DIN - Theoretical and Applied Neurosciences a.a. 2024/2025

Responsible	Institution	Title	Number of hrs	Curriculum	Web platform	Responsible mail
Andrea Pigorini Maria Del Vecchio	UNIMI INCNR	Intracerebral recodings in humans: from acquisition to data analysis and research applications	4/6h	All Curricula	Meet	andrea.pigorini@unimi.it mar.dvecchio@gmail.com
Andrea Pigorini Silvia Casaotto Mario Rosanova	UNIMI	Workshop: Integrating EEG and neuronavigated TMS techniques	24h	Cognitive, Neuroscience, Preclinical	Teams + on site	andrea.pigorini@unimi.it silvia.casarotto@unimit.it mario.rosanova@unimi.it
Judit Gervain	UNIPD	Cognitive Developmental Neuroscience	8h	Cognitive and Behavioral Neuroscience	Zoom	judit.gervain@unipd.it
Chiara Lucifora	ISTC – CNR	Basic course on the application of metaverse in Neuroscience and Humanities research.	3h	Neuroscience and Humanities	Teams	chiara.lucifora@istc.cnr.it
Carmelo M Vicario	UNIME	Applications of Non invasive brain stimulation in Neuroscience Research and Clinical Practice	2h	Neuroscience and Humanities	Teams	cvicario@unime.it

Simona Massimino	UNIME	Neural Correlates of Hypnosis: An EEG Perspective	2h	Neuroscience and Humanities	Teams	simona.massimino@unime.it
Francesca Starita	UNIBO	Functional and neural mechanisms of associative learning	6h	Cognitive and Behavioral Neuroscience	Teams	francesca.starita2@unibo.it
Giuseppe di Pellegrino	UNIBO	Functional Neuroanatomy	3 CFU	Cognitive and Behavioral Neuroscience	Teams	g.dipellegrino@unibo.it
Simone Rossi	UNISI	Advances in brain stimulation	8h (1 CFU)	Preclinical, Clinical and Translational neuroscience	Teams	simone.rossi@unisi.it
Rossella Breveglieri	UNIBO	The cerebral cortex and motor control	8h (1 CFU)	Computational and System Neuroscience	Teams	rossella.breveglieri@unibo.it
Sara Garofalo	UNIBO	The pre-registration revolution: why and how to	3h	Cognitive and Behavioral Neuroscience	Teams	sara.garofalo@unibo.it
Eleonora Russo	SANTANNA PISA	Theories of mind	20h	All curricula	Teams	eleonora.russo@santannapisa.it
Silvestro Micera Alberto Mazzoni	SANTANNA PISA	Neural interfaces and bioelectronic medicine	60h	Computational and System Neuroscience	Teams	silvestro.micera@santannapisa.it alberto.mazzoni@ santannapisa.it
Marco Tamietto	UNITO	Visual awareness and non-conscious perception of emotional stimuli	6h	Cognitive and Behavioral Neuroscience	Webex	marco.tamietto@unito.it

Name	University	Course Title	Hours	Curricula	Platform	Email
Daniela Ovadia (Corso coordinato da Andrea Calvo)	UNITO	Ethics of research and Responsible research: an introduction	8h	All curricula	not available yet	daniela.ovadia@unipv.it
Angelo Gemignani	UNIPI	Neural correlates of meditative practice	4h	Preclinical, Clinical and Translational neuroscience	Microsoft Teams	angelo.gemignani@unipi.it
Massimiliano Olivieri	UNIPA	Metodiche di medicina digitale per la neuroriabilitazione cognitive nello stroke				
Roberto Ciccocioppo Fabio Del Bello	UNICAM	Drug discovery and development from preclinical research to commercialization	21h (3CFU)	Preclinical, Clinical and Translational neuroscience	Webex	
Viviana Trezza	UNIROMA3	Behavioral phenotyping in rodent models of neuropsychiatric disorders	2h	Preclinical, Clinical and Translational neuroscience	Teams	
Maria Pyasik	UNIUD	Virtual reality in cognitive neuroscience research	8h (1 CFU)	All curricula	Teams	maria.pyasik@uniud.it
Vittorio Pizzella	UNICH	Principi di Elettroencefalografia e Magnetoencefalografia - Principles of Electroencephalography and Magnetoencephalography	6h			
Filippo Zappasodi	UNICH	Metodi e applicazioni dell'EEG ad alta densità- Methods and applications of high-density EEG	6h			

Cosimo Del Gratta	UNICH	Principi di risonanza magnetica, risonanza magnetica funzionale e MRI in diffusione - Principles of Magnetic resonance imaging, functional magnetic resonance imaging, and diffusion MRI	6h			
Paolo Capotosto	UNICH	Principi e applicazioni dell'imaging con TMS e di TMS e EEG simultanei - Principles and applications of TMS and concurrent EEG and TMS	4h			
Antonio Ferretti	UNICH	Interpretazione dei segnali fMRI - Interpretation of fMRI signals	6h			
Mauro Gianni Perrucci	UNICH	Principi e metodi di EEG-fMRI simultanei - Principles and methods of simultaneous EEG-fMRI	4h			
Richard Wise	UNICH	Risonanza magnetica multiparametrica per lo studio della fisiologia cerebrale - Multiparametric MRI for the study of brain physiology	6h.			
Carlo Sestieri	UNICH	Paradigmi di ricerca in risonanza magnetica funzionale - Research paradigms in functional magnetic resonance imaging	6h			
Stefania Della Penna	UNICH	Analisi spettrale in EEG e MEG - Spectral analysis in EEG and MEG	6h			
Laura Marzetti	UNICH	Connettività funzionale con EEG e Magnetoencefalografia - Functional connectivity with EEG and Magnetoencephalography	6h			
Silvia Comani	UNICH	Nuovi metodi di denoising dei segnali elettroencefalografici - New methods for denoising EEG signals	6h			

Roberto Guidotti	UNICH	Machine Learning per il neuroimaging - Machine learning for neuroimaging	6h			
Giorgia Committeri	UNICH	Neuroimaging e neuropsicologia - Neuroimaging and neuropsychology	6h			
Simone Di Plinio	UNICH	Modelli statistici per l'integrazione dei dati comportamentali e psicometrici nelle analisi di neuroimmagini - Statistical models for the integration of behavioural and psychometric data in the analysis of neuroimages	6h			
Antea D'Andrea	UNICH	Applicazioni delle tecniche elettrofisiologiche per lo studio delle funzioni cognitive - Application of electrophysiological techniques to the study of cognitive functions	6h			
Annalisa Tosoni	UNICH	Neuroimaging dei processi decisionali - Neuroimaging of decision making	4h			
Valentina Tomassini	UNICH	Neuroimaging nella sclerosi multipla - Neuroimaging in multiple sclerosis	6h			
Giovanna Bubbico	UNICH	Neuroimaging nelle dipendenze - Neuroimaging of addicitions	6h			
Samir Suweis	UNIPD	Graph theory and null models	6+2h (1 CFU)	Computational and System Neuroscience	Zoom	
Marco Piangerelli Sebastiano Pilati	UNICAM	Machine learning and its application (Mutuato da PhD Program in Computer Sciences and Mathematics, UniCam)	14h+14h (4CFU)	Computational and System Neuroscience	Webex	

Angelo Gemignani	UNIPI	The psychobiology of sleep: from Unconsciousness to Oneiric Consciousness	2h	All curricula	Microsoft Teams	angelo.gemignani@unipi.it
Liana Fattore Patrizia Porcu	IN-CNR	Brain sexual dimorphisms, sex differences and steroid hormones modulation of brain functions: Implications for novel therapeutic options	6h (1 CFU)	Cognitive; Preclinical	Zoom o Webex	liana.fattore@in.cnr.it patrizia.porcu@in.cnr.it
Sara Palermo	UNITO	Addressing Awareness Disorders in Neurological and Neuropsychiatric Conditions: Neuropsychological and Neurobiological Insights with Ethico-Legal Implications	6h	All curricula	Webex	sara.palermo@unito.it
Emiliano Ricciardi	IMT School for Advanced Studies Lucca	Introduction to Human Neuroimaging	14h	All Curricula	Team	
Luca Cecchetti	IMT School for Advanced Studies Lucca	Functional Neuroanatomy	20h	All Curricula	Teams	
Tommaso Gili	IMT School for Advanced Studies Lucca	Network Neuroscience and Medicine	20h	All Curricula	Teams	
Tommaso Gili	IMT School for Advanced Studies Lucca	Physics of Magnetic Resonance Imaging	10h	All Curricula	Teams	
Giacomo Handjaras	IMT School for Advanced Studies Lucca	Functional Magnetic Resonance Imaging data analysis – I	20h	All Curricula	Teams	
Giacomo Handjaras	IMT School for Advanced Studies Lucca	Functional Magnetic Resonance Imaging data analysis – II	20h	All Curricula	Teams	

Marco Pagani	IMT School for Advanced Studies Lucca	Functional Magnetic Resonance Imaging data analysis – III	10h	All Curricula	Teams	
Gustavo Cevolani	IMT School for Advanced Studies Lucca	Critical Thinking	20h	All Curricula	Teams	
Gustavo Cevolani	IMT School for Advanced Studies Lucca	Philosophy of Science	20h	All Curricula	Teams	
Gustavo Cevolani	IMT School for Advanced Studies Lucca	Philosophy and Neuroscience in Moral Reasoning	14h	All Curricula	Teams	
Gustavo Cevolani	IMT School for Advanced Studies Lucca	Philosophy of Social Science	10h	All Curricula	Teams	
Giulio Bernardi	IMT School for Advanced Studies Lucca	Analysis of Electrophysiology data – I	30h	All Curricula	Teams	
Davide Bottari	IMT School for Advanced Studies Lucca	Analysis of Electrophysiology data – II	16h	All Curricula	Teams	
Monica Betta	IMT School for Advanced Studies Lucca	Principles of bio-signal analysis	16h	All Curricula	Teams	
Pietro Pietrini	IMT School for Advanced Studies Lucca	Neurobiology of Emotion and Behavior	12h	All Curricula	Teams	

Marta Bortoletto	IMT School for Advanced Studies Lucca	Introduction to Non-Invasive Brain Stimulation	14h	All Curricula	Teams	
Emiliano Ricciardi	IMT School for Advanced Studies Lucca	Introduction to Sensation and Perception	14h	All Curricula	Teams	
Davide Bottari	IMT School for Advanced Studies Lucca	Neuroscience of Perception and Experience-Dependent Plasticity	20h	All Curricula	Teams	
Pietro Pietrini	IMT School for Advanced Studies Lucca	Clinical Psychopathology and Psychiatry	12h	All Curricula	Teams	
Pietro Pietrini	IMT School for Advanced Studies Lucca	Forensic and Legal Psychology	12h	All Curricula	Teams	
Giulio Bernardi	IMT School for Advanced Studies Lucca	Introduction to Consciousness and Sleep	20h	All Curricula	Teams	
Gustavo Cevolani	IMT School for Advanced Studies Lucca	Logic and Formalized Reasoning (long seminars)	10h	All Curricula	Teams	
Luca Cecchetti	IMT School for Advanced Studies Lucca	Social cognition and Affective science – I	10h	All Curricula	Teams	
Giada Lettieri	IMT School for Advanced Studies Lucca	Social cognition and Affective science - II	10h	All Curricula	Teams	

Giacomo Handjaras	IMT School for Advanced Studies Lucca	Introduction to Neurolinguistics	10h	All Curricula	Teams	
Luca Cecchetti	IMT School for Advanced Studies Lucca	Techniques and Methods in Psychological Science	20h	All Curricula	Teams	
Davide Bottari	IMT School for Advanced Studies Lucca	Introduction to Psychophysics	16h	All Curricula	Teams	
Giacomo Handjaras	IMT School for Advanced Studies Lucca	Machine Learning in Psychological Science	10h	All Curricula	Teams	
Monica Betta	IMT School for Advanced Studies Lucca	Basic MATLAB Programming for Neuroscience	20h	All Curricula	Teams	
Ruggero Basanisi	IMT School for Advanced Studies Lucca	Python programming for neuroscience	10h	All Curricula	Teams	
Maurizio Taglialatela	University of Naples Federico II	Ion channels in brain physiology and pathology	8 (1 CFU)	All Curricula	Teams	

Course description

Andrea Pigorini Maria Del Vecchio	UNIMI INCNR	Intracerebral recodings in humans: from acquisition to data analysis and research applications	4/6 H	All Curricula	Meet	andrea.pigorini@unimi.it mar.dvecchio@gmail.com

An overview of data acquisition for intracerebral recordings in humans, conducted during presurgical evaluations in epileptic patients. This type of data is essential for clinical purposes, but it also provides a unique "open window" into the human brain, offering the only opportunity to record brain activity invasively. This course includes an introduction to intracerebral recordings in humans and an overview of the wide range of possibilities such data offers: from evoked potentials and electrical stimulation to their combination with neuroimaging techniques.

Andrea Pigorini Silvia Casaotto Mario Rosanova	UNIMI	Workshop: Integrating EEG and neuronavigated TMS techniques	24 H	Cognitive, Neuroscience, Preclinical	Teams + on site	andrea.pigorini@unimi.it silvia.casarotto@unimit.it mario.rosanova@unimi.it

In this workshop we offer you the opportunity to learn how to integrate EEG & TMS, collect navigated TMS-EEG data and pre-process TMS-evoked potentials using customized Python scripts. On the first day (which is free of charge), in addition to an on-site workshop, we will offer a livestream of the event for those unable to attend in person. The following two days of the workshop will be on-site only. Here, you will be able to actively participate in hands-on nTMS-EEG sessions, during which you will collect data from healthy volunteers. In addition, after providing an overview of data pre-processing, we will enable you to analyze collected data yourself. These practical sessions will be accompanied by a comprehensive description of the nTMS-EEG methodology, of the several functional measures that can be computed from nTMS-EEG data, and of a multiscale overview linking non-invasive measures of cortical reactivity to neuronal events. Attendance on days 2-3 requires a ticket. Sign up soon to reserve one of the limited number of tickets available.

Chiara Lucifora	ISTC – CNR	Basic course on the application of metaverse in Neuroscience and Humanities research.	3h	Neuroscience and Humanities	Teams	chiara.lucifora@istc.cnr.it

The following two days of the workshop will be on-site only. Here, you will be able to actively participate in hands-on nTMS-EEG sessions, during which you will collect data from healthy volunteers. In addition, after providing an overview of data pre-processing, we will enable you to analyze collected data yourself. These practical sessions will be accompanied by a comprehensive description of the nTMS-EEG methodology, of the several functional measures that can be computed from nTMS-EEG data, and of a multiscale overview linking non-invasive measures of cortical reactivity to neuronal events. Attendance on days

2-3 requires a ticket.

Francesca Starita	UNIBO	Functional and neural mechanisms of associative learning	6h	Cognitive and Behavioral Neuroscience	Teams	francesca.starita2@unibo.it

This course will provide an overview of the cognitive, neural and psychophysiological bases of associative learning. We will also explore the role of contiguity, contingency and predicition errors in the establishment of learning. Finally, we will discuss how prediction errors are implemented by dopamine neurons.

Giuseppe di Pellegrino	UNIBO	Functional Neuroanatomy	3 CFU	Cognitive and Behavioral Neuroscience	Teams	g.dipellegrino@unibo.it

The course will provide advanced knowledge on the physical structures, organization, and functions of the human nervous system. Students will learn how key anatomical features of the brain and spinal cord underlie functions, and how damage to these structures can lead to specific functional deficits, for example, due to stroke, trauma or neurodegenerative disease. By the end of the course, students will be able to identify, map and label key functional structures and pathways in horizontal, sagittal, and coronal sections of the human nervous system. The following topics will be covered: Spinal cord; Brain stem (midbrain, pons, medulla) and the cerebellum; Diencephalon and basal ganglia; Cerebral hemispheres; Ventricles and arterial supply of the brain;

Simone Rossi	UNISI	Advances in brain stimulation	8h (1 CFU)	Preclinical, Clinical and Translational neuroscience	Teams	simone.rossi@unisi.it

This course will deal with the physiological basis of noninvasive brain stimulation techniques (TMS, rTMS; tDCS, tACS, tRNS), including safety and neuronavigation. These will be discussed in the frame of research applications, from interference with brain functions to neuroenhancement, for clinical and rehabilitative purposes as well as for investigations on motor and vestibular systems.

Eleonora Russo	SANTANN A PISA	Theories of mind	20h	All curricula	Teams	eleonora.russo@santannapisa.it

Neural networks process and integrate incoming information to drive cognition and behavior. Cognition thus results as emerging property of the dynamical evolution of such distributed networks. This course aims to provide an introductory overview of prominent theories in computational neuroscience and to explore the neural processes underlying cognitive and motor functions such as decision-making, reinforcement learning, and motor control. The course will include the formalization of different population models and the dynamics they generate, as well as the discussion of experimental results supporting these dynamics. Additionally, the course will equip participants with some methodological tools for investigating population coding and dynamics directly from experimental data.

Silvestro Micera Alberto Mazzoni	SANTANN A PISA	Neural interfaces and bioelectronic medicine	60h	Computational and System Neuroscience	Teams	silvestro.micera@santannapisa.it alberto.mazzoni@ santannapisa.it

The course will focus on implantable neuroprostheses, covering topics such as brain-to-machine interfaces, artificial limbs with neural control, sensory and motor neuroprostheses, and neuromodulation of the autonomic nervous system. Students will gain methodologies for developing and validating implantable systems for neuromodulation.

Angelo Gemignani	UNIPI	Neural correlates of meditative practice	4h	Preclinical, Clinical and Translational neuroscience	Microsoft Teams	angelo.gemignani@unipi.it

This course aim is to inform participants of the most recent research in the field of psychophysiology and meditation, through a neuroscientif approach. The topics covered will concern in particular the importance of the brain -system-, with all of its components, in the formation of consciousness and how meditation acts and at what level on the cerebral psychophysiology by quantitatively and qualitatively modifying its functioning.

Roberto Ciccocioppo Fabio Del Bello	UNICAM	Drug discovery and development from preclinical research to commercialization	21h (3CFU)	Preclinical, Clinical and Translational neuroscience		Webex	

The course aims to provide knowledge in the field of drug development. Aspects related to the design of innovative molecules and their development through various preclinical and clinical phases will be addressed. The main steps involved in the development of new molecules and the decision-making process that governs the go-no-go decisions in drug advancement up to the final clinical phases will be analyzed. The course will be accompanied by seminars given by expert colleagues from the pharmaceutical and biotechnology industry.

Viviana Trezza	UNIROMA3	Behavioral phenotyping in rodent models of neuropsychiatric disorders	2h	Preclinical, Clinical and Translational neuroscience	Teams	

The objective of this course is to outline the importance of behavioral phenotyping of animal models of neuropsychiatric diso rders, by showing how the behavioral characteristics of neuropsychiatric disorders can be translated into effective, developmentally-specific and clinically meaningful behavioral readouts in the laboratory setting.

Maria Pyasik	UNIUD	Virtual reality in cognitive neuroscience research	8h (1 CFU)	All curricula	Teams	maria.pyasik@uniud.it

The course aims to provide an overview of virtual reality (VR) and related technologies as a research method in cognitive neu roscience. It will focus on describing the existing types of VR and the cases of their application in research and clinical practice. Finally, we will go over an implementation pipeline of a simple VR scenario (overview of the software, modelling of a 3D environment, object animation, creation and animation of virtual cha racters).

Vittorio Pizzella	UNICH	Principi di Elettroencefalografia e Magnetoencefalografia - Principles of Electroencephalography and Magnetoencephalography	6h			

This course provides students with the basis to understand what electroencephalography (EEG) and magnetoencephalography (MEG) are and their use in neuroscience studies and in the neurological clinic. In detail, the program includes: the neuron and its electrical activity, the current dipole as a model of neuronal activity, the electrical activity of neuronal groups as a generator of the EEG/MEG signal, the instrumentation for the measurement of the EEG/MEG signal, the characteristics of the EEG and MEG signal. The program also includes elements on the analysis of EEG/MEG data and on the applications of MEG in particular. After attending the course, the student will have the basics to be able to follow the courses on "complex analysis methods" and on "specific applications and topics".

Filippo Zappasodi	UNICH	Metodi e applicazioni dell'EEG ad alta densità- Methods and applications of high-density EEG	6h			

The course aims at introducing students to the use of high density electroencephalography (hd-EEG) for measuring brain function in humans. By the end of the course, students should be familiar with the nature of EEG signal and its derivatives, be able to perform experiments using high density EEG and to combine the EEG technique with other neuroimaging modalities, to know the basic step of EEG data analysis and to be able to critically interpret published results of EEG studies. After recalling the basic elements of the technique, the general aspects of the methodology and applications of evoked potential analysis, spectral analysis and time-frequency analysis will be described. Finally, data driven approaches and complementary techniques will be presented (microstates, infra-slow EEG activity, high frequency EEG, neuro-feedback, Brain Computer Interface). This course is preparatory to the hand-on experience in EEG laboratory, in which students will design a simple experiment, record EEG, analyze data and interpret findings.

Cosimo Del Gratta	UNICH	Principi di risonanza magnetica, risonanza magnetica funzionale e MRI in diffusione - Principles of Magnetic resonance imaging, functional magnetic resonance imaging, and diffusion MRI	6h			

In this course the basic elements of the penomenon of nuclear magnetic resonance will be presented, as well as their use in the formation of images from magnetic resonance signals. The principal sequences for the excitation of nuclei for image generation, and the image reconstruction methods will be

described, finally the mechanisms of contrast generation will be explained. Then, the physical and physiological bases of functional magnetic resonance imaging will be described, as well as the generation of contrast in functional images, the principal methods for artifact removal, the methods for data acquisition, and the basics of signal analysis. Finally, the diffusion of water in tissue will be described, as well as how the magnetic resonance signal can be influenced by this diffusion in order to provide pieces of information on the tissues, on a scale much smaller than the saptial resolution of images.

Paolo Capotosto	UNICH	Principi e applicazioni dell'imaging con TMS e di TMS e EEG simultanei - Principles and applications of TMS and concurrent EEG and TMS	4h			

Transcranial magnetic stimulation (TMS) is a non-invasive technique for brain stimulation and is widely used in neuroscience. Furthermore, the combination of such a causal approach with electrophysiological recording (EEG) methods is essential to better understand the functioning of the human brain. The course will provide the doctoral student with the basic principles of TMS, its use in basic research and in different patient groups, and the possible problems of a combined approach (TMS-EEG). The theoretical part together with the practical part made in the laboratory will make the student autonomous to be able to design and develop his own studies.

Antonio Ferretti	UNICH	Interpretazione dei segnali fMRI - Interpretation of fMRI signals	6h			

This course will allow the student to acquire the technical and scientific knowledge for a correct biophysical and physiologi cal interpretation of the signals obtained with modern functional imaging techniques based on nuclear magnetic resonance. The course will discuss in particular the spatial specificity and the temporal dynamics of the BOLD signal, including the impact of the main MRI acquisition sequences. Furthermore, alternative fMRI approaches (e.g., methods based on arterial spin labeling) will be discussed, together with the physical principles of magnetic resonance spectroscopy. The student will develop the ability to evaluate the limits and strength of the discussed techniques critically and independently, for a correct interpretation of the results obtained in a scientific research project.

Mauro Gianni Perrucci	UNICH	Principi e metodi di EEG-fMRI simultanei - Principles and methods of simultaneous EEG-fMRI	4h			

Importance of teaching: The EEG-fMRI multimodal neuroimaging technique allows to acquire EEG and fMRI data simultaneously. This technique is used internationally to study brain activity in normal conditions and in the presence of pathologies. The EEG recorded on the surface of the head reflects the cerebral electrical activity generated by post-synaptic potentials in the cerebral cortex while functional magnetic resonance imaging (with the BOLD technique dependent on the level of oxygen in the blood) detects hemodynamic changes throughout the brain. Their combination therefore allows the direct correlation of these two important measures of brain activity. Contents: The Sources and Temporal Dynamics of Scalp Electric Fields; Sources and Spatial Scales of EEG and ERP Activity; Activity of Delta, Theta, Alpha Rhythms, Fast and Ultra-Fast EEG Rhythms; Functional Microstates of the Brain; EEG Source Imaging; Combined MRI and Physiology; Hemodynamic Correlates to EEG; Challenges in Recording EEG in MR; Types of MR Compatible Equipment; Equipment and Patient Safety; Technical Characteristics of the EEG Amplifier; Sparse fMRI Acquisition; Spike-Triggered EEG-fMRI; Continuous fMRI Acquisition; Scanning Impact; GA Variability; Advanced Recording; Applications; EEG Artefact Sources; Good quality EEG data; General advice: Motion; Average Artefact Subtraction (AAS); Artefact Correction requirements. The training objectives of the course are to provide knowledge of the main results and possible applications of the EEG-fMRI combination technique. Ability to understand and critically analyze the various technical complications for the use of the methodology and the ability to design and perform experiments that are compatible with the specifications required by the multimodal technique.

Richard Wise	UNICH	Risonanza magnetica multiparametrica per lo studio della fisiologia cerebrale - Multiparametric MRI for the study of brain physiology	6h.			

MRI, as well as offering detailed images of brain structure, can be made sensitive to a number of important physiological processes in the brain. The course explains the most important MRI methods that are used to study a wide range of cerebral physiology in the healthy and diseased brain. The course presents: a reminder of the basic physics of MRI; blood oxygenation level dependent (BOLD) functional magnetic resonance imaging (fMRI); physiology of fMRI; ultra-high field fMRI; cerebrovascular physiology including measurement of cerebral blood flow, cerebrovascular reactivity, and vascular compliance; imaging of cerebral oxygen metabolism. At the end of the course the students should be able to: 1) describe the range of physiology (vascular and metabolic) to which MRI can be made sensitive and 2) understand the benefits and limitations of different MRI techniques for quantifying brain physiology.

Carlo Sestieri	UNICH	Paradigmi di ricerca in risonanza magnetica funzionale - Research paradigms in functional magnetic resonance imaging	6h			

The course describes the main experimental designs and analysis techniques employed in cognitive neuroscience research conducted through functional magnetic resonance imaging (fMRI). Following the examination of the peculiar characteristics of the BOLD signal that gives rise to functional resonance images, the course presents the main steps of data preprocessing that allow to increase the signal/noise ratio and compare the results across subjects and

studies. The data analysis techniques are then examined which allow to identify the BOLD response associated with the execution of particular cognitive tasks and follow its temporal dynamics, with particular reference to the general linear models and the most elementary methods of statistical inference. Then the course examine the main experimental designs according to the research needs, with particular reference to the temporal characteristics and experimental control typical of different paradigms and to methods for the decomposition of the BOLD response in event-related paradigms. Finally, the course discuss the main methods of analysis and the functional significance of brain connectivity at rest and during the execution of a task, measured by functional resonance. This course aims to provide specific skills and both basic and advanced notions on the analysis of magnetic resonance data in order to enable the student to design an experiment according to the experimental question, the intrinsic limitations of the technique and the desired experimental control.

Stefania Della Penna	UNICH	Analisi spettrale in EEG e MEG - Spectral analysis in EEG and MEG	6h			

The course aims to introduce the analysis of digital signals with basic knowledge on Fourier analysis, power spectrum, sampling theorem, and time-frequency representation of a signal. Starting from this introduction, the course will describe some applications of the spectral analysis of electroencephalographic and magnetoencephalographic signals for the study of cerebral oscillatory activity in healthy subjects and patients using static and dynamic approaches. Finally, a Matlab practice will be carried out on estimating the power spectral density on real EEG/MEG data, using the methods presented in the theoretical introduction and observing the effect in the estimation. The course will allow the PhD student to acquire the knowledge necessary for understanding literature, and for the design and analysis strategies to be applied in scientific works concerning the aforementioned topics.

Laura Marzetti	UNICH	Connettività funzionale con EEG e Magnetoencefalografia - Functional connectivity with EEG and Magnetoencephalography	6h			

In the last decades, systems neuroscience has made it clear that brain functioning requires the cooperation of several spatially separated brain regions to allow for integrative functions (e.g., vision, audition), as well as for higher order functions (e.g., understanding of actions), for a review see e.g., Rizzolatti et al. (2018). The reliable estimation of this cooperation, i.e., of functional connectivity between brain areas, is thus of primary importance to disclose the physiological and pathological organization of the human brain. To this end, several non-invasive imaging techniques and novel analysis methods have contributed to the examination of whole-brain functional connectivity patterns: functional Magnetic Resonance (fMRI) and functional Near Infrared Spectroscopy (fNIRS) have investigated the level of co-activation between brain regions as a proxy for functional communication (e.g., Smith et al., 2013; Wang et al., 2017), while electrophysiological techniques such as ElectroEncephaloGraphy (EEG) and MagnetoEncephaloGraphy (MEG), have characterized both the level of co-activation between brain regions and the coupling of their respective signals, i.e., the statistical relationship between time-series of

neuronal signals. A recent review on the theory and algorithms of electrophysiological brain connectivity analysis can be found in He et al. (2019).

Silvia Comani	UNICH	Nuovi metodi di denoising dei segnali elettroencefalografici - New methods for denoising EEG signals	6h			

This course aims at introducing the PhD students of the doctoral school in Neuroscience and Imaging to advanced analytical methods developed for the removal of various types of artifacts from electroencephalography (EEG) signals recorded in adults and newborns, highlighting the different problems that are encountered in these two classes of volunteers / patients. We will describe the criteria followed to classify the artifacts, the specific problems encountered in the classification of each artifact type, and the methods developed to automatically detect and remove physiological artifacts that can be recorded simultaneously with cortical activity, in particular artifacts due to involuntary blinking of the eyelids (eyeblinks), ocular movements (eye movements), muscle activity (myogenic interference), cardio-vascular artifacts, and movement artifacts. Finally, examples of both basic and clinical research applications will be provided in which the use of these methods is extremely important for the correct interpretation of EEG signals.

Roberto Guidotti	UNICH	Machine Learning per il neuroimaging - Machine learning for neuroimaging	6h			

In the past two decades the growing interest and applicazione of machine learning in neuroimaging has undoubtedly advanced the understanding of brain-behaviour relationships. Specifically, these predictive models allowed the identification of cognitive and behaviour traits, in memory and perceptual tasks for example, as well as the identification of biomarkers of health and disease. This course is thus important to introduce machine learning concepts and their application in neuroimaging. The course will introduce machine learning concepts, from a mathematical and practical perspective and then the current application in neuroimaging will be presented. A general overview of deep learning methods will be provided, too. The goal of the course will be to make the student comfortable with the key concepts of machine learning methods and, more importantly, to allow them for the proper application of these techniques in their research activities.

Giorgia Committeri	UNICH	Neuroimaging e neuropsicologia - Neuroimaging and neuropsychology	6h			

The course aims at the knowledge of neuropsychology as a cognitive neuroscience and its complex relationship with neuroimaging. It will start with an introduction to neuropsychology through a brief historical-methodological overview of the discipline. Then the main neuroimaging methods used in clinical neuropsychology will be presented (structural/lesional studies, functional studies, structural and functional connectivity studies) and the hodotopic framework will be explained with the exemplary case of hemispatial neglect. Finally, the challenge of combining neuroimaging and neuropsychology to inform cognitive models and clinical practice will be addressed. At the end of the course, students will have to demonstrate that they have learnt about the development of the discipline over time, the specific contribution of neuroimaging to neuropsychological knowledge and the hodotopic framework, in which functional specialization and large-scale integration coexist.

| Simone Di Plinio | UNICH | Modelli statistici per l'integrazione dei dati comportamentali e psicometrici nelle analisi di neuroimmagini - Statistical models for the integration of behavioural and psychometric data in the analysis of neuroimages | 6h | | | |

Through the course "Statistical models for the integration of behavioural and psychometric data in the analysis of neuroimage s", students will learn essential inferential statistical approaches which are is necessary in neuroscientific investigations. Students will learn how to describe, to apply, and to interpret many models including analysis of covariance, mixed-effects models, and principal component analysis. Demonstrative software will be implemented throughout the course (JASP, MatLab, R). Finally, the most common methodological mistakes and pitfalls will be discussed so that young researchers will be able to conduct efficient, reliable experiments and to constructively evaluate theoretical and methodological approaches.

| Antea D'Andrea | UNICH | Applicazioni delle tecniche elettrofisiologiche per lo studio delle funzioni cognitive - Application of electrophysiological techniques to the study of cognitive functions | 6h | | | |

The neural mechanisms of neuronal oscillations will be introduced with respect to their role in cognitive functions, investigated through electrophysiological techniques (MEG / EEG). Specifically, the applications of these techniques will be explored for the study of neural signals underlying different cognitive tasks (e.g. visual-spatial attention, perceptual decision-making); particular attention will be given to the mechanisms of synchronization of neuronal oscillations, at the same or at different frequencies, as the process of choice for communication between different brain areas, favourable for human behaviour. At the end the student will have acquired the fundamental knowledge regarding the paradigms and the electrophysiological techniques in order to investigate the neurophysiological mechanisms underlying cognitive functions.

Annalisa Tosoni	UNICH	Neuroimaging dei processi decisionali - Neuroimaging of decision making	4h			

The course aims at providing a general knowledge about the main cognitive and neurobiological models underlying the decision -making process as well as an overview of the main experimental paradigms and methods of the field of decision neuroscience. The module will illustrate the main models underlying the functional organization and the cognitive components of the decision-making process in the three main research domains: perceptual, memory-based and value-based decision-making. For each domain, the main theoretical model will be described followed by an illustration of the main experimental paradigms and results of a set of selected research studies supporting the reference model presented at the beginning.

Valentina Tomassini	UNICH	Neuroimaging nella sclerosi multipla - Neuroimaging in multiple sclerosis	6h			

This course will discuss behavioural and MRI evidence of damage, repair and systems-level plasticity underlying disability and functional recovery in multiple sclerosis (MS) it being an example of a neuroinflammatory condition of the central nervous system (CNS). Specifically, we will discuss aspects of: Prevention of brain damage and disability in MS: we will discuss MRI research evidence of pathological, clinical, prognostic and therapeutic aspects of MS that aim to prevent damage to the brain and disability. Promotion of repair and recovery from damage and disability by modulation of brain plasticity: we will discuss MRI evidence that generates hypotheses for the mechanisms of cerebral plasticity and their promotion to limit the impact of damage on clinical disability. Because these mechanisms are active also during normal learning, we will touch on aspects of functional anatomy of the healthy brain and its changes with learning. Development of neuroimaging methods for clinical applications: as clinical needs often contribute to advance methodological research, we will explore the methodological advances that MS research in MRI has induced, discussing the development of advanced methods of functional and structural neuroimaging to characterise changes with damage and recovery and to develop novel neuroimaging markers.

Giovanna Bubbico	UNICH	Neuroimaging nelle dipendenze - Neuroimaging of addicitions	6h			

Substance Use Disorders are continually expanding around the world, due to the market entry of new drugs of abuse and the enhancement of "vintage" substances. The psychopathological consequences are increasingly relevant, as are the neuroimaging correlates, which can be differentiated according to

the class of substances taken. A specific focus of the course will also concern the use of psychedelics in the clinical setting and the mechanisms of action of the same identifiable with the most modern fMRI techniques.

Samir Suweis	UNIPD	Graph theory and null models	6+2h (1 CFU)	Computational and System Neuroscience	Zoom	

This course covers some basic concepts of graph theory including connectivity, centralities, assortativity and clustering. Applications on some real networks are also shown. The second part of the course introduces some more advanced topics, such as the use of random graphs (Erdos-Reny, Small-World and Barabasi) as null models, to actually infer biological information from data on brain networks. Upon completion of the course, students will be able to: (1) Calculate the main structural properties of graphs (2) understand the fundamental properties of some families of random graphs; (3) Use random graphs as null models to test different properties of real networks.

Marco Piangerelli Sebastiano Pilati	UNICAM	Machine learning and its application (Mutuato da PhD Program in Computer Sciences and Mathematics, UniCam)	14h+14h (4CFU)	Computational and System Neuroscience	Webex	

The goal of this course is to provide students with the basic skills in the field of statistical modeling of big-data and machine learning. The course will present the basic theoretical concepts and some practical techniques to analyze data and to develop statistical modes, focusing in particular on artificial neural networks.
Topics: Introduction to Probabilistic Learning, Paradigms of ML, Unsupervised (KMeans- Hierarchical), Supervised (SVM-Linear/Logistic), Artificial neural networks, Classification VS Regression, Evaluation Metrics, Overfitting / Underfitting, Deep learning - Convolutional neural networks, Boltzmann Machines, Autoregressive neural networks for density estimation, Hands on tutorials.

Angelo Gemignani	UNIPI	The psychobiology of sleep: from Unconsciousness to Oneiric Consciousness	2h	All curricula	Microsoft Teams	angelo.gemignani@unipi.it

The seminar will focus on the latest research regarding the psychophysiology of sleep, with particular attention to states of consciousness and dreaming

Liana Fattore Patrizia Porcu	IN-CNR	Brain sexual dimorphisms, sex differences and steroid hormones modulation of brain functions: Implications for novel therapeutic options	6h (1 CFU)	Cognitive; Preclinical	Zoom o Webex	liana.fattore@in.cnr.it patrizia.porcu@in.cnr.it

The presence, magnitude, and significance of sex differences in the brain are hotly debated topics in neuroscience, as sex-related differences between men and women may have profound effects on disease susceptibility, pathophysiology, and progression. Sex differences in adults have been postulated to be the direct result of organizational or activational effects of sex hormones, i.e., effects of sex hormones on the brain that occu r either during fetal development or later in life, and/or the result of socialization and experience (i.e., environment). Besides estrogens, progesterone and testosterone, other steroid hormones strongly affects brain functions and processes. Neurosteroids, synthesized both in the periphery and the central nervous system, influence key brain functions through rapid modulation of neuronal excitability via membrane receptors. Aim of this course is to explore current evidence for gender (and sex) differences in brain and behavior and provide an overview on the synthesis, mechanisms of action and effects of neurosteroids in physiological brain function and pathological conditions related to neuropsychiatric and neurological diseases. Finally, the therapeutic action of neurosteroids as rapid-acting, durable antidepressants will be highlighted.

Sara Palermo	UNITO	Addressing Awareness Disorders in Neurological and Neuropsychiatric Conditions: Neuropsychological and Neurobiological Insights with Ethico-Legal Implications	6h	All curricula	Webex	sara.palermo@unito.it

This course is designed to provide a comprehensive overview of the current international understanding of illness awareness in various neurological conditions, including hemiplegia resulting from brain damage, Alzheimer's, Parkinson's, and mood disorders. The content integrates diverse perspectives on etiopathogenic and neurocognitive aspects, supported by neurobiological evidence and neuroimaging data. The course delves into key topics such as metacognition, ianosognosia and reduced self-awareness for neuropsychological symptomatology, and the assessment methods. Special emphasis will be placed on distinguishing these phenomena from psychological defense mechanisms such as denial. The significance of research in this field extends beyond enriching our knowledge of consciousness and awareness processes in humans; it has practical implications in medical-legal patient management and treatment compliance, particularly with respect to informed consent.

Emiliano Ricciardi	IMT School for Advanced Studies Lucca	Introduction to Human Neuroimaging	14h	All Curricula	Team	

For getting more info on the course, registering the course and getting access to the course calendar and lesson links, please contact Scuola IMT - PhD Office phd@imtlucca.it

Luca Cecchetti	IMT School for Advanced Studies Lucca	Functional Neuroanatomy	20h	All Curricula	Teams	

For getting more info on the course, registering the course and getting access to the course calendar and lesson links, please contact Scuola IMT - PhD Office phd@imtlucca.it

Tommaso Gili	IMT School for Advanced Studies Lucca	Network Neuroscience and Medicine	20h	All Curricula	Teams	

For getting more info on the course, registering the course and getting access to the course calendar and lesson links, please contact Scuola IMT - PhD Office phd@imtlucca.it

Tommaso Gili	IMT School for Advanced Studies Lucca	Physics of Magnetic Resonance Imaging	10h	All Curricula	Teams	

For getting more info on the course, registering the course and getting access to the course calendar and lesson links, please contact Scuola IMT - PhD Office phd@imtlucca.it

Giacomo Handjaras	IMT School for Advanced Studies Lucca	Functional Magnetic Resonance Imaging data analysis – I	20h	All Curricula	Teams	

For getting more info on the course, registering the course and getting access to the course calendar and lesson links, please contact Scuola IMT - PhD Office phd@imtlucca.it

Giacomo Handjaras	IMT School for Advanced Studies Lucca	Functional Magnetic Resonance Imaging data analysis – II	20h	All Curricula	Teams	

For getting more info on the course, registering the course and getting access to the course calendar and lesson links, please contact Scuola IMT - PhD Office phd@imtlucca.it

Marco Pagani	IMT School for Advanced Studies Lucca	Functional Magnetic Resonance Imaging data analysis – III	10h	All Curricula	Teams	

For getting more info on the course, registering the course and getting access to the course calendar and lesson links, please contact Scuola IMT - PhD Office phd@imtlucca.it

Gustavo Cevolani	IMT School for Advanced Studies Lucca	Critical Thinking	20h	All Curricula	Teams	

For getting more info on the course, registering the course and getting access to the course calendar and lesson links, please contact Scuola IMT - PhD Office phd@imtlucca.it

Gustavo Cevolani	IMT School for Advanced Studies Lucca	Philosophy of Science	20h	All Curricula	Teams	

For getting more info on the course, registering the course and getting access to the course calendar and lesson links, please contact Scuola IMT - PhD Office phd@imtlucca.it

Gustavo Cevolani	IMT School for Advanced Studies Lucca	Philosophy and Neuroscience in Moral Reasoning	14h	All Curricula	Teams	

For getting more info on the course, registering the course and getting access to the course calendar and lesson links, please contact Scuola IMT - PhD Office phd@imtlucca.it

Gustavo Cevolani	IMT School for Advanced Studies Lucca	Philosophy of Social Science	10h	All Curricula	Teams	

For getting more info on the course, registering the course and getting access to the course calendar and lesson links, please contact Scuola IMT - PhD Office phd@imtlucca.it

Giulio Bernardi	IMT School for Advanced Studies Lucca	Analysis of Electrophysiology data – I	30h	All Curricula	Teams	

For getting more info on the course, registering the course and getting access to the course calendar and lesson links, please contact Scuola IMT - PhD Office phd@imtlucca.it

Davide Bottari	IMT School for Advanced Studies Lucca	Analysis of Electrophysiology data – II	16h	All Curricula	Teams	

For getting more info on the course, registering the course and getting access to the course calendar and lesson links, please contact Scuola IMT - PhD Office phd@imtlucca.it

Monica Betta	IMT School for Advanced Studies Lucca	Principles of bio-signal analysis	16h	All Curricula	Teams	

For getting more info on the course, registering the course and getting access to the course calendar and lesson links, please contact Scuola IMT - PhD Office phd@imtlucca.it

Pietro Pietrini	IMT School for Advanced Studies Lucca	Neurobiology of Emotion and Behavior	12h	All Curricula	Teams	

For getting more info on the course, registering the course and getting access to the course calendar and lesson links, please contact Scuola IMT - PhD Office phd@imtlucca.it

Marta Bortoletto	IMT School for Advanced Studies Lucca	Introduction to Non-Invasive Brain Stimulation	14h	All Curricula	Teams	

For getting more info on the course, registering the course and getting access to the course calendar and lesson links, please contact Scuola IMT - PhD Office phd@imtlucca.it

Emiliano Ricciardi	IMT School for Advanced Studies Lucca	Introduction to Sensation and Perception	14h	All Curricula	Teams	

For getting more info on the course, registering the course and getting access to the course calendar and lesson links, please contact Scuola IMT - PhD Office phd@imtlucca.it

Davide Bottari	IMT School for Advanced Studies Lucca	Neuroscience of Perception and Experience-Dependent Plasticity	20h	All Curricula	Teams	

For getting more info on the course, registering the course and getting access to the course calendar and lesson links, please contact Scuola IMT - PhD Office phd@imtlucca.it

Pietro Pietrini	IMT School for Advanced Studies Lucca	Clinical Psychopathology and Psychiatry	12h	All Curricula	Teams	

For getting more info on the course, registering the course and getting access to the course calendar and lesson links, please contact Scuola IMT - PhD Office phd@imtlucca.it

Pietro Pietrini	IMT School for Advanced Studies Lucca	Forensic and Legal Psychology	12h	All Curricula	Teams	

For getting more info on the course, registering the course and getting access to the course calendar and lesson links, please contact Scuola IMT - PhD Office phd@imtlucca.it

Giulio Bernardi	IMT School for Advanced Studies Lucca	Introduction to Consciousness and Sleep	20h	All Curricula	Teams	

For getting more info on the course, registering the course and getting access to the course calendar and lesson links, please contact Scuola IMT - PhD Office phd@imtlucca.it

Gustavo Cevolani	IMT School for Advanced Studies Lucca	Logic and Formalized Reasoning (long seminars)	10h	All Curricula	Teams	

For getting more info on the course, registering the course and getting access to the course calendar and lesson links, please contact Scuola IMT - PhD Office phd@imtlucca.it

Luca Cecchetti	IMT School for Advanced Studies Lucca	Social cognition and Affective science – I	10h	All Curricula	Teams	

For getting more info on the course, registering the course and getting access to the course calendar and lesson links, please contact Scuola IMT - PhD Office phd@imtlucca.it

Giada Lettieri	IMT School for Advanced Studies Lucca	Social cognition and Affective science - II	10h	All Curricula	Teams	

For getting more info on the course, registering the course and getting access to the course calendar and lesson links, please contact Scuola IMT - PhD Office phd@imtlucca.it

Giacomo Handjaras	IMT School for Advanced Studies Lucca	Introduction to Neurolinguistics	10h	All Curricula	Teams	

For getting more info on the course, registering the course and getting access to the course calendar and lesson links, please contact Scuola IMT - PhD Office phd@imtlucca.it

Luca Cecchetti	IMT School for Advanced Studies Lucca	Techniques and Methods in Psychological Science	20h	All Curricula	Teams	

For getting more info on the course, registering the course and getting access to the course calendar and lesson links, please contact Scuola IMT - PhD Office phd@imtlucca.it

Davide Bottari	IMT School for Advanced Studies Lucca	Introduction to Psychophysics	16h	All Curricula	Teams	

For getting more info on the course, registering the course and getting access to the course calendar and lesson links, please contact Scuola IMT - PhD Office phd@imtlucca.it

Giacomo Handjaras	IMT School for Advanced Studies Lucca	Machine Learning in Psychological Science	10h	All Curricula	Teams	

For getting more info on the course, registering the course and getting access to the course calendar and lesson links, please contact Scuola IMT - PhD Office phd@imtlucca.it

Monica Betta	IMT School for Advanced Studies Lucca	Basic MATLAB Programming for Neuroscience	20h	All Curricula	Teams	

For getting more info on the course, registering the course and getting access to the course calendar and lesson links, please contact Scuola IMT - PhD Office phd@imtlucca.it

Ruggero Basanisi	IMT School for Advanced Studies Lucca	Python programming for neuroscience	10h	All Curricula	Teams	

For getting more info on the course, registering the course and getting access to the course calendar and lesson links, please contact Scuola IMT - PhD Office phd@imtlucca.it

Maurizio Taglialatela	University of Naples Federico II	Ion channels in brain physiology and pathology	8 (1 CFU)	All Curricula	Teams	

The course will address the physiology and pathology of ion channels, with particular emphasis on their role in neurodeelopment and in genetically-determined diseases (channelopathies)