tight spaces”: the patient with headache and progressive neurological impairment (raised intracranial pressure) (Pessina, Riva) (2 hours)

Learning goals: to describe the physiology and pathophysiology of the mechanisms underlying intracranial pressure (ICP) control; to learn causes of ICP alteration; to learn the clinical presentation of ICP hypertension and hypotension; to learn how to treat patients with ICP disorders.

“Growing danger”: the patient with intracranial masses (brain tumors) (Pessina, Riva) (2 hours)

Learning goals: to describe the pathophysiology of intracranial tumor formation and expansion; to describe the clinical presentation of a patient with brain tumor; to learn how to diagnose brain tumors; to learn how to treat patients with brain tumors.

“Snapshots 2”: visualizing intracranial mass lesions (Politi) (2 hours)

Learning goals: to learn how to distinguish intra- and extra-parenchymal mass lesions; to gain familiarity with imaging features of low and high-grade primary brain tumors; to learn how to identify complications arising from increased intracranial pressure; to understand the usefulness of advanced MRI techniques for tumor characterization and tumor grading; to understand the complexity of assessing brain tumor treatment response.

“After the impact”: the patient with head trauma (Pessina, Riva) (2 hours)

Learning goals: to describe the clinical presentation of a patient with head trauma; to describe the direct effects of head trauma; to describe the secondary effects of head trauma; to describe the neuroradiological approach to a patient with head trauma; to describe the management of a patient with head trauma; to describe the complication of head trauma.

Priority Presenting Problems Portfolio: Trauma

“Red alert”: the patient with brain hemorrhage (Pessina, Riva, Pensato) (2 hours)

Learning: to describe the clinical presentation of a patient with different types of brain hemorrhage; to learn the diagnostic workout; to learn the surgical indications in these patients; to learn which are the main causes of brain hemorrhage; to learn the different surgical approaches; to learn the clinical outcomes of surgery of the brain hemorrhagic patients.

“Snapshots 3”: the neuroradiology of head trauma and spontaneous intracranial hemorrhages (Politi) (2 hours)

Learning goals: to learn how to recognize an acute intracranial hemorrhage on CT and MRI images; to

learn to distinguish intraparenchymal hemorrhage from subarachnoid hemorrhage, and subdural hematoma from epidural hematoma; to understand the complication of intracranial hemorrhages and learn how to depict them; to discriminate between a skull fracture and a suture on CT images; to understand the basics of endovascular treatment options for brain aneurysms, arteriovenous malformations and dural arteriovenous fistulae.

“The backbone of neurology”: the patient with spinal diseases (Pessina, Riva) (2 hours)

Learning goals: to describe the clinical presentation of a patient with limb weakness and pain; to learn the diagnostic workout; to learn the surgical indications in these patients; to learn which are the main causes of surgery in the spine; to learn the different surgical approaches; to learn the clinical outcomes of surgery of the spine.

“Intruders at the gate”: the patient with meningitis and encephalitis (Absinta) (2 hours)

Learning goals: to learn what is meningitis and encephalitis (infectious, paraneoplastic and autoimmune); to learn how to approach patient with suspected meningitis and encephalitis; to learn how to establish the diagnosis of patient with suspected meningitis and encephalitis; to learn how to treat patients with suspected meningitis and encephalitis.

Priority Presenting Problems Portfolio: Fever

“The brain on fire”: the patient with relapsing neurological deficits (multiple sclerosis) (Absinta) (4 hours)

Learning goals: to describe the clinical presentation of a young patient with relapsing neurological deficits; to describe the clinical presentation of a patient with sudden vision loss; to learn what is multiple sclerosis; learn how to diagnose multiple sclerosis and the main differential diagnosis (neuromyelitis optica spectrum disorder and MOG-associated disease); to learn how to treat patients with multiple sclerosis and mimicking disorders.

“Snapshots 4”: Neuroimaging of demyelinating disorders and spine degenerative changes (Politi) (2 hours)

Learning goals: to gain familiarity with the imaging features of the different demyelinating disorders; to understand the relevance of neuroimaging in assessing disease progression in demyelinating diseases; to gain familiarity with the imaging features of the different demyelinating disorders; to learn to recognize intervertebral disc bulging, protrusion and extrusion; to learn to depict spinal canal and neuroforaminal stenosis.

“Reading the electric code”: clinical neurophysiology (Doneddu) (1 hour)

Learning goals: to learn the main neurophysiological tests (electroneurography, electromyography, electroencephalography, and evoked potentials) used for neurological diagnosis. To learn how they work, their indications, and their limitations.

“When motor neurons fail”: the patient with progressive muscle weakness and atrophy (motor neuron disease) (Doneddu) (2 hour)

Learning goals: to describe the clinical presentations of a patient with motor neuron disease; to learn how to assess a patient with progressive muscle weakness and atrophy; to learn how to diagnose amyotrophic lateral sclerosis; to learn how to manage the patient with amyotrophic lateral sclerosis.

“Stripped wires”: the patient with rapidly progressive palsy (polyradiculoneuritis) (Nobile-Orazio) (2 hours)

Learning goals: to describe the clinical presentation of a patient with rapidly progressive palsy; to learn

how to evaluate a patient with rapidly progressive palsy; to learn the main causes of rapidly progressive palsy; to learn how to distinguish peripheral from central rapidly progressive palsy; to learn what is acute demyelinating inflammatory polyradiculoneuritis (Guillain-Barré syndrome); to learn what is acute myelitis; to learn how to diagnose and treat Guillain-Barré syndrome.

“The final synapse”: the weak and fatigable patient (neuromuscular disorders) (Nobile-Orazio) (1 hour)

Learning goals: to describe the clinical presentation of a patient with weakness or fatigability; to learn how to evaluate a patient with a suspected myasthenia gravis; to learn how to diagnose and treat a patient with myasthenia gravis; to learn how to evaluate a patient with a suspected myopathy; to learn what are the main causes of myopathy; to learn how to distinguish the main causes of myopathy; to learn how to treat a patient with myopathy.

“Muscle matters”: the patient with progressive muscle weakness (myopathies) (Liberatore) (2 hours)

Learning goals: to learn the muscle diseases most frequently encountered in clinical practice; understand the differential diagnosis of myopathies and be familiar with the laboratory and instrumental tests necessary for diagnosis; to gain insights on therapeutic approaches.

“Autopilot gone awry”: autonomic nervous system disorders (Pensato) (2 hours)

Learning goals: to learn the main disorders that affect the autonomic nervous system; to learn to recognize the symptoms and signs of dysautonomia and formulate reasoned diagnostic hypotheses, choose appropriate laboratory and instrumental tests based on the clinical scenario, outlines of therapy.

“Now think like a neurologist”: reasoned approach to neurological symptoms, diagnostic algorithms and clinical cases (Doneddu, Pensato, Absinta, Politi) (2 hours)

Learning goals: to learn the correct approach to differential diagnosis and orientation for the most common neurological symptoms encountered in clinical practice; to learn diagnostic algorithms tailored for symptom-based diagnosis and gain skills in distinguishing and managing neurological symptoms or scenarios that necessitate timely diagnosis and treatment; to learn how to effectively address urgent neurological conditions; to appropriate choice of imaging test based on the clinical scenario and correct interpretation and clinical-instrumental correlation.

Introduction to Mental Health (Perna/Caldirola)

Learning goals: Understand what mental health is and what is the field of psychiatry; Understand the the distinction between normality and psychopathology. Understand the concept of comorbidity in psychiatry.

Mental health in the digital era & Personalized Medicine in Psychiatry (Perna/Caldirola) Learning goals: Defining the concept of personalized medicine in psychiatry. Apply personalized medicine in psychiatric disorders. Become aware the future of personalized medicine in psychiatry. Understand the role of mental health in the digital era.

Anxiety Disorders (Perna/Caldirola)

Learning goals: Define the organizing principles of the different anxiety disorders, Describe the main clinical features of the different anxiety disorders Discuss the etiopathogenetic models, Organize a treatment plan.

Obsessive compulsive spectrum & Eating Disorders (Perna/Caldirola)

Learning goals: Define the organizing principles of the different obsessive-compulsive spectrum and eating disorders, Describe the main clinical features of obsessive compulsive and eating disorders, Discuss the etiopathogenetic models. Organize a treatment plan.

Mood Disorders (Perna)

Learning goals. Define the organizing principles of the different mood disorders. Describe the main clinical features of the different mood disorders. Discuss the etiopathogenetic models. Organize a treatment plan.

Psychotic Disorders (Perna)

Learning goals: Define the organizing principles of the different psychotic disorders. Describe the main clinical features of the different psychotic disorders. Discuss the etiopathogenetic models. Organize a treatment plan

Personality Disorders (Perna)

Learning goals: Define the organizing principles of the different personality disorders. Describe the main clinical features of the different personality disorders. Discuss the etiopathogenetic models. Organize a treatment plan

Somatization Disorders and Drug Use Disorders (Caldirola)

Learning goals: Define the organizing principles of the different personality disorders, Describe the main clinical features of the different personality disorders, Discuss the etiopathogenetic models, Organize a treatment plan

Emergency Psychiatry (Perna)

Learning goals: Manage suicide risks, Manage aggressive behaviors, Manage panic attacks and/or acute anxiety, Manage iatrogenic emergencies related to psychotropic medications. Describe legal issues in psychiatry.

Teaching methods

Lectures, clinical case discussions, teamwork. Lecture materials are provided to students only after the class to encourage their active participation in the clinical case-based lectures. Students are expected to acquire additional knowledge through the recommended textbooks, which will provide foundational and supplementary information essential for mastering the course.

Students are advised to consult UpToDate (<https://www.uptodate.com/>) for all the topics included in this syllabus.

Suggested textbook:

- *Adams & Victor's Principles of Neurology, 12th edition, by Ropper, Samuels, Klein, Prasad – McGraw-Hill Education 2023*

Other textbooks:

- *Neuroanatomy through clinical cases by Hal Blumenfeld – Oxford University Press_ 2021*
- *Learning Radiology, Recognizing the Basics, 3rd Edition, by William Herring – Elsevier 2015*
- *Neuroradiology: The Requisites, 4th Edition, by Rohini Nadgir, David Yousem – Elsevier 2016*
- *Handbook of Neurosurgery, 9th Edition, by Mark S. Greenberg – Thieme Medical Publishers 2019*
- *Stahl's Essential Psychopharmacology: Neuroscientific Basis and Practical Applications, by Stephen Stahl, 5th Edition, Cambridge University Press, 2021*

- *Goodwin and Guze's Psychiatric Diagnosis*, by North CS & Yutzy SH, 7th Edition, Oxford University Press, 2019
- *Oyeboade F. Sims' Symptoms in the Mind: Textbook of Descriptive Psychopathology*, 7th Edition, Elsevier, 2022

Verification of learning

The exam will assess students' knowledge of the topics covered during the course, their ability to diagnose and formulate differential diagnosis of common neurological symptoms, and their competence in conducting targeted anamneses based on clinical contexts. It will also test their ability to recognize and manage urgent neurological scenarios that threaten patient safety and require immediate attention. The exam will not solely focus on information presented in lectures via PowerPoint; students are expected to thoroughly study the lesson topics using recommended sources and textbooks and integrate this knowledge to deepen their understanding and enhance their clinical reasoning skills.

Written tests will assess the student's overall preparation and skills and will be preliminary to the final oral exam. The test will encompass 30 multiple-choice or open questions (5 each for Neurology, Neurosurgery, Neuroimaging and 15 for Psychiatry). The threshold for passing the test is $\geq 60\%$ of correct answers in each module. Each correct answer will be assigned one point, thus meaning that students will be admitted to the oral exam with a starting grade ranging from 18 to 30. The oral exam will consist of three main components: (1) localization of neurological symptoms; (2) discussion of a neurological disease, including its key pathological, clinical, diagnostic, and therapeutic features (e.g., motor neuron disease); (3) analysis of a neurological clinical case. The oral exam will adjust the written exam grade by a range of -4 to +4, depending on its outcome.