Compulsory modules:

INS IN Introduction to Neuroscience	Einführung in die Neurowissenschaften	Compulsory module	13 CP = 390 h		10 SWH
			Contact study 10 SWH / 150 h	Self study 240 h	

Content

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 as well as methodological developments , e.g. optogenetics.
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 institutes
Weekend seminar
Presenting and discussing research projects within the Master’s programme; thematisation of ethical and legally relevant aspects in the neurosciences

Objectives

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

Helpful previous knowledge

None

Assignment of module (course / department)	Interdisciplinary Neuroscience / FB15
Suitable for other courses	no
Times offered	Once per year, winter semester
Duration	Module covers the first two semesters of the course
Person in charge	Head of examination board
Confirmation of module completion:	
Proof of participation	In all units (except lectures)
Course assessment	Seminar talk in both seminars (WiSe, SoSe) related to the lectures
Teaching forms	Lecture, seminar, colloquium, self-studies
Tuition language	English

Modul exam	**Form / duration/ content(if applicable)**
Cumulative module exam:	One written exam (90 minutes long) per set of lectures:”Neuroscience I –selected topics” and “Neuroscience II – selected topics” (each at the end of a semester)
Determination of module grading	arithmetic average of the grades of both written exams

	Introduction to Neuroscience	Form of teaching	SWH	CP	Semester			
					1	2	3	4
	Lecture Selected topics in Neurosciences I	L, SeStu	3	4	X			
	Seminar to the lecture Selected topics in Neurosciences I	S, SeStu	1	2	X			
	Lecture Selected topics in Neurosciences II	L, SeStu	2	3		X		
	Seminar to the lecture Selected topics in Neurosciences II	S, SeStu	1	2		X		
	Introductory session	L, S	0.5	0.5	X			
	Colloquia	Ko	0.5	0.5	X			
	Weekend seminar	S, SeStu	2	1	X			
	Module exam			0	X	X		
	Sum		10	13				

INS BM **Introduction into Basic Methods in Neuroscience**	**Einführung in Basismethoden der Neurowissenschaften**	**Compulsory module**	**13 CP = 390 h**		11 SWH
			Contact study 11 SWH / 165 h	Self study 225 h	

Content

The module focusses on the following areas:

(1) Methods of cell biology, molecular biology and genetics: Imparting of knowledge on practical and theoretical basics for working with chemical solutions, physical-chemical features of proteins and their isolation, subcellular fractioning and centrifugation, preparation of cell cultures, immune-histology and microscopy and the basic principles of molecular genetics and genomics.

(2) Anatomy of the central nervous system: Using slices, plastic models and stored data-sets the structure and the development of the human brain and spinal cord are shown, including the autonomous nervous system and the cerebral blood supply. Furthermore imaging methods like MRI and fMRI are introduced. Also the evaluation of brains and animal model organisms are discussed.

(3) Electrophysiology: In lectures and seminars/discussions the basics of membrane potentials, action potentials, forwarding of potentials, synaptic morphology/geometry/function are dealt with. Important methods for recognition and analysis of single neurons (extracellular, intracellular, patch-clamp) and neural networks activity are discussed. Both electrical and optical techniques of neural stimulation are presented.

(4) MATLAB-programming and statistics: Basics of programming of neural data recordings and analysis with MATLAB are discussed. A focus lies on practical programming exercises. Basic statistical methods are introduced, discussed and realised in MATLAB.

(5) Legal and ethical aspects of animal experimentation, genetic manipulations, biological safety and proper scientific conduct are imparted.

Objectives

Within this module the students learn to discuss intensely and independently theoretical as well as practical contents of the study. They attain practical competence in cellular and molecular lab techniques, cell culture techniques and programming of neuro-biological questions in MATLAB. When having finished the module they have basic knowledge on neurogenetics. They have fundamental knowledge on human brain anatomy as well as animal models, can identify important cerebral structures and interpret histological preparations adequately. They possess basic knowledge regarding neural potentials and synaptic mechanisms and can assess potentialities and limitations of electro-physiological technologies. They can apply adequate statistical methods in assessing significance and comparison of neural records. They will attain competence regarding rules of good scientific practice, and to keep the directives regarding genetic works, bioassay practices, and animal welfare.

Requirements for participating

None

Helpful previous knowledge

None

Assignment of module (course/department)	MSc Interdisciplinary Neuroscience / FB15
Suitable for other courses	no
Times offered	Once per year, 1. half of the winter semester
Duration	6 weeks (3-4 days per week)
Person in charge	Head of examination board
Confirmation of module completion:	
Proof of participation	Regular participation in all units
Course assessment	Successful (at least grade 4 =„sufficient“) performance in graded tests following each teaching unit listed under „content“

Teaching forms	Practical, lecture, seminar, exercises, self study
Tuition language	English
Module exam **Final modul exam**	**Form / duration / content (if applicable)** none

		Form of teaching	SWH	CP	Semester			
					1	2	3	4
	Introduction into Basic Methods in Neuroscience	L, S, P, exercises, SeStu	11	13	X			
	Methods of cell biology, molecular biology and genetics							
	Anatomy of the central nervous system							
	Electrophysiology							
	MATLAB programming and statistics							
	Legal and ethical aspects of animal experimentation							
	Sum		11	13				

INS MN Methods in Neuroscience	Einführung in neurowissenschaftliche Arbeitstechniken	Compulsory module	15 CP = 450 h		15 SWH
			Contact study 15 SWH / 225 h	Self-study 225 h	

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 project so that their thesis work can be completed successfully in the time available.

Objectives

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 experimental designs. They will be competent in criticizing methods and assessing artefacts.

Requirements for participating

Successful completion of the module “Introduction to Neurosciences” and the module “Basic Methods in Neuroscience” as well as at least 2 out of the 3 elective modules

Helpful previous knowledge:

Assignment of module (course/department)	Interdisciplinary Neuroscience / FB15
Suitable for other courses	no
Times offered	As of 3rd semester of the course
Duration	6 weeks
Person in charge	Representatives of elective modules
Confirmation of completion	
Participation	
Course assessment	Practical protocol
Teaching forms	Practical, self-study
Tuition language	English
Module exam **Module completion exam**	**Form / duration / content (if applicable)** none

	Methods in Neuroscience	Teaching forms	SWH	CP	Semester			
					1	2	3	4
	Practical	P, SeStu	15	15			X	

INS CC Current Concepts in Neuroscience	Forschungskonzepte in den Neurowissenschaften	Compulsory module	16 CP = 480 h		16 SWH
			Contact study 16 SWH / 245 h	Self-study 235 h	

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.

Weekendseminar:

Presentation and discussion of research projects in the neurosciences; thematisation of ethical and legally relevant aspects in the neurosciences

Objectives

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.
The students attain competence regarding rules of good scientific practise, and ethical aspects of topical methods in neuroscience like neural stimulation or neuroenhancement. They will attain topical knowledge concerning bioassay practise, protection of animals directives and animal welfare act.

Requirements for participating

Successful completion of the module “Introduction to Neurosciences” and the module “Basic Methods of Neuroscience” as well as at least 2 out of the 3 elective modules

Helpful previous knowledge:

Assignment of module (course/department)	Interdisciplinary Neuroscience / FB15
Suitable for other courses	no
Times offered	As of 3rd semester of the course
Duration	6 weeks
Person in charge	Representatives of elective modules
Confirmation of completion	
Participation	
Course assessment	written research concept
Teaching forms	Practical, seminar, self-study
Tuition language	English
Module exam **Module completion exam**	**Form / duration / content (if applicable)** Non-graded oral exam: seminar talk

Current Concepts in Neuroscience	Teching forms	SWH	CP	Semester 1	2	3	4
Project work	P, SeStu	15	15			X	
Weekend seminar	S, SeStu	1	1			X	

INS MA Masterthesis	Masterarbeit	Compulsory module	30 CP = 900 h		30 SWH
			Contact study 30 SWH / 450 h	Self-study 450 h	

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.

Objectives

The students will be able to work intensively and in detail on a scientific question. They will have learned practical application of modern research methods and who to produce a written work in the style of a scientific publication.

Requirements for participating

Proof of at least 79 CP

Helpful previous knowledge:

Assignment of module (course/department)	Interdisciplinary Neuroscience / FB15
Suitable for other courses	No
Times offered	The timing is open
Duration	6 months
Person in charge	Representatives of elective modules
Confirmation of completion	None
Participation	
Course assessment	
Teaching forms	Practical, self-study
Tuition language	English
Module exam	**Form / duration/ content (if applicable)**
Module completion exam	Graded written work in the form of a Master's thesis , the grades will carry double the weight of the grades in all other modules

Masterthesis	Teaching forms	SWH	CP	Semester			
				1	2	3	4
Masterthesis	P, SeStu	30	30				X

Elective Modules **Subject Area A: Basic Neuroscience**

INS A-0 **External Practical Module “Basic Neuroscience”**	**Externes Praxismodul „Neurowissenschaftliche Grundlagenforschung“**	**Elective module**	**11 CP = 330 h**		**11 SWH**
			Contact study **11 SWH / 165 h**	**Self-study** **165 h**	

Content

The practical provides basic methods and technologies in basic research in the neurosciences. The students work on own topical projects under instructions and introduce the results in the form of a seminar talk. They learn how to present scientific work through writing up an appropriate result protocol.

The module can be offered by departments of the Goethe university, from other universities in Germany and foreign countries as well as by external-university research facilities.

Objectives

The students gain knowledge in the realisation of neuro-biological experiments in the area of basic research. They learn working independently on scientific questions based on relevant publications.

Requirements for participating

none

Helpful previous knowledge:

none

Assignment of module (course/department)	Interdisciplinary Neuroscience / FB15
Suitable for other courses	
Times offered	Depending on provider
Duration	Depending on provider
Person in charge	Head of examination board of the master’s degree course “Interdisciplinary Neuroscience
Confirmation of completion	
Participation	Regular participation
Course assessment	The regulations of the provider of the elective module are applied. If the provider does not request any study proofs, a working report must be written,and talks have to be given on both, results of own experiments and topical literature.
Teaching forms	Practical, self-study
Tuition language	Depending on provider
Module exam	**Form / duration / content (if applicable)**
Module completion exam	The regulations of the provider of the elective module are applied. If grading is not scheduled by the provider, the module completion exam shows a graded protocol.

	External Practical Module “Basic Neuroscience”	Teaching forms	SWH	CP	Semester 1	2	3	4
	Practical	P, SeStu	11	11	X			
	Module exam							
	Sum		11	11				

INS A-1 Cellular and Molecular Basis of Signal Transfer in the Nervous System	Zelluläre und molekulare Grundlagen des Signaltransfers im Nervensystem	Elective module	11 CP = 330 h		11 SWH
			Contact study 11 SWH / 165 h	Self-study 165 h	

Offered only until summer semester 2016

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 subcellular 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.

Objectives

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

Helpful previous knowledge:

none

Assignment of module (course/department)	Interdisciplinary Neuroscience / FB15
Suitable for other courses	yes
Times offered	Once per year; summer semester
Duration	4 weeks
Person in charge	Apl. Prof. Walter Volknandt
Confirmation of completion	
Participation	Regular participation
Course assessment	1 seminar talk on the results of one’s own experiments, 1 seminar talk on current publications, work report
Teaching forms	Practical, self-study
Tuition language	English
Module exam **Module completion exam**	**Form / duration / content (if applicable)** Graded protocol

Cellular and Molecular Basis of Signal Transfer in the Nervous System	Teaching forms	SWH	CP	Semester 1	2	3	4
Practical	P, SeStu	11	11	X			
Module exam							
Sum		11	11				

INS A-2 **Auditory Neuroscience: Active Hearing**	Sensorische Mechanismen aktiver Hör-Wahrnehmung	**Elective module**	**11 CP = 330 h**		**11 SWH**
			Contact study 11 SWH / 165 h	**Self-study 165 h**	

Content

The practical teaches fundamental methods in auditory neuroscience such as neurophysiology, neurohistology and biomechanics in different animal models, like mammals, humans and insects. The students work on their own projects, like brain stem response measurements in tinnitus animals, otoacoustic emissions, nanomechanics of hearing organ motion or enzyme staining of brain slices with supervision. At the end, students will 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.

Objectives

Familiarity with carrying out electrophysiological experiments, measuring otoacoustic emissions, familiarity with anesthetizing 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

Helpful previous knowledge:

none

Assignment of module (course/department)	Interdisciplinary Neuroscience / FB15
Suitable for other courses	yes
Times offered	Once per year, winter semester
Duration	6 weeks
Person in charge	Dr. Manuela Nowotny/Prof. Manfred Kössl
Confirmation of completion	
Participation	Regular participation
Course assessment	1 seminar talk on the results of one’s own experiments, 1 seminar talk on current publications, work report
Teaching forms	Practical, self-study
Tuition language	English
Module exam	**Form / duration / content (if applicable)**
Module completion exam	Graded protocol

Auditory Neuroscience: Active Hearing	Teaching forms	SWH	CP	Semester			
				1	2	3	4
Practical	P, SeStu	11	11	X			
Module exam							
Sum		11	11				

INS A-4 Functional Anatomy of the Retina	Funktionale Anatomie der Retina	Elective module	11 CP = 330 h		11 SWH
			Contact study 11 SWH / 165 h	Self-study 165 h	

Content

The practical introduces histological techniques for visualising and documenting neuronal structures (fixation, dissection, immunostaining, laser-scanning microscopy, electron-microscopy) 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.

Objectives

Familiarity with carrying out immunocytochemical staining, using light and electron microscopes, working on scientific questions based on relevant publications.

Requirements for participating

none

Helpful previous knowledge:

none

Assignment of module (course/department)	Interdisciplinary Neuroscience / FB15
Suitable for other courses	
Times offered	Once per year, summer semester
Duration	4 weeks
Person in charge	PD Dr. Silke Haverkamp
Confirmation of completion	
Participation	Regular participation
Course assessment	1 seminar talk on the results of one’s own experiments, 1 seminar talk on current publications, work report
Teaching forms	Practical, self-study
Tuition language	English
Module exam	**Form / duration / content (if applicable)**
Module completion exam	Graded protocol

Functional Anatomy of the Retina	Teaching forms	SWH	CP	Semester 1	2	3	4
Practical	P, SeStu	11	11	X			
Module exam							
Sum		11	11				

INS A-5 Clock Mechanisms in Mammalian Neurons and Neuroendocrine Cells	Zeitgeber-Mechanismen in Säugerneuronen und neuroendokrinen Zellen	Elective module	11 CP = 330 h		11 SWH
			Contact study 11 SWH / 165 h	Self-study 165 h	

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.

Objectives

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

Helpful previous knowledge:

none

Assignment of module (course/department)	Interdisciplinary Neuroscience / FB15
Suitable for other courses	
Times offered	Once per year, summer semester
Duration	4 weeks
Person in charge	Prof. Jörg Stehle
Confirmation of completion	
Participation	Regular participation
Course assessment	1 seminar talk on the results of one’s own experiments, 1 seminar talk on current publications, work report
Teaching forms	Practical, self-study
Tuition language	English
Module exam **Module completion exam**	**Form / duration / content (if applicable)** Graded protocol or written exam (45 minutes)

Clock Mechanisms in Mammalian Neurons and Neuroendocrine Cells	Teaching forms	SWH	CP	Semester 1	2	3	4
Practical	P, SeStu	11	11		X		
Module exam							
Sum		11	11				

INS A-6 Cellular and Molecular Bioligy of the Circadian System	Zell-und Molekularbiologie des circadianen Systems	Elective module	11 CP = 330 h		11 SWH
			Contact study 11 SWH / 165 h	Self-study 165 h	

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.

Objectives

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

Helpful previous knowledge:

none

Assignment of module (course/department)	Interdisciplinary Neuroscience / FB15
Suitable for other courses	
Times offered	Once per year, summer semester
Duration	4 weeks
Person in charge	Prof. Horst-Werner Korf
Confirmation of completion	
Participation	Regular participation
Course assessment	1 seminar talk on the results of one’s own experiments, 1 seminar talk on current publications, work report
Teaching forms	Practical, self-study
Tuition language	English
Module exam	**Form / duration / content (if applicable)**
Module completion exam	Graded protocol

Cellular and Molecular Biology of the Circadian System	Teaching forms	SWH	CP	Semester 1	2	3	4
Practical	P, SeStu	11	11		X		
Module exam							
Sum		11	11				

INS A-7 **Neurobiology of the Nematode *Caenorhabditis elegans***	**Neurobiologie des Nematoden *Caenorhabditis elegans***	**Elective module**	**11 CP = 330 h**		**11 SWH**
			Contact study 11 SWH / 165 h	**Self-study 165 h**	

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.

Objectives

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

Helpful previous knowledge:

none

Assignment of module (course/department)	Interdisciplinary Neuroscience / FB15
Suitable for other courses	
Times offered	Twice per year, winter semester, summer semester
Duration	4-6 weeks
Person in charge	Prof. Alexander Gottschalk
Confirmation of completion	
Participation	Regular participation
Course assessment	1 seminar talk on the results of one's own experiments, work report
Teaching forms	Practical, self-study
Tuition language	English
Module exam	**Form / duration / content (if applicable)**
Module completion exam	Graded protocol

Neurobiology of the Nematode *Caenorhabditis elegans*	Teaching forms	SWH	CP	Semester 1	2	3	4
Practical	P, SeStu	11	11	X			
Module exam							
Sum		11	11				

INS A-8 Neuropharmacology	Neuropharmakologie	Elective module	11 CP = 330 h		11 SWH
			Contact study 11 SWH / 165 h	Self-study 165 h	

Content

This module teaches principles and methods of neuropharmacology. Our lab works with animal models of neurodegenerative disease such as stroke and dementia of the Alzheimer type. We use in vitro- as well as in vivo-methods, with a focus on microdialysis which allows access to the extracellular fluid. In demonstrations and experiments, students will be trained to manufacture probes for microdialysis studies and will carry out measurements of neurotransmitters (e.g. acetylcholine, glutamate) and energy metabolites (glucose, lactate). Major topics will include investigations of the central cholinergic system and of the energy metabolism in the brain under ischemic conditions.

The students will write protocols for their own work and will analyze their data both graphically and statistically in a way that would permit publication; thus, the students will learn basics of scientific work. The individual projects will be presented as seminar talks at the end of the module. In a further seminar talk, they will present an original piece of research (publication) from the field of neuropharmacology.

Objectives

Familiarity with biological and analytical experiments, basic knowledge in animal experimentation. Theory and practice of microdialysis, analysis of neurotransmitters and metabolites with chromatographic (HPLC) and enzymatic procedures. Addressing scientific questions with the help of relevant literature.

Requirements for participating

none

Helpful previous knowledge:

none

Assignment of module (course/department)	Interdisciplinary Neuroscience / FB15
Suitable for other courses	yes
Times offered	Twice per year, winter semester, summer semester
Duration	4 weeks
Person in charge	Prof. Jochen Klein
Confirmation of completion	
Participation	Regular participation
Course assessment	1 seminar talk on the results of one’s own experiments, 1 seminar talk on current publications, work report
Teaching forms	Practical, self-study
Tuition language	English
Module exam	**Form / duration / content (if applicable)**
Module completion exam	Graded protocol

Neuropharmacology	Teaching forms	SWH	CP	Semester 1	2	3	4
Practical	P, SeStu	11	11	X			
Module exam							
Sum		11	11				

INS A-9 Cellular Physiology of Dopaminergic Neurons	Zelluläre Neurophysiologie dopaminerger Neurone	Elective module	11 CP = 330 h		11 SWH
			Contact study 11 SWH / 165 h	Self-study 165 h	

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.

Objectives

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

Helpful previous knowledge:

none

Assignment of module (course/department)	Interdisciplinary Neuroscience / FB15
Suitable for other courses	
Times offered	Once per year, summer semester
Duration	4 weeks
Person in charge	Prof. Jochen Roeper
Confirmation of completion	
Participation	Regular participation
Course assessment	1 seminar talk on the results of one's own experiments, 1 seminar talk on current publications, work report
Teaching forms	Practical, self-study
Tuition language	English
Module exam	**Form / duration / content (if applicable)**
Module completion exam	Graded protocol

Cellular Neurophysiology of Dopaminergic Neurons	Teaching forms	SWH	CP	Semester 1	2	3	4
Practical	P, SeStu	11	11		X		
Module exam							
Sum		11	11				

INS A-10 Neurophysiology and Behaviour	Neurophysiologie und Verhalten	Elective module	11 CP = 330 h		11 SWH
			Contact study 11 SWH / 165 h	Self-study 165 h	

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.

Objectives

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

Helpful previous knowledge:

none

Assignment of module (course/department)	Interdisciplinary Neuroscience / FB15
Suitable for other courses	yes
Times offered	Once per year, summer semester
Duration	4 weeks
Person in charge	Prof. Bernd Grünewald
Confirmation of completion	
Participation	Regular participation
Course assessment	1 seminar talk on the results of one’s own experiments, 1 seminar talk on current publications, work report
Teaching forms	Practical, self-study
Tuition language	English
Module exam	**Form / duration / content (if applicable)**
Module completion exam	Graded protocol

Neurophysiology and Behaviour	Teaching forms	SWH	CP	Semester 1	2	3	4
Practical	P, SeStu	11	11	X			
Module exam							
Sum		11	11				

INS A-11 Developmental Neurobiology	Entwicklungs-neurobiologie	Elective module	11 CP = 330 h		11 SWH
			Contact study 11 SWH / 165 h	Self-study 165 h	

Offered only until summer semester 2016

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.

Objectives

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

Helpful previous knowledge:

none

Assignment of module (course/department)	Interdisciplinary Neuroscience / FB15
Suitable for other courses	yes
Times offered	Twice per year, winter semester, summer semester
Duration	4 weeks
Person in charge	Prof. Amparo Acker-Palmer
Confirmation of completion	
Participation	Regular participation
Course assessment	1 seminar talk on the results of one’s own experiments, 1 seminar talk on current publications, work report
Teaching forms	Practical, self-study
Tuition language	English
Module exam	**Form / duration / content (if applicable)**
Module completion exam	Graded protocol

Developmental Neurobiology	Teaching forms	SWH	CP	Semester 1	2	3	4
Practical	P, SeStu	11	11	X			
Module exam							
Sum		11	11				

INS A-12 The Neuro-Vascular Interface	Die neuro-vasculäre Schnittstelle	Elective module	11 CP = 330 h		11 SWH
			Contact study 11 SWH / 165 h	Self-study 165 h	

Content

The practical course offers basic theoretical and experimental knowledge in the area of the brain vasculature in developmental and pathological neurobiology. Principal areas of research are the development and maintenance of the blood-brain barrier (BBB), and its relevance for neuronal function. The students take part on ongoing experiments in the laboratory to elucidate the molecular mechanisms of BBB formation. Their work may include: basic mouse genetics techniques and the handling of transgenic mice (various reporter mouse strains for the Wnt pathway as well as conditional/inducible gain- and loss-of-functions strains), processing of brain tissue for in situ hybridization and immunohistochemisty, isolation of primary cortical microvessels from mice, transfection and infection techniques, immunofluorescence, confocal and live-cell microscopy, biochemical techniques including protein gel electrophoresis, Western blot and immunoprecipitation.

The results of the practical course are presented by every student on the form of a written protocol and a talk at the end of the course. The students also take part on 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 on the field of their own projects.

Objectives

Students learn the basic techniques to study cellular and molecular Neurobiology (as detailed above). By the end of the course they have been in direct contact with mice and/or cells in vitro and they learn how to appropriately handle mouse tissue and cells for experiments. The students are in an international environment and learn how to write and communicate their results in English.

Requirements for participating

none

Helpful previous knowledge:

none

Assignment of module (course/department)	Interdisciplinary Neuroscience / FB15
Suitable for other courses	yes
Times offered	Once per year, summer semester
Duration	4 weeks
Person in charge	PD Dr. Stefan Liebner
Confirmation of completion	
Participation	Regular participation
Course assessment	1 seminar talk on the results of one’s own experiments, 1 seminar talk on current publications, work report
Teaching forms	Practical, self-study
Tuition language	English
Module exam **Module completion exam**	**Form / duration / content (if applicable)** Graded protocol

The Neuro-Vascular Interface	Teaching forms	SWH	CP	Semester 1	2	3	4
Practical	P, SeStu	11	11		X		
Module exam							
Sum		11	11				

INS A-14 Embryonic and Adult Neurogenesis	Embryonale und adulte Neurogenese	Elective module	11 CP = 330 h		11 SWH
			Contact study 11 SWH / 165 h	Self-study 165 h	

Content

Topic of this practical course are principles of neurogenesis in vertebrates, with special focus on cell intrinsic mechanisms governing cell fate specification and differentiation of adult and embryonic stem- and progenitor cells in the brain.

The students work on their own projects with supervision and present their results in the form of a seminar talk. In addition, one original publication from recent literature relevant to his/her research project will be presented and discussed. The results obtained during the course will be recorded in a written results protocol either in the form of a short research paper or of a short grant application in order to allow the students to gain first practical experience in these two important forms of scientific writing.

Objectives

The practical course teaches basic techniques in cellular and molecular developmental neuroscience. Model organisms used are mice and chick embryos. Emphasis will be placed on retroviral gene transfer *in vivo* and *in vitro*; working with cell lines and primary cell cultures (embryonic and adult neural stem and progenitor cells); biochemical techniques (sub cellular fractionation, protein purification); immunohistochemistry, in situ hybridization; working with transgenic animals.

Requirements for participating

none

Helpful previous knowledge:

none

Assignment of module (course/department)	Interdisciplinary Neuroscience / FB15
Suitable for other courses	yes
Times offered	Once per year, summer semester
Duration	4 weeks
Person in charge	Prof. Dorothea Schulte
Confirmation of completion	
Participation	Regular participation
Course assessment	1 seminar talk on the results of one’s own experiments, 1 seminar talk on current publications, work report
Teaching forms	Practical, self-study
Tuition language	English
Module exam	**Form / duration / content (if applicable)**
Module completion exam	Graded protocol

Embryonic and Adult Neurogenesis	Teaching forms	SWH	CP	Semester			
				1	2	3	4
Practical	P, SeStu	11	11		X		
Module exam							
Sum		11	11				

INS A-15 Electrophysiological recordings in freely behaving animals	Elektrophysiologische Ableitungen an sich frei bewegenden Tieren	Elective module	11 CP = 330 h		11 SWH
			Contact study 11 SWH / 165 h	Self-study 165 h	

Content

This practical will introduce students to the techniques used to examine neural activity in freely behaving animals. Students will record neural activity extracellularly from the hippocampus of mice performing a spatial working memory task and analyze the neural data in relation to the animal's behavior. Students will learn how to train animals to perform a behavioral task, how to perform extracellular recordings in freely behaving animals; how to extract the spiking of individual neurons as well as local field potentials from the neural data; and how to analyze these signals in relation to each other and the animals' behavior. Students will present the data they have collected and analyzed at the end of the practical. In addition, they are required to present one recent paper that is relevant to the work in a journal club.

Objectives

Behavioral training; basic knowledge of techniques used to record and analyze neural activity from freely behaving animals; ability to generate scientific hypotheses based on previous literature and design experiments to test them.

Requirements for participating

none

Helpful previous knowledge:

none

Assignment of module (course/department)	Interdisciplinary Neuroscience / FB15
Suitable for other courses	yes
Times offered	Twice per year, winter semester, summer semester
Duration	4 weeks
Person in charge	Dr. Torfi Sigurdsson
Confirmation of completion	
Participation	Regular participation
Course assessment	1 seminar talk on the results of one's own experiments, 1 seminar talk on current publications, work report
Teaching forms	Practical, self-study
Tuition language	English
Module exam	**Form / duration / content (if applicable)**
Module completion exam	Graded protocol

	Electrophysiological recordings in freely behaving animals	Teaching forms	SWH	CP	Semester 1	2	3	4
	Practical	P, SeStu	11	11	X			
	Module exam							
	Sum		11	11				

INS A-17 Auditory Function and Dysfunction: Behavior and Physiology	Gestörte Wahrnehmung beim Hören: Verhaltens-untersuchungen und Physiologie	Elective module	11 CP (insg.) = 330 h		11 SWH
			Contact study 11 SWH / 165 h	Self-study 165 h	

Content

The practical teaches techniques to determine auditory function and dysfunction in rodents. These techniques can be used to determine effects of pharmacological or behavioral treatments of sensory disorders such as tinnitus or hearing loss. The focus is on behavioral techniques suitable to characterize the disorder rather precisely in comparison to normal functions. All steps that are necessary for a project in the field are taught in this practical: study design, animal handling, control of experimental parameters, pharmacological treatment of animals, and data analysis. The behavioral analysis is paralleled by basic electrophysiological measurements necessary to determine the effects of dysfunction and treatments at the physiological level. The students work on their own projects under supervision and present their results in the form of a seminar talk. The main focuses are: measuring and analyzing behavioral data, performing efficient physiological experiments to determine auditory function, and statistical evaluation methods. Preparation of a potential publication will be the final part of the project. 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 cognition and hearing.

Objectives

Familiarity with carrying out well controlled behavioral experiments (animal handling, measuring and analyzing behavioral data, statistical analysis). Performing physiological measurements including electrophysiological recording in minimally invasive preparations. Additional aspects are: introduction to software for data handling, signal processing, and graphical display. Deriving scientific questions from the current literature. Knowledge about the usage and limitations of animal models for neurological diseases.

Requirements for participating

none

Helpful previous knowledge:

none

Assignment of module (course/department)	Interdisciplinary Neuroscience / FB15
Suitable for other courses	yes
Times offered	Once a year, summer semester
Duration	6 weeks
Person in charge	PD Dr. Bernhard Gaese
Confirmation of completion	
Participation	Regular participation
Course assessment	1 seminar presentation on the results of one’s own experiments, 1 seminar presentation on recent scientific papers, work report
Teaching forms	Practical, self-study
Tuition language	English
Module exam	**Form / duratiom/ content (if applicable)**
Module completion exam	Graded protocol

	Teaching forms	SWH	CP	Semester 1	2	3	4
Auditory Function and Dysfunction: Behavior and Physiology	P, SeStu	11	11		X		
Module exam							
Sum		11	11				

INS A-18 Information Processing in the Central Auditory System	Informationsverarbeitung im Zentralen Hörsystem	Elective module	11 CP (insg.) = 330 h		11 SWH
			Contact study 11 SWH / 165 h	Self-study 165 h	

Content

The practical covers the whole range of techniques to investigate brain activity underlying the processing of sensory information in the auditory domain. The focus is on electrophysiological single cell techniques in rodents in the awake and anesthetized preparations. Brain activity is acquired and analyzed with the goal to understand behavioral responses following auditory stimulation. Cognitive aspects (e.g. context-dependence) are taken into account. The students work on their own projects under supervision and present their results in the form of a seminar talk. The main focuses are measuring and analyzing neuronal activity in different configurations of in-vivo recording techniques. The following analysis includes modern techniques of signal processing, efficient handling of larger data sets and statistical evaluation methods. Preparation of a potential publication will be the final part of the project 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 cognition and hearing.

Objectives

Familiarity with carrying out physiological experiments (animal handling, surgery, measuring and analyzing electrical activity at the single neuron level. Combining physiology with neuroanatomical and histological staining techniques. Basic introduction to behavioral control. Introduction to software for data handling, signal processing, statistical analysis and graphical display. Understanding cognitive influences on sensory information processing as an important aspect of context-dependent behavior. Deriving scientific questions from the current literature.

Requirements for participating

none

Helpful previous knowledge:

none

Assignment of module (course/department)	Interdisciplinary Neuroscience / FB15
Suitable for other courses	yes
Times offered	Once a year, summer semester
Duration	6 weeks
Person in charge	PD Dr. Bernhard Gaese
Confirmation of completion	
Participation	Regular participation
Course assessment	1 seminar presentation on the results of one’s own experiments, 1 seminar presentation on recent scientific papers, work report
Teaching forms	Practical, self-study
Tuition language	English
Module exam	**Form / duratiom/ content (if applicable)**
Module completion exam	Graded protocol

	Teaching forms	SWH	CP	Semester 1	2	3	4
Information Processing in the Central Auditory System	P, SeStu	11	11		X		
Module exam							
Sum		11	11				

INS A-19 Neuronal basis of acoustic communication in mammals	Neuronale Grundlagen der akustischen Kommunikation bei Säugetieren	Elective module	11 CP (insg.) = 330 h		11 SWH
			Contact study 11 SWH / 165 h	Self-study 165 h	

Content

The main goal of this course is to understand how mammals communicate using acoustic information (sounds). The course is designed from the perspective of the “broadcaster-receiver” approach, and therefore it is consequently subdivided into two parts. The first part is meant for understanding the sounds broadcasted by two mammalian species (Mongolian gerbils and bats) while they are communicating. Basically, using bioacoustics tools, the students will try to figure out the vocal alphabet of bats and gerbils. The second part of the course deals with the receiver. In this part, the students will learn how the gerbil’s voice is processed in the brain by neurons located in the auditory cortex. The main aim here is to assess what happens in the brain when an animal hears a behaviorally relevant sound. At the beginning of each course part, there will be introductory discussions that will provide the students with the necessary theoretical background for conducting and understanding the different experiments. An introduction to statistics and to MATLAB will also be offered. The final report will be written in the form of a scientific paper, and the results will be presented in the form of a short talk.

Objectives

By the end of the course, the students should be able to: (1) Understand basic concepts of bioacoustics such as the sound as a mechanical wave, sound transduction using microphones, analog-to-digital conversion using sound cards. (2) Measure basic parameters of a sound wave (frequency, duration, intensity). (3) Perform basic surgeries required for acquiring neuronal data. (4) Understand basic neuroscience concepts such as: action potential, local field potential, receptive field, brain topography, spike clustering, brain oscillations. (5) Testing hypothesis using basic statistical tests (normality tests, parametric and non-parametric t-tests and analyses of variance (ANOVA)).

Requirements for participating

none

Helpful previous knowledge:

none

Assignment of module (course/department)	Interdisciplinary Neuroscience / FB15
Suitable for other courses	yes
Times offered	Once a year, summer semester
Duration	5 weeks
Person in charge	Dr. Julio Hechavarria /Prof. Manfred Kössl
Confirmation of completion	
Participation	Regular participation
Course assessment	1 seminar presentation on the results of one’s own experiments, 1 seminar presentation on recent scientific papers, work report
Teaching forms	Practical, self-study
Tuition language	English
Module exam	**Form / duratiom/ content (if applicable)**
Module completion exam	Graded protocol

	Teaching forms	SWH	CP	Semester 1	2	3	4
Neuronal basis of acoustic communication in mammals	P, SeStu	11	11		X		
Module exam							
Sum		11	11				

INS A-20 Learning and Memory: From single neuron to circuit physiology	Lernen und Gedächtnis-bildung: Von der Physiologie einzelner Neuronen bis zum Netzwerk	Elective module	11 CP (insg.) = 330 h		11 SWH
			Contact study 11 SWH / 165 h	Self-study 165 h	

Content

The practical provides an introduction to current topics in the field of mammalian learning and memory. The students work on their own projects under supervision. Using in vitro patch-clamp recordings in slices of mouse auditory cortex, the students will characterize the basic properties of different, genetically-identified cortical neurons. In a second step, they can participate in ongoing experiments in the lab that address the circuit mechanisms of auditory fear learning and memory expression in vivo. The results are recorded in the form of a protocol and presented as a seminar talk. In a second seminar, the students present a recent research paper from the area of learning and memory.

Objectives

The participants will learn the practical realisation, the planning and evaluation of electrophysiological experiments on the subject Learning and Memory. Besides they are introduced by discussions and own presentation in up-to-date questions in this field of research.

Requirements for participating

none

Helpful previous knowledge:

Laboratory experience

Assignment of module (course/department)	Interdisciplinary Neuroscience / FB15
Suitable for other courses	
Times offered	Twice per year; winter semester, summer semester
Duration	4 weeks
Person in charge	Dr. Johannes Letzkus / Prof. Manfred Kössl
Confirmation of completion	
Participation	Regular participation
Course assessment	1 seminar presentation on the results of one’s own experiments, 1 seminar presentation on recent scientific papers, work report
Teaching forms	Practical, self-study
Tuition language	English
Module exam **Module completion exam**	**Form / Dauer / ggf. Inhalt** graded protocol

	Teaching forms	SWH	CP	Semester 1	2	3	4
Learning and Memory: From single neuron to circuit physiology	P, SeStu	11	11	X			
Module exam							
Sum		11	11				

INS A-21 Cellular, molecular and systemic Neurobiology in mouse and zebrafish	Zelluläre, molekulare und systemische Neurobiologie in Maus und Zebrafisch	Elective module	11 CP = 330 h		11 SWH
			Contact study 11 SWH / 165 h	Self-study 165 h	

Content

The practical course offers basic theoretical and experimental knowledge in the area of cellular, molecular and systemic neurobiology in mouse and zebrafish. The students work on their own projects under supervision and present the results in the form of a seminar talk. In a second seminar talk they present an original publication from the field of their projects. By writing a result protocol, they will learn how to write scientific reports.

The practical course is divided in two units. The first part includes the following tasks: basic mouse genetic techniques, processing of brain tissue for immunohistochemistry, basic techniques of working with neuronal cell cultures, immunofluorescence microscopy, confocal microscopy, and biochemical techniques including protein gel electrophoresis and Western blotting. In the second part of the practical course, the students will be introduced to basic zebrafish genetics using methods in molecular biology and histological techniques, confocal microscopy and brightfield microscopy as well as zebrafish embryo manipulation and basic behavioral tests.

Objectives

Students learn the basic techniques for studying cellular, molecular, and systemic neurobiology (as detailed above). They work with cultured cells under sterile conditions, with the epifluorescence microscope and the stereo microscope. The students will be trained in zebrafish embryo handling and basic genetic techniques, and quantify and analyse the obtained data and images. The students are in an international environment and learn how to write and communicate their results in English.

Requirements for participating

none

Helpful previous knowledge:

none

Assignment of module (course/department)	Interdisciplinary Neuroscience / FB15
Suitable for other courses	yes
Times offered	Once per year; summer semester
Duration	4 weeks
Person in charge	Prof. Amparo Acker-Palmer, Bettina Kirchmaier, Franziska Foss
Confirmation of completion	
Participation	Regular participation
Course assessment	1 seminar talk on the results of one’s own experiments, 1 seminar talk on current publications, work report
Teaching forms	Practical, self-study
Tuition language	English
Module exam	**Form / duration / content (if applicable)**
Module completion exam	Graded protocol

Cellular and Molecular Basis of Signal Transfer in the Nervous System	Teaching forms	SWH	CP	Semester 1	2	3	4
Practical	P, SeStu	11	11		X		
Module exam							
Sum		11	11				

Elective Modules Subject Area B: Clinical Neuroscience

INS B-0 External Practical Module “Clinical Neuroscience”	Externes Praxismodul „Klinische Neurowissenschaften“	Elective module	11 CP = 330 h		11 SWH
			Contact study 11 SWH / 165 h	Self-study 165 h	

Content

The practical provides basic methods and technologies in clinical neurosciences. The students work on own topical projects under instructions and introduce the results in the form of a seminar talk. They learn how to present scientific work through writing up an appropriate result protocol.

The module can be offered by departments of the Goethe university, from other universities in Germany and foreign countries as well as by external-university research facilities.

Objectives

The students gain knowledge in the realisation of experiments in the area of clinical neurosciences. They learn working independently on scientific questions based on relevant publications.

Requirements for participating

none

Helpful previous knowledge:

none

Assignment of module (course/department)	Interdisciplinary Neuroscience / FB15
Suitable for other courses	
Times offered	Depending on provider
Duration	Depending on provider
Person in charge	Head of examination board of the master’s degree course “Interdisciplinary Neuroscience
Confirmation of completion	
Participation	Regular participation
Course assessment	The regulations of the provider of the elective module are applied. If the provider does not request any study proofs, a working report must be written,and talks have to be given on both, results of own experiments and topical literature.
Teaching forms	Practical, self-study
Tuition language	Depending on provider
Module exam	**Form / duration / content (if applicable)**
Module completion exam	The regulations of the provider of the elective module are applied. If grading is not scheduled by the provider, the module completion exam shows a graded protocol.

External Practical Module “Clinical Neuroscience”	Teaching forms	SWH	CP	Semester 1	2	3	4
Practical	P, SeStu	11	11	X			
Module exam							
Sum		11	11				

INS B-1 Ageing and Neurodegeneration	Altern und Neurodegeneration	Elective module	11 CP = 330 h		11 SWH
			Contact study 11 SWH / 165 h	Self-study 165 h	

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.

Objectives

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

Helpful previous knowledge:

none

Assignment of module (course/department)	Interdisciplinary Neuroscience / FB15
Suitable for other courses	
Times offered	Twice per year, winter semester, summer semester
Duration	4 weeks
Person in charge	Prof. Georg Auburger
Confirmation of completion	
Participation	Regular participation
Course assessment	1 seminar presentation on the results of one’s own experiments, 1 seminar presentation on recent scientific papers, work report
Teaching forms	Practical, self-study
Tuition language	English
Module exam **Module completion exam**	**Form / duratiom/ content (if applicable)** Graded protocol

Ageing and Neurodegeneration	Teaching forms	SWH	CP	Semester 1	2	3	4
Practical	P, SeStu	11	11	X			
Module exam							
Sum		11	11				

INS B-2 Physiology and Pharmacology of Pain	Schmerzphysiologie und Schmerzpharmakologie	Elective module	11 CP = 330 h		11 SWH
			Contact study 11 SWH / 165 h	Self-study 165 h	

Offered only until winter semester 2015/16

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.

Objectives

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

Helpful previous knowledge:

none

Assignment of module (course/department)	Interdisciplinary Neuroscience / FB15
Suitable for other courses	
Times offered	Once per year, winter semester
Duration	4 weeks
Person in charge	Prof. Dr. Ellen Niederberger
Confirmation of completion	
Participation	Regular participation
Course assessment	1 seminar talk on the results of one’s own experiments, 1 seminar talk on current publications, work report
Teaching forms	Practical, self-study
Tuition language	English
Module exam **Module completion exam**	**Form / duration / content (if applicable)** Written exam (45 min)

Physiology and Pharmacology of Pain	Teaching forms	SWH	CP	Semester 1	2	3	4
Practical	P, SeStu	11	11	X			
Module exam							
Sum		11	11				

INS B-4 **Plasticity in Hippocampus – Morphology, Physiology, and Clinical Relevance**	**Plastizität im Hippocampus – Morphologie, Physiologie und klinische Relevanz**	**Elective module**	**11 CP = 330 h**		**11 SWH**
			Contact study 11 SWH / 165 h	**Self-study 165 h**	

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.

Objectives

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

Helpful previous knowledge:

none

Assignment of module (course/department)	Interdisciplinary Neuroscience / FB15
Suitable for other courses	yes
Times offered	Twice per year, winter semester, summer semester
Duration	4 weeks
Person in charge	PD Dr. Stephan Schwarzacher; Prof. Thomas Deller
Confirmation of completion	
Participation	Regular participation
Course assessment	1 seminar talk on the results of one’s own experiments, 1 seminar talk on current publications, work report
Teaching forms	Practical, self-study
Tuition language	English
Module exam	**Form / duration / content (if applicable)**
Module completion exam	Graded protocol

Plasticity in Hippocampus – Morphology, Physiology, and Clinical Relevance	Teaching forms	SWH	CP	Semester 1	2	3	4
Practical	P, SeStu	11	11	X			
Module exam							
Sum		11	11				

INS B-6 Brain Damage and Neuroprotection	Hirnschädigung und Neuroprotektion	Elective module	11 CP = 330 h		11 SWH
			Contact study 11 SWH / 165 h	Self-study 165 h	

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.

Objectives

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

Helpful previous knowledge:

none

Assignment of module (course/department)	Interdisciplinary Neuroscience / FB15
Suitable for other courses	
Times offered	Once per year, summer semester
Duration	4 weeks
Person in charge	Prof. Donat Kögel, Prof. Abdelhaq Rami
Confirmation of completion	
Participation	Regular participation
Course assessment	1 seminar talk on the results of one’s own experiments, 1 seminar talk on current publications, work report
Teaching forms	Practical, self-study
Tuition language	English
Module exam **Module completion exam**	**Form / duration / content (if applicable)** Graded protocol

Brain Damage and Neuroprotection	Teaching forms	SWH	CP	Semester 1	2	3	4
Practical	P, SeStu	11	11		X		
Module exam							
Sum		11	11				

INS B-7 Clinical Paediatric Neurology	Klinische Neuropädiatrie	Elective module	11 CP = 330 h		11 SWH
			Contact study 11 SWH / 165 h	Self-study 165 h	

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.

Objectives

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

Helpful previous knowledge:

Basic knowledge of German language

Assignment of module (course/department)	Interdisciplinary Neuroscience / FB15
Suitable for other courses	
Times offered	Once per year, winter semester
Duration	2-4 weeks
Person in charge	Prof. Dr. Matthias Kieslich
Confirmation of completion	
Participation	Regular participation
Course assessment	1 seminar talk on the results of one’s own experiments, 1 seminar talk on current publications, work report
Teaching forms	Practical, self-study
Tuition language	English
Module exam **Module completion exam**	**Form / duration / content (if applicable)** Graded protocol

Clinical Paediatric Neurology	Teaching forms	SWH	CP	Semester 1	2	3	4
Practical	P, SeStu	11	11	X			
Module exam							
Sum		11	11				

INS B-8 Clinical Neuroimaging	Klinisches Neuroimaging	Elective module	11 CP = 330 h		11 SWH
			Contact study 11 SWH / 165 h	Self-study 165 h	

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.

Objectives

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

Helpful previous knowledge:

Basic knowledge of German language

Assignment of module (course/department)	Interdisciplinary Neuroscience / FB15
Suitable for other courses	
Times offered	4 times per year, winter semester, summer semester
Duration	4-6 weeks
Person in charge	Prof. Dr. Joachim Berkefeld
Confirmation of completion	
Participation	Regular participation
Course assessment	1 seminar talk on the results of one’s own experiments, 1 seminar talk on current publications, work report
Teaching forms	Practical, self-study
Tuition language	English
Module exam	**Form / duration / content (if applicable)**
Module completion exam	Graded protocol

Clinical Neuroimaging	Teaching forms	SWH	CP	Semester 1	2	3	4
Practical	P, SeStu	11	11	X			
Module exam							
Sum		11	11				

INS B-9 Clinical Auditory Neuroscience	Klinische Auditorische Neurowissenschaften	Elective module	11 CP = 330 h		11 SWH
			Contact study 11 SWH / 165 h	Self-study 165 h	

Content

The practical teaches most important basics of objective and subjective audiometric measurement techniques to assess hearing disorders. Pure tone and speech audiometry as well as clinical application of otoacoustic emissions, impedance measurements of the eardrum, and different methods of auditory brainstem response recording (BERA, CERA, ASSR, MMN) shall be demonstrated. The fitting of implantable hearing aids and cochlear implants will be shown in different patients. Intra-operative assessment of neuro-physiological auditory responses will be also part of the practical.

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 neuro-physiological stimulation/recording of auditory responses. They learn how to present scientific work through writing up an appropriate result protocol. The main topics are: psychoacoustic measurements of auditory perception with electrical stimulation by means of cochlear implants, investigation of different recording techniques to assess frequency specific responses of the auditory system, use of computer/software in evaluating data and generating stimuli.

Objectives

Familiarity with carrying out psycho-acoustical experiments, measuring auditory brainstem responses, basics of audiometry, learning how to work on scientific questions based on relevant publications.

Requirements for participating

none

Helpful previous knowledge:

none

Assignment of module (course/department)	Interdisciplinary Neuroscience / FB15
Suitable for other courses	
Times offered	4 times per year, winter semester, summer semester
Duration	4 weeks
Person in charge	Prof. Uwe Baumann
Confirmation of completion	
Participation	Regular participation
Course assessment	1 seminar talk on the results of one’s own experiments, 1 seminar talk on current publications, work report
Teaching forms	Practical, self-study
Tuition language	English
Module exam	**Form / duration / content (if applicable)**
Module completion exam	Graded protocol

Clinical Auditory Neuroscience	Teaching forms	SWH	CP	Semester 1	2	3	4
Practical	P, SeStu	11	11	X			
Module exam							
Sum		11	11				

INS B-10 Experimental and Translational Psychiatry	Experimentelle und translationale Psychiatrie	Elective module	11 CP = 330 h		11 SWH
			Contact study 11 SWH / 165 h	Self-study 165 h	

Content

The aim of this practical is to introduce students to a wide-range of experimental techniques that are used to study psychiatric disorders from the bench to the bedside. The wide variety of translational projects that students can participate in include cell culture techniques to functionally evaluate gene candidates identified from studies in large cohorts of patients, the assessment of the effect of drug targeted, viral vector targeted or knockout mice in behavioural tests relevant for psychiatric disorders. After such experiments, a variety of immunohistochemical and histological characterisations are performed. There is also the possibility to gain insight into how neuroimaging methods, such as functional magnetic resonance imaging, electroencephalography and magnetoencephalography are used to assess aberrant neural processing and coordination in psychiatric disorders.

Objectives

Students will receive training in a range of molecular and behavioural techniques commonly used to study psychiatric disorders and design experiments using the knowledge gained. They will also receive basic knowledge about the disorders, particularly mood and anxiety disorders, schizophrenia and attention-deficit hyperactivity disorder, in a series of seminars and journal clubs (including the option to participate in case presentations).

Requirements for participating

none

Helpful previous knowledge:

none

Assignment of module (course/department)	Interdisciplinary Neuroscience / faculty 16
Suitable for other courses	
Times offered	Twice,winter semester, summer semester
Duration	6 weeks
Person in charge	Prof. David Slattery
Confirmation of completion	
Participation	Regular participation
Course assessment	1 seminar talk on experimental results, 1seminar journal article, work report
Teaching forms	Practical, self-study
Tuition language	English
Module exam **Module completion exam**	**Form / duration / content (if applicable)** Graded protocol

Experimental and Translational Psychiatry	Teaching forms	SWH	CP	Semester 1	2	3	4
Practical	P, SeStu	11	11	X	X		
Module exam							
Sum		11	11				

Electice Modules Subject Area C: Cognitive and computational neuroscience

INS C-0 External Practical Module “Cognitive and theoretical Neuroscience”	**Externes Praxismodul „Cognitive und theoretische Neurowissenschaften“**	**Elective module**	**11 CP = 330 h**		**11 SWH**
			Contact study 11 SWH / 165 h	**Self-study 165 h**	

Content

The practical provides basic methods and technologies in the area of cognitive and theoretical neurosciences. The students work on own topical projects under instructions and introduce the results in the form of a seminar talk. They learn how to present scientific work through writing up an appropriate result protocol.

The module can be offered by departments of the Goethe university, from other universities in Germany and foreign countries as well as by external-university research facilities.

Objectives

The students gain knowledge in the realisation of experiments in the area of cognitive neurosciences and/or in computational modeling of neurobiological questions . They learn working independently on scientific questions based on relevant publications.

Requirements for participating

none

Helpful previous knowledge:

none

Assignment of module (course/department)	Interdisciplinary Neuroscience / FB15
Suitable for other courses	
Times offered	Depending on provider
Duration	Depending on provider
Person in charge	Head of examination board of the master’s degree course “Interdisciplinary Neuroscience
Confirmation of completion	
Participation	Regular participation
Course assessment	The regulations of the provider of the elective module are applied. If the provider does not request any study proofs, a working report must be written,and talks have to be given on both, results of own experiments and topical literature.
Teaching forms	Practical, self-study
Tuition language	Depending on provider
Module exam **Module completion exam**	**Form / duration / content (if applicable)** The regulations of the provider of the elective module are applied. If grading is not scheduled by the provider, the module completion exam shows a graded protocol.

External Practical Module “Cognitive and theoretical Neuroscience”	Teaching forms	SWH	CP	Semester 1	2	3	4
Practical	P, SeStu	11	11	X			
Module exam							
Sum		11	11				

INS C-1 Non-Invasive Methods in Human Cognition Research	Nicht-invasive Methoden der Kognitionsforschung am Menschen	Elective module	11 CP = 330 h		11 SWH
			Contact study 11 SWH / 165 h	Self-study 165 h	

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.

Objectives

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

Helpful previous knowledge:

Basic knowledge in cognitive Psychology

Assignment of module (course/department)	Interdisciplinary Neuroscience / FB15
Suitable for other courses	
Times offered	Once per year, summer semester
Duration	4 weeks
Person in charge	Prof. Dr. Jochen Kaiser
Confirmation of completion	
Participation	Regular participation
Course assessment	1 seminar talk on the results of one’s own experiments, 1 seminar talk on current publications, work report
Teaching forms	Practical, self-study
Tuition language	English
Module exam	**Form / duration / content (if applicable)**
Module completion exam	Graded protocol

Non-Invasive Methods in Human Cognition Research	Teaching forms	SWH	CP	Semester 1	2	3	4
Practical	P, SeStu	11	11		X		
Module exam							
Sum		11	11				

INS C-3 Modelling and Simulation	Modellierung und Simulation	Elective module	11 CP = 330 h		8 SWH
			Contact study 8 SWH / 120 h	Self-study 210 h	

Content

This module is equivalent to the module M-SIM 1c: Modellierung und Simulation 1, offered in the Master course “Informatics”, Faculty 12 (Computer Science and Mathematics). It consists of a lecture (SIM1) and a practical course (SIM1-PR). The lecture imparts: 1) Introduction to vector analysis: functions of several variables, derivatives and integrals, integral theorems. 2) Modeling: Modeling approaches, conservation equations, constitutive relations. 3) Simulation methods:

a) Finite-difference methods for ordinary differential equations: consistency, convergence, stability. b) Discretisation methods for partial differential equations: Finite differences, finite elements.

The practical offers complementary programming work to the lecture.

Objectives

Familiarity with the basics of modelling and numerical simulation

Requirements for participating

none

Helpful previous knowledge:

Contents of the mathematical basic lectures as well as the lecture „introduction to the numerical mathematics“, programming knowledge

Assignment of module (course/department)	Master Informatics / Department 12 Mathematics
Suitable for other courses	
Times offered	Once per year, winter semester
Duration	One semester
Person in charge	Prof. Gabriel Wittum
Confirmation of completion	
Participation	
Course assessment	Programming task to SIM1-PR
Teaching forms	Lecture, Practical, self-study
Tuition language	Normally German, English if required
Module exam **Module completion exam**	**Form / duration / content (if applicable)** Oral exam or written exam (180 min)to SIM1, depending on number of participants

Modelling and Simulation	Teaching forms	SWH	CP	Semester 1	2	3	4
Practical	P, SeStu	8	8	X			
Lecture	V						
Module exam			3				
Sum			11				

INS C-4 Virtual Hippocampus – Introduction to Computational Neuroscience	Virtueller Hippocampus – Einführung in die Computer-Modellierung neuronaler Systeme	Elective module	11 CP = 330 h		11 SWH
			Contact study 11 SWH / 165 h	Self-study 165 h	

Content

The practical and seminars provide an overview of computational and mathematical modeling of neural systems specifically focusing on modeling neurons and networks of the hippocampus. The course is an entry to the theoretical methods and approaches used to model the brain at different levels, ranging from synapses and dendrites to neurons and neural circuits. The aim is to learn standard techniques for building, managing, and using models that are closely linked to experimental data, especially those that involve hippocampal cells with complex anatomical and biophysical properties. Computational (in silico) experiments include large-scale network simulations in biophysically realistic and data-driven models of the hippocampus as well as single-cell simulations in morphologically reconstructed hippocampal neurons.

In the accompanying seminars, the relevance of computational models for understanding the function of the brain is discussed using examples from recent research papers.

Objectives

basic cable and network modeling techniques; learning how to use NEURON (software for for empirically-based simulations of neurons and networks of neurons, http://www.neuron.yale.edu/neuron/); learning how to work on scientific questions based on relevant publications.

Requirements for participating

none

Helpful previous knowledge:

Background in Physics, Mathematics or Informatics

Assignment of module (course/department)	Interdisciplinary Neuroscience / FB15
Suitable for other courses	
Times offered	Twice per year, winter semester, summer semester
Duration	4 weeks
Person in charge	PD Dr. Peter Jedlicka
Confirmation of completion	
Participation	Regular participation
Course assessment	1 seminar talk on the results of one’s own experiments, 1 seminar talk on current publications, work report
Teaching forms	Practical, self-study
Tuition language	English
Module exam **Module completion exam**	**Form / duration / content (if applicable)** Graded protocol

Virtual Hippocampus – Introduction to Computational Neuroscience	Teaching forms	SWH	CP	Semester 1	2	3	4
Practical	P, SeStu	11	11	X			
Module exam							
Sum		11	11				

INS C-5 Studying Human Cognition with Magnetoencephalography	Neuroimaging kognitiver Prozesse mittels Magnetenzephalographie	Elective module	11 CP = 330 h		11 SWH
			Contact study 11 SWH / 165 h	Self-study 165 h	

Content

Core techniques of non-invasive human electrophysiology using a perceptual closure paradigm. Students will create their own stimuli (Mooney faces) from photographs. In doing this, student's will learn the difference between feature based perceptual processes and knowledge based perceptual processes.The created stimuli will be tested in psychophysical measurements (accuracy, reaction times, D', A'). After selection of optimal stimuli, we will proceed with MEG measurements using these stimuli. Students will have the opportunity to operate the MEG systems themselves. Students will learn how to analyse the recorded MEG data using the open source software package Fieldtrip (http://fieldtrip.fcdonders.nl/) and will have the opportunity to compare results to previous in-house studies using similar content.

Objectives

Knowledge on MEG signal generation and fundamental analysis techniques (event related fields, analysis of oscillatory activity), creating an experimental protocol using the software package „Presentation“, performing MEG measurements according to the Glasgow standards. Criticall evaluation of the student's own results and comparison to the literature will be a central part of of the Final protocol. Presentation of results in a scientific talk.

Requirements for participating

none

Helpful previous knowledge:

Background in Physics, Mathematics or Informatics

Assignment of module (course/department)	Interdisciplinary Neuroscience / FB15
Suitable for other courses	
Times offered	Once per year, winter semester
Duration	4 weeks
Person in charge	Prof. Michael Wibral
Confirmation of completion	
Participation	Regular participation
Course assessment	1 seminar talk on the results of one’s own experiments, work report
Teaching forms	Practical, self-study
Tuition language	English
Module exam	**Form / duration / content (if applicable)**
Module completion exam	Graded protocol

Studying Human Cognition with Magnetoencephalography	Teaching forms	SWH	CP	Semester			
				1	2	3	4
Practical	P, SeStu	11	11	X			
Module exam							
Sum		11	11				

INS C-7 Cognitive Neuroscience – Higher Cognitive Functions	Höhere kognitive Funktionen	Elective module	11 CP = 330 h		11 SWH
			Contact study 11 SWH / 165 h	Self-study 165 h	

Content

This practical course gives an overview of our research of the neural bases of higher cognitive functions, in the context of current projects in the areas of working memory, language processing, motion imagery and executive control functions. There may also be the opportunity to participate in developmental studies investigating neuro-cognitive development in primary school age. Depending on currently ongoing projects, the students can participate in neurocognitive studies (using techniques such as fNIRS, fMRI, EEG, or behavioral measurements) or in the area of signal processing of neurophysiological data. Aim of the practical course is to learn about the theoretical background of the projects, as well as data acquisition, data analysis, and interpretation of results. Students are encouraged to work independently.

Students are expected to write a protocal documenting their work in the lab. In an ongoing seminar, recent studies form the cognitive neuroscience literature are discussed and students will have the opprtunity to give a talk.

Objectives

Cognitive and neurocognitive models, methods of experimental psychology, basics of acquisition and analysis of neurocognitive data. Learning how to work on scientific questions based on relevant publications.

Requirements for participating

none

Helpful previous knowledge:

Basic knowledge in Matlab, Python or other programming experience

Assignment of module (course/department)	Interdisciplinary Neuroscience / FB15
Suitable for other courses	
Times offered	Twice per year, winter semester, summer semester
Duration	4 weeks
Person in charge	Prof. Christian Fiebach
Confirmation of completion	
Participation	Regular participation
Course assessment	1 seminar talk on the results of one’s own experiments or seminar talk on current publications, work report
Teaching forms	Practical, self-study
Tuition language	English
Module exam	**Form / duration / content (if applicable)**
Module completion exam	Graded protocol

Cognitive Neuroscience – Higher Cognitive Functions	Teaching forms	SWH	CP	Semester 1	2	3	4
Practical	P, SeStu	11	11	X			
Module exam							
Sum		11	11				

INS C-8 Systems Neuroscience – Sensorimotor and cognitive networks	Neuronale Netzwerke	Elective module	11 CP = 330 h		11 SWH
			Contact study 11 SWH / 165 h	Self-study 165 h	

Content

The module introduces students on neural networks (cortical and subcortical) which are important for cognitive and sensomotoric processing. A main focus lies in the investigation of hemispheric lateralisation, mainly concerning linguistic processing and motor control of movements of the hand. Healthy volunteers and patients are examined in view of their behavioral reactions and under use of electric and magneto-encephalographic techniques. In addition, electrocorticographic data are raised by patients during brain operations.

The students get familiarized with the used methods and acquire knowledge on the organisation principles of neural networks. The students will work on a specific fMRI case study in the first week of the module and then carry out behavioral tests and imaging experiments independently or under instructions as well as visit weekly seminars.

Objectives

Acquisition and analysis of human functional imaging or neurophysiological data (patients and/or healthy controls). Learning how to work on scientific questions based on relevant publications.

Requirements for participating

none

Helpful previous knowledge:

none

Assignment of module (course/department)	Interdisciplinary Neuroscience / FB15
Suitable for other courses	
Times offered	Twice per year, winter semester, summer semester
Duration	4 weeks
Person in charge	PD Dr. Christian Kell
Confirmation of completion	
Participation	Regular participation
Course assessment	1 seminar talk on the results of one’s own experiments, 1 seminar talk on current publications, work report
Teaching forms	Practical, self-study
Tuition language	English
Module exam	**Form / duration / content (if applicable)**
Module completion exam	Graded protocol

	Systems Neuroscience – Sensorimotor and cognitive networks	Teaching forms	SWH	CP	Semester 1	2	3	4
	Practical	P, SeStu	11	11	X			
	Module exam							
	Sum		11	11				

INS C-9 Information Theory for Neuroscientists	Informationstheorie für Neurowissenschaftler	Elective module	11 CP = 330 h		10 SWH
			Contact study 10 SWH / 150 h	Self-study 180 h	

Content

Neural networks exist to process information. This course provides the information theory necessary to understand neural information processing quantitatively. It takes an intuitive approach to information theory that is particularly suited for neuroscientist. To demonstrate the usefullness of information theory the course will start with introduing David marr's classic three level hypothesis of understanding neural systems and demosntrates how information theory is essential to understand neural systems at the level of the algorithms they perform. The course will also detail some of the many links between information theory and Bayesian statistics. All information theoretic measures introduced in the course will be discussed by examples from the literature (measures include, response specific information, stimulus specific surprise, local transfer entropy und local active Information storage,excess entropy, maximum entropy principle). Course participants will have the possibility to apply information theory to their own or to example data using theopensource software JIDT and TRENTOOL.

Objectives

Knowledge of the basic information theoretic measures, such as Entropy, mutual information, etc. and an intuitive understanding of their meaning. The course will also refresh knoweldge of probability theory.

Requirements for participating

basic knowledge about probabilities

Helpful previous knowledge:

Programming experience in MATLAB, OCTAVE or Java

Assignment of module (course/department)	Interdisciplinary Neuroscience / FB15
Suitable for other courses	
Times offered	Once per year, summer semester
Duration	6 weeks
Person in charge	Prof. Michael Wibral
Confirmation of completion	
Participation	Regular participation
Course assessment	Working on exercices
Teaching forms	Lecture, Practical, self-study
Tuition language	English
Module exam **Module completion exam**	**Form / duration / content (if applicable)** Graded project work

Information Theory for Neuroscientists	Teaching forms	SWH	CP	Semester 1	2	3	4
Practical	P, SeStu	11	11		X		
Lecture	V						
Module exam							
Sum		11	11				

INS C-10 Computational neuroanatomy – quantitative analysis and modeling	Neuroanatomische Modellierung	Elective module	11 CP (insg.) = 330 h		11 SWH
			Contact study 11 SWH / 165 h	Self-study 165 h	

Content

Based on neuroanatomical data from recent advances in microscopy and genetic techniques, we will generate models with a main focus on dendritic and axonal interactions. We will use image processing tools and quantitative analysis methods in the computer to digitise various anatomic components from microscopy image stacks. In their digital form, measured geometric properties can be matched to corresponding biophysical principles. For example, we can observe and measure the formation of neural circuits during development by using time-lapse imaging series. The measured structure of dendrites and axons then enables conclusions about connectivity and function in those circuits. The observed principles will then be tested in simple quantitative models. The module *Computational Neuroanatomy* will therefore bridge the way from data analysis to the generation of a scientific theory using simple computer models.

Objectives

The participants will learn to handle biological data using quantitative methods (incl. the usage of Matlab). They will further learn to generate simple models that reproduce the trends observed in these data. The projects will be selected to match the current research focus in the lab.

Requirements for participating

none

Helpful previous knowledge:

Programming experience

Assignment of module (course/department)	Interdisciplinary Neuroscience / FB15
Suitable for other courses	
Times offered	Twice per year, winter semester, summer semester
Duration	4 weeks
Person in charge	Dr. Hermann Cuntz
Confirmation of completion	
Participation	Regular participation
Course assessment	1 seminar presentation on the results of one’s own experiments, 1 seminar presentation on recent scientific papers, work report
Teaching forms	Practical, self-study
Tuition language	English
Module exam	**Form / Dauer / ggf. Inhalt**
Module completion exam	Graded protocol (Practical exam: solving a computational problem)

Computational neuroanatomy – quantitative analysis and modelling	Teching forms	SWH	CP	Semester 1	2	3	4
Practical	P, SeStu	11	11	X			
Module exam							
Sum		11	11				

INS C-11 Computational Modeling of Neuronal Plasticity	Computer-Modellierung neuronaler Plastizität	Elective module	11 CP = 330 h		11 SWH
			Contact study 11 SWH / 165 h	Self-study 165 h	

Content

This lab course offers an introduction to the design and implementation of computer models of neural networks and the modeling of neuronal plasticity mechanisms. The course is a practical introduction to central methods of Computational Neuroscience, which investigates the functioning of the brain at multiple levels with the help of computational models. Participants implement and analyze standard neuron models and network architectures. The focus is on the role of plasticity mechanisms, their impact on network dynamics and their role in learning. The benefits and limitations of computer models for understanding brain function are discussed in the context of examples from the literature. Participants present their results in a talk and prepare a final report.

Objectives

Participants learn how to implement computer models of neural networks as well as different plasticity mechansisms and learning approaches. They learn to address a scientific question in the context of relevant literature.

Requirements for participating

Please consult with „ Modulverantwortlichen“ regarding prerequisites.

Helpful previous knowledge:

Programming abilities in at least one programming language (e.g. Python, Matlab, Java)
Background in a quantitative discipline (e.g. Physics, Mathematics, Computer Science or Engineering). Basic knowledge in the areas lineare algebra, probability and statistics, differential equations, numerical methods.

Assignment of module (course/department)	Interdisciplinary Neuroscience / FB15
Suitable for other courses	
Times offered	Twice per year, summer semester
Duration	4 weeks
Person in charge	Prof. Dr. Jochen Triesch
Confirmation of completion	
Participation	Regular participation
Course assessment	1 seminar presentation on the results of one’s own experiments, work report
Teaching forms	Practical, self-study
Tuition language	English
Module exam	**Form / duration / content (if applicable)**
Module completion exam	Graded protocol

Computational Modeling of Neuronal Plasticity	Teaching forms	SWH	CP	Semester 1	2	3	4
Practical	P, SeStu	11	11		X		
Module exam							
Sum		11	11				

INS C-12 Computational neural dynamics	Rechnergestützte neuronale Dynamik	Elective module	11 CP (insg.) = 330 h		11 SWH
			Contact study 11 SWH / 165 h	Self-study 165 h	

Content

Our aim will be to understand how connectivity and the spiking dynamics of individual neurons interact to give rise to complex collective phenomena such as information transmission, oscillations, or wave emergence in a neural network. We will use spiking neurons in computer simulations and pen-and-paper calculations to predict the dynamics emerging in a given network. Specifically, the students will write own code and will mostly work on new, open scientific problems that are not part of the textbook knowledge. The module Computational neural dynamics will therefore teach students to formulate own models, learn to solve or simulate these models, and teach them how to evaluate the findings and compare them to known biological observations. Among the effects, which we will include in the spiking network models, will be synaptic plasticity, firing rate adaptation, or different connectivity profiles.

Objectives

The participants will learn how to solve differential equations and write own computer code, e.g. in Python, C or Matlab. They will learn how to distill minimal theoretical models from physiological observations and published research. The student projects will be aligned with the ongoing research in the Tchumatchenko lab.

Requirements for participating

none

Helpful previous knowledge:

Previous knowledge in physics, mathematics or informatics and coding

Assignment of module (course/department)	Interdisciplinary Neuroscience / FB15
Suitable for other courses	
Times offered	Twice per year; summer semester
Duration	4 weeks
Person in charge	Dr. Tatjana Tchumatchenko/Prof. Manfred Kössl
Confirmation of completion	
Participation	Regular participation
Course assessment	1 seminar presentation on the results of one’s own experiments, 1 seminar presentation on recent scientific papers, work report
Teaching forms	Practical, self-study
Tuition language	English
Module exam	**Form / Dauer / ggf. Inhalt**
Module completion exam	Graded protocol (Practical exam: solving a computational problem)

	Teching forms	SWH	CP	Semester 1	2	3	4
Computational neural dynamics	P, SeStu	11	11		X		
Module exam							
Sum		11	11				

INS C-13 Models for Neural Circuit Development	Modelle der Entwicklung neuronaler Schaltkreise	Elective module	11 CP (insg.) = 330 h		11 SWH
			Contact study 11 SWH / 165 h	Self-study 165 h	

Content

This module will focus on understanding the principles guiding the formation of sensory maps and receptive fields during the development of sensory circuits. The students will obtain an overview of existing models of the development of topography, ocular dominance columns, orientation and direction selectivity in the visual cortex. We will examine how different mechanisms including: emergence of diverse single neuron properties and activity-dependent synaptic plasticity interact during development to give rise to functional circuits. In addition to synaptic plasticity, which is more commonly studied, the focus will be on the role of the specific biophysical properties at the single neuron level. The students will have the opportunity to analyze (electrophysiological or Calcium imaging) data from visual cortex and build their own models of the assembly and tuning of developing neuronal circuits.

Objectives

Students will learn to analyze and interpret neural data, build and simulate computational models (e.g. in C, Matlab, or Python), and analyze model results in relation to experiments. Acquired skills include: statistical analysis, computer programming and simulations.

Requirements for participating

None

Helpful previous knowledge:

Some programming experience and background in a quantitative discipline (physics, mathematics, engineering, informatics).

Assignment of module (course/department)	Interdisciplinary Neuroscience / FB15
Suitable for other courses	
Times offered	Twice per year, winter semester, summer semester
Duration	4 weeks
Person in charge	Dr. Julijana Gjorgjieva
Confirmation of completion	
Participation	Regular participation
Course assessment	1 seminar presentation on the results of one’s own experiments, 1 seminar presentation on recent scientific papers, work report
Teaching forms	Practical, self-study
Tuition language	English
Module exam	**Form / Dauer / ggf. Inhalt**
Module completion exam	Graded protocol

	Teching forms	SWH	CP	Semester 1	2	3	4
Models for Neural Circuit Development	P, SeStu	11	11	X	X		
Module exam							
Sum		11	11				

INS C-14 Cognitive Psycholgy – Attention, Perception & Memory	Kognitive Psychologie – Aufmerksamkeit, Wahrnehmung und Gedächtnis	Elective module	11 CP = 330 h		11 SWH
			Contact study 11 SWH / 165 h	Self-study 165 h	

Content

This practical course provides an introduction to conducting research in Human Cognitive Science also known as Cognitive Psychology. In particular, students taking part will be able to gather hands-on experience in designing, programming, executing and analysing experiments in the areas of visual attention, scene perception, and memory. Depending on currently ongoing projects in the “Scene Grammar Lab”, the students can participate in neurocognitive studies using techniques such as EEG, eye tracking (both stationary and mobile ET glasses), and/or psychophysics. At the end of this practical course the students will have learned about the theoretical background of the projects, as well as data acquisition, data analysis, and interpretation of results. While we expect the students to work independently, the various members of the lab will be there to help where possible.

As part of our weekly lab colloquium, students will be able to learn about other ongoing projects and will have the opportunity to present their work in this informal setting. At the end of the course, students are expected to write a brief paper (intro, methods, results, discussion) on the study they were working on.

Objectives

Reading up on theoretical backgrounds in the field of attention, perception, and memory, learning methods of experimental psychology, basics of acquisition and analysis of (neuro-)cognitive data, performing basic statistical analyses and writing a scientific paper.

Requirements for participating

none

Helpful previous knowledge:

Basic knowledge in Matlab/Python, as well as statistical analyses using R. Looking at our webpage beforehand might also be helpful: www.SceneGrammarLab.com.

Assignment of module (course/department)	Interdisciplinary Neuroscience / FB 15
Suitable for other courses	
Times offered	Once per year, winter semester
Duration	4 weeks
Person in charge	Prof. Melissa Vo
Confirmation of completion	
Participation	Regular participation
Course assessment	1 colloquium talk discussing the outcome of the conducted experiment(s), 1 scientific report
Teaching forms	Practical, self-study
Tuition language	English
Module exam	**Form / duration / content (if applicable)**
Module completion exam	Graded paper

Cognitive Psycholgy – Attention, Perception & Memory	Teaching forms	SWH	CP	Semester 1	2	3	4
Practical	P, SeStu	11	11	X			
Module exam							
Sum		11	11				

Elective Modules Subject Area D: Applied Aspects of Neuroscience

INS D-0 **External Practical Module “Applied Aspects of Neuroscience”**	Externes Praxismodul „Angewandte Aspekte in den Neurowissenschaften“	**Elective module**	**11 CP = 330 h**		**11 SWH**
			Contact study **11 SWH / 165 h**	**Self-study** **165 h**	

Content

The practical provides basic methods and technologies in the area of applied aspects of neurosciences. The students work on own projects under instructions and introduce the results in the form of a seminar talk. They learn how to present scientific work through writing up an appropriate result protocol.
The module can be offered by departments of the Goethe university, from other universities in Germany and foreign countries as well as by external-university research facilities.

Objectives

The students gain knowledge in the realisation of experiments in the area of applied neurosciences. They learn working independently on scientific questions based on relevant publications.

Requirements for participating

none

Helpful previous knowledge:

none

Assignment of module (course/department)	Interdisciplinary Neuroscience / FB15
Suitable for other courses	
Times offered	Depending on provider
Duration	Depending on provider
Person in charge	Head of examination board of the master’s degree course “Interdisciplinary Neuroscience
Confirmation of completion	
Participation	Regular participation
Course assessment	The regulations of the provider of the elective module are applied. If the provider does not request any study proofs, a working report must be written,and talks have to be given on both, results of own experiments and topical literature.
Teaching forms	Practical, self-study
Tuition language	Depending on provider
Module exam **Module completion exam**	**Form / duration / content (if applicable)** The regulations of the provider of the elective module are applied. If grading is not scheduled by the provider, the module completion exam shows a graded protocol.

External Practical Module “Applied Aspects of Neuroscience”	Teaching forms	SWH	CP	Semester 1	2	3	4
Practical	P, SeStu	11	11	X			
Module exam							
Sum		11	11				

INS D-1 Behavioral Biology in Zoos	Verhaltensbiologie in Zoos	Elective module	11 CP = 330 h		11 SWH
			Contact study 11 SWH / 165 h	Self-study 165 h	

Content

The module consists of a seminar, an internship and excursion. Fundamental aspects and current issues of Zoology are taught in the seminar at the beginning based on original work, which will be presented by the students and then discussed as a group. The excursion to various zoos and a research internship in the 'Opel Zoo' serve to solidify theoretical principles. The focus will be on ecological, physiological and ethological research. Other topics include: historical development of zoos, zoos & conservation, population biology & breeding programs at the zoo, animal husbandry (nutrition, behaviour, enrichment, mixed species exhibits), veterinary fundamentals, organization and structural development, enclosure design and planning, education at the Zoo. The methodological approach to the practical components depends on the selected research focus, with classical to modern methods of behaviour research available. They may include laboratory activities (microscopic and physiological studies) and imaging techniques (such as thermographic measurements with infrared cameras or video analysis with high-speed cameras).

The students present their results at the end of the module in the form of an oral presentation. In a further lecture they learn to critically appraise original work at the 'Opel Zoo'. These presentations will be held in English and students are given detailed feedback in terms of content and structure. By drafting a protocol in the form of a paper they become acquainted with the writing of a scientific publication. Following a detailed briefing on the methodology, planning, implementation, logging and analysis of the original data will be completed by the students independently.

Objectives

The students acquire basic principles in the field of zoo biology (behaviour research in the zoo, enrichment, husbandry, conservation aspects), as well as the application of modern imaging techniques. You will learn methodology for the implementation of behavioural studies and how to address scientific problems while bearing in mind current concepts in the relevant literature.

Requirements for participating

none

Helpful previous knowledge:

none

Assignment of module (course/department)	Interdisciplinary Neuroscience / FB15
Suitable for other courses	yes
Times offered	Once per year, summer semester
Duration	5 weeks
Person in charge	Prof. Dr. Paul Dierkes
Confirmation of completion	
Participation	Regular participation
Course assessment	1 seminar presentation on the results of one’s own experiments, 1 seminar presentation on recent scientific papers, work report
Teaching forms	Seminar, practical, self-study, excursion
Tuition language	English
Module exam **Module completion exam**	**Form / duration / content (if applicable)** Graded protocol

Behavioral Biology in Zoos	Teaching forms	SWH	CP	Semester 1	2	3	4
Practical	P, SeStu	11	11		X		
Seminar	S						
Excursion	Ex						
Exam							
Sum		11	11				

INS WP-0 Free-choice Studies	Individuelle Studien	Elective module	11 CP = 330 h		11 SWH
			Contact study 11 SWH / 165 h	Self-study 165 h	

Content

See description of respective module.

Modules can originate from e.g. Master programs of the departments of Informatics and Mathematics (FB 12), Biochemistry, Chemistry and Pharmacy (FB 14), Biosciences (FB 15), Philosophy and History (FB 8), Psychology and Sports Sciences (FB 05).

The module can also be offered by other universities in Germany and foreign countries. Alternatively an industrial placement or research training period can be carried out in a university or external-university research institution or a company.

Objectives

See description of respective module

Requirements for participating

none

Helpful previous knowledge:

none

Assignment of module (course/department)	Interdisciplinary Neuroscience / FB15
Suitable for other courses	
Times offered	Depending on provider
Duration	Depending on provider
Person in charge	Head of examination board of the master’s degree course “Interdisciplinary Neuroscience
Confirmation of completion	
Participation	Regular participation
Course assessment	The regulations of the provider of the elective module are applied. If the provider does not request any study proofs, a working report must be written, and talks have to be given on both, results of own experiments and topical literature.
Teaching forms	Practical, Tutorial, Lecture, Seminar, Excursion, self-study
Tuition language	Depending on provider
Module exam	**Form / duration / content (if applicable)**
Module completion exam	The regulations of the provider of the elective module are applied. If grading is not scheduled by the provider, the module completion exam shows a graded protocol.

Free-choice studies	Teaching forms	SWH	CP	Semester 1	2	3	4
Practical, Tutorial, Lecture, Seminar, Excursion; Self-Study	P, SeStu; L, S, Ex	11	11	X			
Module exam							
Sum		11	11				