Description of modules for the Master's course

The English version is for general information only and not legally relevant.

Mast INS IN	**Introduction to Neurosciences**	C 15 CP

Series of lectures on selected topics in neurosciences I (WS)
Content: Cellular, molecular and physiological background to the function of nerve and glia cells. Mechanisms of signal transduction. Plasticity, learning, memory, sensory systems, motor control, nervous system function, basis of cognition, development of the nervous system, rhythmic control of nerve function and anatomy of the human brain.
Series of lectures on selected topics in neurosciences II (SS)
The lectures go into more detail about specific aspects of experimental neurology, pathology and diagnostics, including non-invasive analyses of the human brain, degenerative diseases of the nervous system and medical psychology.
Seminars relating to the lectures in selected topics in neurosciences I and II
The students will assess research papers relevant to the lectures
Introductory sessions
Introducing neurobiology research in Frankfurt. Presenting the Master's programme.
Colloquium
Participating in 7 neurobiology oriented colloquia at the institute
Weekend seminar
Presenting and discussing research projects within the Master's programme

Competence: The students gain broad interdisciplinary background knowledge about neurosciences and their possible applications. They learn about neuroscientific research concepts and should be in the position to link together various specific areas and paradigms in neurosciences. They will be able to critically assess scientific research papers in the form of an oral presentation.

Requirements for participating: None

Special note: Lectures and seminar presentations in English

Suitable for other courses: Master's course Faculty15

Times offered: Module covers the first two semesters of the course and starts in the winter semester

Conformation of module completion: Proof of participation in all units, where participation in one of the two seminars relating to the lecture series includes a seminar talk.

Cumulative module exams: One written exam (45 minutes long) per set of lectures (each at the end of a semester).

Name of unit	**Form**	**SWH**	**Semester/CP**			
			1	**2**	**3**	**4**
Lectures on selected topics in neurosciences 1	**L**	**2**	3			
Seminars on selected topics in neurosciences 1	**S**	**1**	2			
Lectures on selected topics in neurosciences 2	**L**	**2**		3		
Seminars on selected topics in neurosciences 2	**S**	**1**		2		
Introductory session	**L/S**	**2**	2			
Colloquium	**Co**	**1**	1	1		
Weekend seminar	**S**	**1**	1			

Mast INS MN	**Methods in Neurosciences**	C 15 CP

Content: The module is a practical on “Introduction to scientific research techniques”. The aim is to teach the students as much as possible about the most important experimental techniques recommended for the specialised topics of their Master’s degree so that their thesis work can be completed successfully in the time available.

Competence: After completing the module, the students will be familiar with the basic techniques that apply directly to a Master’s project in their chosen topic. They will be able to efficiently find information about methods from publications and the Internet and evaluate the feasibility of carrying out experimental protocols. They will be competent in criticizing methods and assessing artefacts.

Requirements for participating: Successful completion of the module “Introduction to Neurosciences” as well as at least 3 out of the 4 elective modules

Special note: …

Suitable for other courses: No

Times offered: After the third semester of the course (winter semester)

Conformation of module completion: Non-graded conformation of participation in the form of a written practical protocol

Module completion exam: None

Name of unit	**Form**	**SWH**	**Semester/CP**			
			1	**2**	**3**	**4**
Practical: Introduction to scientific research techniques	**P**	**15**			15	

Mast INS CC	**Current Concepts in Neurosciences**	C 16 CP

Content: The module includes a practical project and a seminar that aims to provide the students with the most important theoretical background for developing a research concept in one neurobiological topic. After working on recent scientific papers, they should identify critical unanswered questions as well as develop research strategies to solve them.

Competence: After completing the module, the students will be familiar with developing scientific research concepts as well as how to incorporate these into grant applications. The students will develop critical skills to assess the relevance and validity of different or even contradictory theories and research concepts.

Requirements for participating: Successful completion of the module "Introduction to Neurosciences" as well as at least 3 out of the 4 elective modules

Special note: …

Suitable for other courses: No

Times offered: After the third semester of the course (winter semester)

Conformation of module completion: 2 non-graded performance assessments, one for written research concepts and one for giving a talk in a seminar

Module completion exam: None

Name of unit	**Form**	**SWH**	**Semester/CP**			
			1	**2**	**3**	**4**
Project work on developing a research concept	**Pr**	**15**			15	
Weekend seminar	**S**	**1**			1	

Mast INS MA	**Master's Thesis**	C	30 CP

Content: As part of the Master's degree a student uses scientific methods to work intensively and in detail on a particular question for a period of 6 months. The work can be experimental, empirical or analytic. The results must be written up in a Master's thesis in the style of a scientific paper. The quality of the work will be assessed based on the written thesis by the supervisor and a second referee.

Competence / learning and qualification aims:

- Ability to work intensively and in detail on a scientific question
- Producing a written work in the style of a scientific publication
- Practical application of modern research methods

Timing and duration of the module: The timing is open, the duration is 6 months

Requirements for participation: At least 75 CP as well as completion of the modules Mast INS and MN.

Special note: The Master's degree is usually supervised by a university professor who regularly organises compulsory or elective units in Master's courses.

Suitable for other courses: No

Conformation of completion (proof of participation or performance): None

Module completion exam: Written in the form of a Master's thesis (the grades will carry double the weight of the grades in all other modules).

Requirement for gaining credit points for the module: Passing the module exam.

			Semester/CP			
Unit	**Type**	**SWH**	**1**	**2**	**3**	**4**
Master's thesis	**MA**					30

Specialised Modules

All specialised modules are optional modules and each contributes 11 CP to the degree course. The distribution of practicals, seminars and individual lectures within a specialized module varies between the subject; similarly equating SWH to CP varies since there are different conversion factors in the various subject areas. The four required optional modules must be chosen from at least two different theme areas (see list of elective modules).

Specialized module theme area A: Basic Neurosciences

Mast INS A-1	**Cellular and Molecular Basis of Signal Transfer in the Nervous System**	O 15 CP

Content: The practical focuses on basic techniques used in cellular and molecular neurobiology. The students work on their own project with supervision, and present the results in the form of a seminar talk. In another seminar talk they assess an original piece of research from the field of cellular and molecular neurobiology. They learn how to present scientific work through writing up an appropriate result protocol. The main topics are: protein biochemistry methods to study nerve function, including sub-cellular fractionation, the basics of working with neuronal cell culture, cell transfection, and cytology of cultured cells and tissue sections from the brain, as well as working with digital images.

Competence: Familiarity with isolating neuronal cell organelles, independently characterising organelle proteins, sterile work and cultivation and transfection of cells, independently using a fluorescence microscope and computer-aided evaluation of lab data and image data, familiarity with anesthetising lab animals, independently working on scientific questions based on relevant publications.

Requirements for participating: None

Special note: Lectures and protocols in English

Suitable for other courses: Master's course Faculty15

Times offered: Twice per year in the winter and summer semester, each in the first half; 4 weeks of whole day block practicals as well as 4 hours per week of seminars.

Conformation of module completion: Written practical protocol, 1 seminar talk on the results of one's own experiments, 1 seminar talk on current publications.

Module completion exam: Written exam (45 minutes)

Name of unit	**Form**	**SWH**	**Semester/CP**			
			1	**2**	**3**	**4**
Cellular and molecular basis of signal transfer in the nervous system	**P, S**	**11**	11			

Mast INS A-2	**Auditory Neuroscience**	O 11 CP

Content: The practical teaches basic electrophysiological conductance techniques and bio-acoustic measuring techniques to investigate the auditory system in laboratory mammals and insects *in vivo*. The students work on their own projects with supervision, and present their results in the form of a seminar talk. In a further seminar talk they present an original piece of research from the field of auditory neurobiology. They learn how to present scientific work through writing up an appropriate result protocol. The main topics are: physiological properties of nerves in the midbrain and cortex, investigating active sensory amplification mechanisms in the inner ear, psychoacoustic analyses in humans, use of computer/software in evaluating data and generating stimuli.

Competence: Familiarity with carrying out electrophysiological experiments, measuring otoacoustic emissions, familiarity with anesthetising and surgical procedures in animal experiments, application of neuroanatomical techniques, learning how to work on scientific questions based on relevant publications.

Requirements for participating: None

Special note: Talks and reports in English

Suitable for other courses: Master's course Faculty15

Times offered: Twice per year in the winter and summer semester, each in the first half; 4 weeks of block practicals with seminars.

Conformation of completion: Written practical protocol, 1 seminar talk on the results of one's own experiments, 1 seminar talk on recent scientific papers.

Module completion exam: Written exam (45 minutes)

Name of unit	**Form**	**SWH**	**Semester/CP**			
			1	**2**	**3**	**4**
Auditory neuroscience	**P, S**	**11**	11			

Mast INS A-3	**Molecular Control of Neuronal Differentiation**	O 11 CP

Content: The practical addresses molecular biological, cell biological and immunohistological techniques for analysing neuronal differentiation. The students work on projects related to current research in the group and participate in the group's journal club and progress report seminars. In two seminar talks they present the thematic background to their project and their results. They learn how to present scientific work through writing up an appropriate result protocol.

Competence: Familiarity with carrying out molecular biological cell biological and immunohistological experiments, working on scientific questions.

Requirements for participating: None

Special note: Talks and reports in English

Suitable for other courses: Master's course Faculty15

Times offered: Once a year in the winter semester, second half; 4-6 weeks of block practicals.

Conformation of completion: Written practical protocol, 1 seminar talk on the results of one's own experiments, 1 seminar talk on recent scientific papers.

Module completion exam: Written exam (45 minutes)

Name of unit	**Form**	**SWH**	**Semester/CP**			
			1	**2**	**3**	**4**
Molecular control of neuronal differentiation	**P, S**	**11**	11			

Mast INS A-4	**Functional Anatomy of the Retina**	O 11 CP

Content: The practical introduces histological techniques for visualising and documenting neuronal structures (fixation, dissection, immunostaining, microscopy, micro-photography) and as an example a glimpse into the neuronal switching circuits that determine the function of the mammalian retina.
The students work on their own projects under supervision and present their results in the form of a seminar talk. In an additional seminar talk they assess an original piece of research from the field of visual neurobiology. They learn how to present scientific work through writing up an appropriate result protocol.

Competence: Familiarity with carrying out immunocytochemical staining, using microscopes, working on scientific questions based on relevant publications.

Requirements for participating: None

Special note: Talks and reports in English

Suitable for other courses: Master's course Faculty15

Times offered: Once a year in the winter semester, first half; 4-week block practical

Conformation of completion: Written practical protocol, 1 seminar talk on the results of one's own experiments, 1 seminar talk on recent scientific papers.

Module completion exam: Written exam (45 minutes)

Name of unit	**Form**	**SWH**	**Semester/CP**			
			1	**2**	**3**	**4**
Functional anatomy of the retina	**P, S**	**11**	11			

Mast INS A-5	**Clock Mechanisms in Mammalian Neurons and Neuroendocrine Cells**	O 11 CP

Content: The practical presents the basics of generating endogenous circadian rhythms in mammalian neurons. Here, the students analyze the cellular and molecular elements for chronobiological behaviour, working under supervision, and write up the results. Then the results obtained are presented in the form of a seminar talk. In a further seminar talk they present original research from the area of chrononeurobiology. The following techniques will be introduced: immunohistochemistry, protein gel electrophoresis, RNA extraction, RT-PCR, densitometry.

Competence: Basic knowledge about cell and molecular biology, basic skills in neuroanatomy of the mammalian brain, basics in chronobiological systems biology, learning to work on scientific questions based on relevant publications.

Requirements for participating: None

Special note: Talks and reports in English

Suitable for other courses: Master's course Faculty15

Times offered: Once a year in the summer semester, first half; 4-week block practical.

Conformation of completion: Written practical protocol, 1 seminar talk on the results of one's own experiments, 1 seminar talk on recent scientific papers.

Module completion exam: Written exam (45 minutes)

Name of unit	**Form**	**SWH**	**Semester/CP**			
			1	**2**	**3**	**4**
Clock mechanisms in mammalian neurons and neuroendocrine cells	**P, S**	**11**		**11**		

Mast INS A-6	**Cellular and Molecular Biology of the Circadian System**	O 11 CP

Content: The practical provides a look into the basic circadian system in mammals. The students also work on their own projects under supervision. The results are recorded in the form of a protocol and presented as a seminar talk. In a further seminar talk the participants present a recent research paper from the area of circadian rhythms. The following molecular biology and cell biology techniques will be used: PCR, cloning, handling cell cultures, transfection of cell lines, *in situ* hybridisation, immunohistochemistry, Western blotting.

Competence: Familiarity with basic molecular biology and cell biology. Learning to work on scientific questions based on relevant publications. Writing up scientific work in the form of a written practical protocol.

Requirements for participating: None

Special note: Protocols and seminar talks in English

Suitable for other courses: Master's course Faculty15

Times offered: Once a year in the second half of the summer semester; 4-week block practical

Conformation of completion: Written practical protocol, 1 seminar talk on the results of one's own experiments, 1 seminar talk on recent scientific papers.

Module completion exam: Written exam (45 minutes)

Name of unit	**Form**	**SWH**	**Semester/CP**			
			1	**2**	**3**	**4**
Cellular and molecular biology of the circadian system	**P, S**	**11**		**11**		

Mast INS A-7	**Neurobiology of the nematode *Caenorhabditis elegans***	O 11 CP

Content: This practical focuses on basic methods for investigating the nervous system of *Caenorhabditis elegans*. As well as more general molecular biology methods, this involves genetic methods (crosses, genotyping) as well as simple behaviour assays without and with the effect of specific agonists for ligand mediated ion channels (nicotinic acetylcholine receptors, GABA receptors) that are used for general characterization of the function of neuromuscular synapses. In addition, cell biology methods for expression analysis of transgenes (GTP-fusion proteins) or endogenous proteins (using specific antibodies) in relation to the genetic background are part of the lab's standard repertoire. More specialised methods that are used are exogenous stimulation of neurons in *C. elegans* by light, transmitted by the transgene expressed, photo-activated cation channel rhodopsin-2, as well as electrophysiological conductance from *C. elegans* muscle cells (the latter only as a demonstration, since the method is too complicated to learn in 6 weeks).

The students work on a current research project under the supervision of a PhD student and present the results in the form of a seminar talk. They learn how to present scientific work through writing up their result protocol.

Competence: Familiarity with standard methods to analyse an invertebrate nervous system, genetic methods for making crosses, cell biology methods, molecular biology methods, learning to work on scientific questions based on relevant publications.

Requirements for participating: None

Special note: Protocol and seminar talk

Suitable for other courses: Master's course Faculty15, Master's in Biochemistry

Times offered: 4-6 weeks in the lab, full-time

Conformation of completion: Written practical protocol, 1 seminar talk on the results of one's own experiments.

Module completion exam: Written exam (45 minutes)

Name of unit	**Form**	**SWH**	**Semester/CP**			
			1	**2**	**3**	**4**
Neurobiology of the nematode *Caenorhabditis elegans*	**P, S**	**11**	11			

Mast INS A-8	**Theoretical and Applied Microdialysis**	O	11 CP

Content: The practical introduces the theory and application of microdialysis, a method that allows access to the extracellular space. The students under supervision learn how to build and implant microdialysis probes as well as measure neurotransmitters (e.g. acetylcholine) and important metabolites (e.g. glucose, lactate). The main focus of the analyses will probably be central cholinergic functions as well as ischemia and reperfusion.

The experimental results will be recorded and prepared as a potential publication with graphical and statistical analyses of the data. In this way the students will learn the basic techniques in scientific work. After completion, the individual projects will be presented and discussed in the form of a seminar talk. In a further seminar talk the students will present an original piece of research from the area of applied microdialysis.

Competence: Familiarity with carrying out biological and analytic experiments, basic knowledge about anesthetising and surgical procedures in animal experiments, analysis of transmitters and metabolites using chromatographic and enzymatic procedures. Working on scientific questions based on relevant publications.

Requirements for participating: None

Special note: One talk should be held and discussed in English

Suitable for other courses: No

Times offered: Once a year in the summer semester, second half; 4-week block practical

Conformation of completion: Written practical protocol, 1 seminar talk on the results of one's own experiments, 1 seminar talk on recent scientific papers.

Module completion exam: Written exam (45 minutes)

Name of unit	**Form**	**SWH**	**Semester/CP**			
			1	**2**	**3**	**4**
Theoretical and applied microdialysis	**P, S**	**11**		**11**		

Mast INS A-9	**Cellular Neurophysiology of Dopaminergic Neurons**	O 11 CP

Content: The practical covers basic electrophysiological single cell techniques (patch-clamp recordings & extracellular electrodes) of the dopaminergic midbrain system of mice *in vivo* and *in vitro*. The students work on their own projects under supervision and present their results in the form of a seminar talk. In a further seminar talk they present an original piece of research from the field of basal ganglia neurophysiology and pathophysiology (e.g. Parkinsos's disease, schizophrenia, drug addiction). The main focuses are measuring and evaluating neuronal activity (current-clamp) and measuring (voltage-clamp) as well as biophysical and pharmacological characterisation of this neuronal activity mediated by synaptic and post-synaptic mechanisms (e.g. ion channels) with various configurations of the patch-clamp technique. This also includes using statistical evaluation methods. The students learn about the associated stochastic background and how to use the relevant software, which involves interdisciplinary cooperation with the BSc/MSc courses in mathematics.

Competence: Familiarity with carrying out electrophysiological experiments, measuring and analysing electrical activity of dopaminergic neurons *in vivo* and *in vitro*, using and evaluating the patch-clamp technique to characterise biophysical and pharmacological properties of synaptic and post-synaptic ion channels. Combination of the patch-clamp technique with neuroanatomical and immunohistological analyses. Basic computer modelling of neuronal activity. Stochastic description and statistical analysis of the recorded time sequence data. Understanding the molecular pathophysiological correlation between important diseases of the dopaminergic system and their corresponding mouse models.

Requirements for participating: None

Special note: Talks and protocol in English

Suitable for other courses: No

Times offered: Once a year in the summer semester, first half; 4-week block practical

Conformation of completion: Written practical protocol, 1 seminar talk on the results of one's own experiments, 1 seminar talk on recent scientific papers.

Module completion exam: Written exam (45 minutes)

Name of unit	**Form**	**SWH**	**Semester/CP**			
			1	**2**	**3**	**4**
Cellular neurophysiology of dopaminergic neurons	**P, S**	**11**		**11**		

Mast INS A-10	**Neurophysiology and Behaviour**	O 11 CP

Content: The practical investigates the neurophysiological basis of behaviour control. The students work on their own project on a theme defined together beforehand. The techniques that are taught include: cell physiology (patch-clamp conductance, intracellular conductance, calcium imaging, cell culture); neuroanatomy (staining methods, brain preparation, confocal laser microscopy, fluorescence microscopy); behavioural experiments (behaviour pharmacology, extracellular conductance, learning and memory, social behaviour). Insects (honey bees, drosophila) are used as model organisms. The principle areas are: how ion channels and transmitter receptors work, neuromodulation, learning behaviour, olfactory memory formation, and social behaviour of bees.

The students present their results in the form of a seminar talk and poster. In a further seminar talk they learn how to critically assess analytic physiological and behavioural research papers. These presentations are held in English and the students receive comprehensive feedback about the content and style of the presentation. They become familiar with writing a scientific publication by producing a protocol in the form of a paper.

After the individual experimental steps have been explained, the students mostly work independently, from planning to carrying out, writing up and evaluating the research data.

Competence: Planning, carrying out and evaluating neurobiology experiments, measuring ion flow; observing and quantifying behaviour; neuroanatomical methods. How to approach scientific questions, working with publications. Preparing scientific papers and presentations.

Requirements for participating: None

Special note: Talks, protocol and poster in English

Suitable for other courses: Master's degree Faculty15

Times offered: Twice a year in the winter and summer semester, each in the first half; 4-week block practical with seminars

Conformation of completion: Written practical protocol, 1 seminar talk on the results of one's own experiments, 1 seminar talk on recent scientific papers.

Module completion exam: Written exam (45 minutes)

Name of unit	**Form**	**SWH**	**Semester/CP**			
			1	**2**	**3**	**4**
Neurophysiology and Behaviour	**P, S**	**11**	11			

Mast INS A-11	**Developmental Neurobiology**	O 11 CP

Content: The practical course offers basic theoretical and experimental knowledge in the area of developmental neurobiology. Principal areas of research are the development and plasticity of the synapse as well as migration of neurons during cortex development. The students take part in ongoing experiments in the laboratory to elucidate the molecular mechanisms of these processes. Their work includes: basic mouse genetics techniques and the handling of a mouse colony, processing of brain tissue for *in situ* hybridisation and immunohistochemisty, isolation of primary hippocampal and cortical neurons from mice, transfection of primary neurons, immunofluorescence microscopy, confocal microscopy, Biochemical techniques including protein gel electrophoresis, Western blotting and immunoprecipitation.

The results of the practical course are presented by every student in the form of a written protocol and a talk at the end of the course. The students also take part in the weekly lab meetings where they learn about the ongoing research of all the members of the group. In a Journal Club every student presents a recent publication in the field of their own projects.

Competence: Students learn the basic techniques for studying cellular and molecular neurobiology (as detailed above). By the end of the course they have been in direct contact with mice and learn how to handle a mouse colony. The students are in an international environment and learn how to write and communicate their results in English.

Requirements for participating: None

Special note: Communication, talks and protocol in English

Suitable for other courses: Master's degree Faculty15, also useful for the course "Cell Biology"

Times offered: Once a year in summer semester

Conformation of completion: Written practical protocol, and 2 talks

Module completion exam: Written exam (45 minutes)

Name of unit	**Form**	**SWH**	**Semester/CP**			
			1	**2**	**3**	**4**
Developmental neurobiology	**P, S**	**11**		**11**		

Specialised module theme area 2: Clinical Neurosciences

Mast INS B-1	**Ageing and Neurodegeneration**	O	11 CP

Content: The practical course introduces basic analysis techniques for mouse models of the neurodegenerative diseases Parkinson's and ataxia. The students are trained in objective methods to measure motor and behaviour patterns (Offenfeld, Rotarod, etc.), statistical evaluation for progression analyses (ANOVA, Regression, etc.) as well as molecular genetic mutation tests (tail biopsy, DNA extraction, quantitative PCR) and analysing the expression profile of mutated tissue. They work on current projects under supervision, report on up to date science in a Journal Club, and present the experimental results in the form of a seminar talk. They learn how to present scientific work through writing up a result protocol.

Competence: Basic knowledge about designing and carrying out motor-behaviour analyses in rodents as well as statistical evaluation. Learning methods in cell biology (fibroblasts/cell culture, transfection), molecular genetics/biology (quantitative PCR, Western blots), histological methods, learning to work on scientific questions based on relevant publications.

Requirements for participating: None

Special note: Talks and protocol in English

Suitable for other courses: No

Times offered: Twice a year, in the second half of the summer or winter semester; 4-week block practical

Conformation of completion: Written practical protocol, 1 seminar talk on the results of one's own experiments, 1 seminar talk on recent scientific papers.

Module completion exam: Written exam (45 minutes)

Name of unit	**Form**	**SWH**	**Semester/CP**			
			1	**2**	**3**	**4**
Aging and neurodegeneration	**P, S**	**11**	11			

Mast INS B-2	**Physiology and Pharmacology of Pain**	O 11 CP

Content: The practical focuses on basic methods for investigating the mechanisms of how pain arises and particularly the pharmacology of this in various human, animal and cell culture models. Under supervision the students perform and document the experiments themselves in small groups. At the end of the practical the results are presented and discussed in a seminar talk. Current topics in pain research are presented and discussed in a Journal Club accompanying the practical, where each student prepares a talk on an recent research paper.

Competence: Familiarity with human pain models, observing the behaviour of experimental animals and presenting various pain models, preparing tissue for immunohistochemistry and Western blots, setting up neuronal cell culture, introduction to calcium imaging, measuring primary sensory neurons and pharmacological effects, learning about *in vitro* cell culture models for investigating the pharmacology of inflammation mechanisms, measuring inflammation mediators in a cell culture model, preparing scientific papers, preparing one's own results in the form of a talk and written protocol.

Requirements for participating: None

Special note: Talks and reports in English

Suitable for other courses: No

Times offered: Once a year in the winter semester, first half; 4-week block practical

Conformation of completion: Written practical protocol, 1 seminar talk on the results of one's own experiments, 1 seminar talk on recent scientific papers.

Module completion exam: Written exam (45 minutes)

Name of unit	**Form**	**SWH**	**Semester/CP**			
			1	**2**	**3**	**4**
Physiology and pharmacology of pain	**P, S**	**11**	11			

Mast INS B-3	**Human Neuroanatomy and Neurohistology**	O 11 CP

Content: The module provides basic knowledge in human neuroanatomy and neurohistology and comprises lectures and a practical.

The topics addressed in the lectures are: meninges, blood vessels supplying the brain, development of the central nervous system, parts of the brain, building blocks of the nervous system, spinal cord with brachial and lumbosacral plexus, ascending and descending nerve tracts, rhombencephalon and mesencephalon, brain nerves, vestibular organs, cerebellum, diencephalons and neuroendocrine system, eyes and optical nerve, auditory tract, olfactory system, limbic system and neocortex.

The four-day practical concentrates on macroscopic anatomy of the brain and spinal cord, meninges, blood vessel supply, analysis of brain sections, and thin slice anatomy with imaging procedures; also working on microscopic anatomy of the spinal cord, cortex and cerebellum in terms of cyto-architecture, immunocytochemistry and Golgi silver staining. There is also a brief introduction to the neuropathology of neurodegenerative diseases (Parkinson's, Alzheimer's).

Competence: Knowledge about macro and micro-anatomy of the human brain; learning about the morphological background to understanding imaging procedures and structurally oriented neurobiology research methods, propaedeutic to neuropathology

Requirements for participating: None

Special note: None

Suitable for other courses: Master's degree Faculty15

Times offered: Once a year in the winter semester, second half

Conformation of completion: Regular attendance required

Module completion exam: Written exam (45 minutes)

Name of unit	**Form**	**SWH**	**Semester/CP**			
			1	**2**	**3**	**4**
Human neuroanatomy and neurohistology	**P, L**	**11**	11			

Mast INS B-4	**Plasticity in Hippocampus – Morphology, Physiology, and Clinical Relevance**	O 11 CP

Content: The practical and seminars provide an interdisciplinary overview of the plasticity of the hippocampus. Physiological experiments include conductance of electrical potential *in vivo* in hippocampal sections and section cultures, as well as how they are affected by electrical stimuli and pharmaceuticals. The aim is to learn the various standard techniques for analysing hippocampal plasticity and comparing how they are applied in research. Anatomical experiments demonstrate analyses of changes in cellular morphology following central nervous system damage, or neuronal over-stimulation.

The accompanying seminars compare the experimental models used for neurological diseases. The relevance of animal experimental models for understanding human diseases are discussed using examples from recent research papers.

Competence: Basic electrophysiological and anatomic techniques; preparing tissue slices and organ-specific slice cultures; confocal microscopy; learning how to work on scientific questions based on relevant publications.

Requirements for participating: None

Special note: Talks and reports in English

Suitable for other courses: Molecular medicine

Times offered: Once a year; second half of the summer semester; 4-week block practical.

Conformation of completion: Written practical protocol, 1 seminar talk on the results of one's own experiments, 1 seminar talk on recent scientific papers.

Module completion exam: Written exam (45 minutes)

Name of unit	**Form**	**SWH**	**Semester/CP**			
			1	**2**	**3**	**4**
Plasticity in hippocampus – morphology, physiology, and clinical relevance	**P, S**	**11**		**11**		

Mast INS B-5	**Motor Cortex Neurophysiology**	O 11 CP

Content: The practical teaches basic stimulation techniques (transcranial magnetic stimulation) for non-invasive and painless neurological analyses of the human corticospinal tract and motor cortex. The students learn about stimulation methods to determine the excitability of stimulatory and inhibitory networks in the motor cortex, and to characterise connections between the pre-motor region and the primary motor cortex. They work on current projects under supervision and present their results in the form of a seminar talk. They learn how to produce a scientific paper by writing a results protocol. In another seminar talk they present and critically assess a recent research paper on the theme of excitability / plasticity in the motor cortex.

Competence: Basic knowledge about designing and carrying out clinical neurophysiological experiments in humans, learning about physiolological methods (transcranial magnetic stimulation (TMS), MR-navigated TMS, electromyography), learning how to work on scientific questions based on relevant publications.

Requirements for participating: None

Special note: Talks and reports in English

Suitable for other courses: No

Times offered: Once a year in the summer semester, second half; 4-week block practical.

Conformation of completion: Written practical protocol, 1 seminar talk on the results of one's own experiments, 1 seminar talk on recent scientific papers).

Module completion exam: Written exam (45 minutes)

Name of unit	**Form**	**SWH**	**Semester/CP**			
			1	**2**	**3**	**4**
Motor cortex neurophysiology	**P, S**	**11**		**11**		

Mast INS B-6	Brain Damage and Neuroprotection	O 11 CP

Content: The practical involves experiments using the following methods: cultivating neuronal cells (primary cells and neuronal cell lines), inducing ischemia *in vivo* in rats, *in vitro* hypoxia/ischemia, application of further stress stimuli *in vitro*, assessing neuronal cell death and neuroprotection by cytokines and pharmaceuticals *in vitro* and *in vivo*, detecting proteins and other compounds in the cell using fluorescence and laser scanning microscopy, transcriptional stress responses in neurons as well as transfection techniques and live cell imaging.

Competence: Familiarity with cell culture techniques and molecular biological techniques in experimental neurosciences, knowledge about anesthetising and surgical approaches in animal experiments, learning how to work on scientific questions based on relevant publications.

Requirements for participating: None

Special note: Practical / lab hospital block, talks and reports in English

Suitable for other courses: No

Times offered: Once a year in the summer semester, second half; 3-4-week block practical

Conformation of completion: Written practical protocol, 1 seminar talk on the results of one's own experiments, 1 seminar talk on recent scientific papers).

Module completion exam: Written exam (45 minutes)

Name of unit	**Form**	**SWH**	**Semester/CP**			
			1	**2**	**3**	**4**
Brain Damage and neuroprotection	**P, S**	**11**		**11**		

Mast INS B-7	**Clinical Paediatric Neurology**	O 11 CP

Content: The practical investigates neurological questions in children. The main themes are developmental neurobiology in the first year of life, applied neurophysiology in children, neuropaedriatric medicine including epilepsy syndromes and neurotraumatology. The students take part in relevant investigations, write up an experimental protocol and present their results in the form of a seminar talk. They give an additional seminar talk on recent original research papers.

Competence: Familiarity with standard methods in clinical neuropaediatry, acquiring experience in handling patients as well as classifying typical clinical symptoms, learning how to work on scientific questions based on relevant publications.

Requirements for participating: None

Special note: 2-4 weeks of practicals and hospital work

Suitable for other courses: No

Times offered: Once a year in the winter semester, second half

Conformation of completion: Written practical protocol, 1 seminar talk on the results of one's own experiments, 1 seminar talk on recent scientific papers.

Module completion exam: Written exam (45 minutes)

Name of unit	**Form**	**SWH**	**Semester/CP**			
			1	**2**	**3**	**4**
Clinical paediatric neurology	**P, S**	**11**	11			

Mast INS B-8	**Clinical Neuroimaging**	O 11 CP

Content: The practical provides an introduction to basic image analysis, image interpretation and acquiring data by examining the CNS (cerebral and spinal) with neuroradiological imaging procedures. The following procedures are used: molecular resonance tomography (MRT) of the head and spinal column, computer tomography (CT) of the skull and spinal column, digital cerebral and spinal subtraction angiography (DSA) as well as an introduction to basic neuroradiological intervention measures.

In addition, the practical presents the theoretical / physical background to individual analysis procedures in neuroradiology focussing on nuclear resonance tomography. This will deal with the physical basis of MRT / image composites, sequences and sequence parameters of MRT, diffusion and perfusion weighted MRT imaging, tractography (fibre tracking), functional MRT (fMRT), nuclear resonance spectroscopy analysis (MR spectroscopy).

The students compile a written protocol on the investigations carried out and present this along with the theoretical background in the form of a seminar talk.

Competence: Familiarity with neuroanatomy (cerebral/spinal) as well as the skull and spinal column; basic knowledge about relevant neurological diseases. Learning about indications for neuroradiological examination, acquiring and interpreting images as well as assigning them to typical individual clinical pictures.

Requirements for participating: None

Special note: None

Suitable for other courses: No

Times offered: In both halves of the winter and summer semester; each with a 6-week block practical

Conformation of completion: Written practical protocol, 1 seminar talk on the methods covered and their practical / theoretic background.

Module completion exam: Written exam (45 minutes)

Name of unit	**Form**	**SWH**	**Semester/CP**			
			1	**2**	**3**	**4**
Clinical neuroimaging	**P, S**	**11**	11			

Specialised module theme area 3: Cognitive and computational neuroscience

Mast INS C-1	**Modern Non-Invasive Methods in Human Cognition Research**	O	11 CP

Content: The practical focuses on non-invasive techniques for measuring brain activity in humans that have significantly influenced recent cognition research. This includes functional magnetic resonance tomography (fMRT), EEG, including stimulation correlated potentials (SCP), and magnetic encephalography (MEG). Following a theoretical introduction to the basics of each method, the students carry out their own experiments on central cognitive functions such as perception, attention, working memory and speech. They should be made aware of the advantages and disadvantages of each method and learn the main steps in evaluating the results. The project topics should be related to current projects in the participating research groups in cognitive neurology and the Institute for Medical Psychology who are responsible for supervising the students. The results should be presented in the form of a seminar talk. A protocol should be written up in the style of a scientific paper. In an additional seminar talk the students should present and critically assess recent published research on a related theme.

Competence: Basic knowledge about the design and carrying out of cognitive experiments in humans, learning about relevant physiological methods (fMRT, EEG, MEG), learning about working on scientific questions based on relevant publications.

Requirements for participating: None

Special note: Protocols and seminar talks in English

Suitable for other courses: No

Times offered: Once a year in the summer semester, first half; 4-week block practical

Conformation of completion: Written practical protocol, 1 seminar talk on the results of one's own experiments, 1 seminar talk on recent scientific papers.

Module completion exam: Written exam (45 minutes)

Name of unit	**Form**	**SWH**	**Semester/CP**			
			1	**2**	**3**	**4**
Modern non-invasive methods in human cognition research	**P, S**	**11**		**11**		

Mast INS C-2	**Cognitive Development across the Life-Span**	O 11 CP

Content: A: The module provides an introduction to numerous psychological methods, test procedures and techniques for measuring cognitive abilities in people from different age groups (infants, young children, school children, young adults, older people). These will be taught using examples of on-going experiments, available archived material as well as recent data and video material. One part of the course will address simultaneous psychological and fMRT measurements. With reference to early development stages of cognitive function, FIAS modelling adapted development steps will be carried out together with groups using connectionistic models.

Content B: Knowledge about the origin and changes in the cognitive system over the lifespan taking into account various development phases (normal versus atypical development); knowledge about experimental design and methods; acquiring information on human development at different levels (behaviour, brain activation, modelling) and linking these.

Competence: Familiarity with developmental psychology and the range of methods. Correlating psychological, behaviour-based measurements and imaging procedures; acquiring basic knowledge about modelling early cognitive development.

Requirements for participating: None

Special note: None

Suitable for other courses: BSc (diploma) and/or Master's in psychology (extra experience with research orientated practical and seminar)

Times offered: Practicals in the research unit Developmental Psychology are offered continuously, with space for ca. 2-3 practical students in the various projects following arrangement with the leader of the research unit. Seminars are held during the time of lectures.

Conformation of completion: A talk (possibly poster presentation) as well as written practical protocol

Module completion exam: Written exam (45 minutes)

Name of unit	**Form**	**SWH**	**Semester/CP**			
			1	**2**	**3**	**4**
Cognitive development across the life-span	**P, S**	**11**		**11**		

Example of a course timetable

Semester	Unit	CP	Time required / when
1	Introductory unit (module: Introduction to Neurosciences)	2	1 week, half day, at semester start
	Lectures on selected topics in neurosciences I with seminars (module: Introduction to Neurosciences)	5	3 SWH
	Colloquium (module: Introduction to Neuroscience)	1	1 SWH, 14 days
	Weekend seminar (module: Introduction to Neurosciences, Current Concepts in Neurosciences)	1	1 SWH
	Elective module. 1	11	1st semester half
	Elective module 2	11	2nd semester half
2	Lectures on selected topics in neurosciences II with seminars (module: Introduction to Neurosciences)	5	3 SWH
	Colloquium (module: Introduction to Neuroscience)	1	1 SWH, 14 days
	Elective module 3	11	1st semester half
	Elective module 4	11	2nd semester half
3	Project work (module: Current Concepts in Neurosciences)	16	16 SWH, 6 weeks
	Module: Methods in Neurosciences	15	15 SWH, 6 weeks
4	Master's project	30	6 months
Total		120	

Compulsory module "Introduction to Neurosciences" (15 CP) covered in 1st and 2nd sem.
Introductory sessions (1 week); Lecture series 1 + 2 with seminars (WS & SS);
Colloquium; weekend seminar
Compulsory module "Current Concepts in Neurosciences" covered in 3rd semester (15 CP)
Project work; weekend seminar
Compulsory module "Methods in Neurosciences" covered in 3rd semester (15 CP) is a practical