Master’s program
Interdisciplinary Neuroscience

Course Manual
To the examination regulations 2023

August 2023
### Compulsory Modules

<table>
<thead>
<tr>
<th>Name of module</th>
</tr>
</thead>
<tbody>
<tr>
<td>INS IN 1 Introduction to Neuroscience 1</td>
</tr>
<tr>
<td>INS IN 2 Introduction to Neuroscience 2</td>
</tr>
<tr>
<td>INS BM Basic Methods in Neuroscience</td>
</tr>
<tr>
<td>INS MN Methods in Neuroscience</td>
</tr>
<tr>
<td>INS CC Current Concepts in Neuroscience</td>
</tr>
<tr>
<td>INS MA Master thesis</td>
</tr>
</tbody>
</table>

### Elective modules with optional courses

**INS A: Elective Module Basic Neuroscience**

<table>
<thead>
<tr>
<th>Optional courses in elective A: Basic Neuroscience</th>
<th>Person in charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>INS A-0 External elective course “Basic Neuroscience”</td>
<td>Head of Master’s program</td>
</tr>
<tr>
<td>INS A-5 Clock Mechanisms in Mammalian Neurons and Neuroendocrine Cells</td>
<td>Prof. Erik Maronde</td>
</tr>
<tr>
<td>INS A-7 Neurobiology of the Nematode <em>Caenorhabditis elegans</em></td>
<td>Prof. Alexander Gottschalk</td>
</tr>
<tr>
<td>INS A-9 Dopaminergic Neurons in schizophrenia mouse models</td>
<td>Dr. Natascha Diamantopoulou</td>
</tr>
<tr>
<td>INS A-10 Neurophysiology and Behaviour</td>
<td>Prof. Bernd Grünewald</td>
</tr>
<tr>
<td>INS A-12 The Neuro-Vascular Interface</td>
<td>PD Dr. Stefan Liebner</td>
</tr>
<tr>
<td>INS A-14 Genetics and Epigenetics of Neurogenesis and Gliogenesis</td>
<td>Prof. Dorothea Schulte</td>
</tr>
<tr>
<td>INS A-15 Recording neuronal activity in freely behaving animals</td>
<td>Dr. Torfi Sigurdsson</td>
</tr>
<tr>
<td>INS A-17 Auditory Function and Dysfunction: Behavior and Physiology</td>
<td>PD Dr. Bernhard Gaese</td>
</tr>
<tr>
<td>INS A-18 Information Processing in the Central Auditory System</td>
<td>PD Dr. Bernhard Gaese</td>
</tr>
<tr>
<td>INS A-19 Neuronal basis of acoustic communication in mammals</td>
<td>Dr. Julio Hechavarria</td>
</tr>
<tr>
<td>INS A-21 Cellular, molecular and systemic Neurobiology in mouse and zebrafish</td>
<td>Prof. Amparo Acker-Palmer</td>
</tr>
<tr>
<td>INS A-22 Optogenetics and calcium-recordings in freely behaving animals</td>
<td>Dr. Sevil Duvarcı</td>
</tr>
<tr>
<td>INS A-23 Cellular and molecular mechanisms in neurovascular disorders</td>
<td>Prof. Jasmin Hefendehl</td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
</tr>
<tr>
<td>------------</td>
<td>--------------------------------------------------------------------</td>
</tr>
<tr>
<td>INS A-24</td>
<td>Deciphering brain activity during natural behaviour in real time</td>
</tr>
<tr>
<td>INS A-25</td>
<td>Neuroscience of Navigation and Self-Motion</td>
</tr>
<tr>
<td>INS A-26</td>
<td>Analysis of Social Networks</td>
</tr>
<tr>
<td>INS A-27</td>
<td>Instinctive Behaviour Circuits</td>
</tr>
</tbody>
</table>

**INS B: Elective Module Clinical Neuroscience**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Optional courses in elective B: Clinical Neuroscience</th>
<th>Person in Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>INS B-0</td>
<td>External elective course “Clinical Neuroscience”</td>
<td>Head of Master’s program</td>
</tr>
<tr>
<td>INS B-2</td>
<td>Physiology and Pharmacology of Inflammatory Reactions</td>
<td>Prof. Ellen Niederberger</td>
</tr>
<tr>
<td>INS B-4</td>
<td>Plasticity in Hippocampus – Morphology, Physiology, and Clinical Relevance</td>
<td>Prof. Thomas Deller</td>
</tr>
<tr>
<td>INS B-6</td>
<td>Brain Damage and Neuroprotection</td>
<td>Prof. Donat Kögel, Prof. Adelhay Rami</td>
</tr>
<tr>
<td>INS B-7</td>
<td>Clinical Paediatric Neurology</td>
<td>Prof. Matthias Kieslich</td>
</tr>
<tr>
<td>INS B-8</td>
<td>Clinical Neuroimaging</td>
<td>Prof. Stefan Weidauer</td>
</tr>
<tr>
<td>INS B-9</td>
<td>Clinical Auditory Neuroscience</td>
<td>Prof. Uwe Baumann</td>
</tr>
<tr>
<td>INS B-10</td>
<td>Experimental and Translational Psychiatry</td>
<td>Prof. David Slattery</td>
</tr>
<tr>
<td>INS B-11</td>
<td>Neurobiological human cell models</td>
<td>Prof. Andreas Chiocchetti</td>
</tr>
<tr>
<td>INS B-12</td>
<td>Neuroimaging Biomarkers in Psychiatry</td>
<td>Prof. Christine Ecker</td>
</tr>
<tr>
<td>INS B-13</td>
<td>Translational Neuro-Oncology Research</td>
<td>Dr. Ann-Christin Hau</td>
</tr>
</tbody>
</table>

**INS C: Elective Module Cognitive and Computational Neuroscience**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Optional courses in elective C: Cognitive and Computational Neuroscience</th>
<th>Person in Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>INS C-0</td>
<td>External elective course „Cognitive and Computational Neuroscience“</td>
<td>Head of Master’s program</td>
</tr>
<tr>
<td>INS C-1</td>
<td>Modern non-invasive Methods in Human Cognition research</td>
<td>Prof. Jochen Kaiser</td>
</tr>
<tr>
<td>INS C-4</td>
<td>Virtual Hippocampus - Introduction to Computational Neuroscience</td>
<td>Prof. Peter Jedlicka</td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
<td>Instructor</td>
</tr>
<tr>
<td>-------------</td>
<td>------------------------------------------------------------------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>INS C-7</td>
<td>Cognitive Neuroscience – Higher Cognitive Functions</td>
<td>Prof. Christian Fiebach</td>
</tr>
<tr>
<td>INS C-8</td>
<td>Systems Neuroscience – Sensorimotor and Cognitive Networks</td>
<td>PD Dr. Christian Kell</td>
</tr>
<tr>
<td>INS C-10</td>
<td>Computational Neuroanatomy – quantitative analysis and modelling</td>
<td>Dr. Hermann Cuntz</td>
</tr>
<tr>
<td>INS C-11</td>
<td>Computational Modeling of Neuronal Plasticity</td>
<td>Prof. Jochen Triesch</td>
</tr>
<tr>
<td>INS C-14</td>
<td>Cognitive Psychology – Attention, Perception &amp; Memory</td>
<td>Prof. Melissa Vo</td>
</tr>
<tr>
<td>INS C-15</td>
<td>Developmental and Cognitive Neuroscience</td>
<td>Prof. Yee-Lee Shing</td>
</tr>
<tr>
<td>INS C-16</td>
<td>Cognitive and perceptual processes in the human brain</td>
<td>Prof. Rosanne Rademaker</td>
</tr>
</tbody>
</table>

**INS D: Elective Module Applied Neuroscience**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Person in Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>INS D-0</td>
<td>External elective course „Applied Neuroscience“</td>
<td>Head of Master’s program</td>
</tr>
<tr>
<td>INS D-1</td>
<td>Behavioral Biology in Zoos</td>
<td>Prof. Paul Dierkes</td>
</tr>
</tbody>
</table>

**INS WP: Free choice studies**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Person in Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>INS WP</td>
<td>Free-choice studies</td>
<td>Head of Master’s program</td>
</tr>
</tbody>
</table>
Compulsory Modules:

<table>
<thead>
<tr>
<th>INS IN 1</th>
<th>Einführung in die Neurowissenschaften 1</th>
<th>Compulsory module</th>
<th>8 CP = 240 h</th>
<th>8 CP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Contact study 7 SWH / 105 h</td>
<td>Self study 135 h</td>
</tr>
</tbody>
</table>

Content

**Introductory session (WS)**
Introducing neurobiology research in Frankfurt. Presenting the Master’s program

**Lecture Selected topics in Neuroscience 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, good scientific practice

**Seminar related to the lecture Selected topics in Neuroscience I (WS)**
The students will assess research papers relevant to the lectures

**Colloquium (WS, SS)**
Participation in 7 neuroscience-oriented colloquia in the institutes

**Weekend seminar (WS)**
Presenting and discussing research projects within the Master’s programme; thematisation of ethical and legally relevant aspects in the neurosciences

Learning results / Competence objectives

The students have a broad interdisciplinary basic knowledge of the neurosciences and their possible applications. They are familiar with neuroscientific research concepts and are able to link different subfields and paradigms of neuroscience. They will be able to critically assess scientific research papers in the form of an oral presentation. They have knowledge of the guidelines for good scientific practice.

Requirements for participating

none

Helpful previous knowledge

none

Assignment of module (program / department)

MSc Interdisciplinary Neuroscience / FB15

Suitable for other study programs

In the winter semester, colloquia also in the Sumr semester

Duration

2 Semesters

Person in charge

Head of study program

Semester-related proofs

Proof of participation (regular and active participation) for all events, (except lectures)

Study achievements

1 seminar talk (30 minutes) in the seminar to the lecture series "Selected Topics in Neuroscience I"

Teaching forms

Lecture, seminar, colloquia

Tuition language

English

Module exam

Module final exam consisting of:

<table>
<thead>
<tr>
<th>Introduction to Neuroscience 1</th>
<th>Form of teaching</th>
<th>SWH</th>
<th>CP</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vorlesung Selected topics in Neuroscience I</td>
<td>V</td>
<td>3</td>
<td>4</td>
<td>X</td>
</tr>
<tr>
<td>Seminar to the lecture Selected topics in Neuroscience I</td>
<td>S</td>
<td>1</td>
<td>2</td>
<td>X</td>
</tr>
<tr>
<td>Introductory session</td>
<td>V</td>
<td>1</td>
<td>0.5</td>
<td>X</td>
</tr>
<tr>
<td>Colloquia</td>
<td>Ko</td>
<td>0.5</td>
<td>0.5</td>
<td>X</td>
</tr>
<tr>
<td>Weekend seminar</td>
<td>S</td>
<td>0.5</td>
<td>1</td>
<td>X</td>
</tr>
<tr>
<td>Sum</td>
<td></td>
<td>7</td>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>
### Introduction to Neuroscience 2

**Compulsory module**

<table>
<thead>
<tr>
<th>5 CP = 150 h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact study</td>
</tr>
<tr>
<td>3 SWH / 45 h</td>
</tr>
<tr>
<td>Self study</td>
</tr>
<tr>
<td>105 h</td>
</tr>
</tbody>
</table>

#### Content

**Lecture Selected topics in Neuroscience II (SS)**

The lecture delves into specific aspects of experimental neurology, pathology and diagnostics including non-invasive studies of the human brain, degenerative diseases of the nervous system and medical psychology, as well as methodological developments such as optogenetics.

**Seminar to the Lecture Selected topics in Neuroscience II (SS)**

The students will assess research papers relevant to the lectures.

#### Learning results / Competence objectives

The students have a broad interdisciplinary basic knowledge of the neurosciences and their possible applications. They are familiar with neuroscientific research concepts and are able to link different subfields and paradigms of neuroscience. 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 (program / department)

MSc Interdisciplinary Neuroscience / FB15

#### Times offered

In the Summer semester

#### Duration

1 Semester

#### Person in charge

Head of study program

#### Semester-related proofs

- **Proof of participation**
  - Proof of participation (regular and active participation) for the seminar

- **Study achievements**
  - 1 seminar talk (30 minutes) in the seminar to the lecture series "Selected Topics in Neuroscience II"

#### Teaching forms

Lecture, seminar

#### Tuition language

English

#### Module exam

**Module final exam consisting of:**

<table>
<thead>
<tr>
<th>Form / duration / content(if applicable)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Written exam for the lecture &quot;Selected Topics of Neuroscience II&quot; (duration: 90 minutes)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Introduction to Neuroscience 2</th>
<th>Form of teaching</th>
<th>SWH</th>
<th>CP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture Selected topics in Neuroscience II</td>
<td>V</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Seminar to the lecture Selected topics in Neuroscience II</td>
<td>S</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

**Sum**

<table>
<thead>
<tr>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
</tr>
<tr>
<td>3</td>
</tr>
</tbody>
</table>

---

### Notes

- **INS IN 2**
  - Einführung in die Neurowissenschaften 2

---

5
### Content

The module focusses on the following areas:

1. **Methods of cell biology, molecular biology and genetics**: Imparting 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.

### Learning results / Competence 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 electrophysiological 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 (program / department)

MSc Interdisciplinary Neuroscience / FB15

### Suitable for other study programs

None

### Times offered

In the winter semester

### Duration

1 Semester (block course over 6 weeks)

### Person in charge

Head of study program

### Semester-related proofs

**Proof of participation**: Regular participation in all events (except lectures)

**Study achievements**: Successful completion of study achievements ("pass") in the form of tests/exercises following each of the focus areas listed under "Content" or a portfolio across all focus areas.

### Teaching forms

Lecture, seminar, exercises

### Tuition language

English

### Module exam

**Module final exam consisting of**: none
<table>
<thead>
<tr>
<th>Course</th>
<th>Form of teaching</th>
<th>SWH</th>
<th>CP</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Methods in Neuroscience</td>
<td>V, S, Üb</td>
<td>11</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Methods of cell biology, molecular biology and genetics</td>
<td>V, S, Üb</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Anatomy of the central nervous system</td>
<td>V, S, Üb</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrophysiology</td>
<td>V, S, Üb</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MATLAB programming and statistics</td>
<td>V, Üb</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Legal and ethical aspects of animal experimentation</td>
<td>V, Üb</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sum</td>
<td>11 13</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The module is a practical on “Deepening 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.

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.

Successful completion of the modules “Introduction to Neuroscience I”, “Introduction to Neuroscience II” and “Basic Methods in Neuroscience” as well as at least 2 out of the 3 elective modules.

Assignment of module (program / department)  MSc Interdisciplinary Neuroscience / FB15

Suitable for other study programs

Times offered  Each semester

Duration  1 Semester (block course over 6 weeks)

Person in charge  Representatives of elective modules

Semester-related proofs

Proof of participation

Study achievements  Protocol (10–30 pages)

Teaching forms  Practical

Tuition language  English

Module exam

Module final exam consisting of:

Form / duration / content (if applicable)  none

Methods in Neuroscience

Form of teaching  SWH  CP  Semester

Practical  P  15  15

<table>
<thead>
<tr>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>X</td>
</tr>
</tbody>
</table>
Current Concepts in Neuroscience

**Compulsory Module**

<table>
<thead>
<tr>
<th>Contact study</th>
<th>Self study</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 SWH / 245 h</td>
<td>235 h</td>
</tr>
</tbody>
</table>

**Credits**

16 CP = 480 h

**Content**

The module comprises a project work and a seminar with the aim of providing students with the essential theoretical basis for developing a research concept in a neurobiological subfield. After familiarization with current literature work, students will identify critical open questions and develop research strategies to address them. During the seminar, the different research directions of the Master's program will be presented and discussed in the form of scientific posters.

**Learning results / Competence objectives**

Upon completion of the module, students are familiar with the development of scientific research concepts and are able to integrate them into a third-party funding proposal. The students have developed judgment regarding the relevance and realism of different and also contradictory theories and research concepts. The students acquire extended competences regarding rules of good scientific practice and ethical aspects of neuroscience. They are able to design, present and discuss a scientific poster.

**Requirements for participating**

Successful completion of the modules “Introduction to Neuroscience I”, “Introduction to Neuroscience II” and “Basic Methods in Neuroscience” as well as at least 2 out of the 3 elective modules.

**Helpful previous knowledge**

none

**Assignment of module (program / department)**

MSc Interdisciplinary Neuroscience / FB15

**Suitable for other study programs**

MSc Interdisciplinary Neuroscience / FB15

**Times offered**

Each semester

**Duration**

1 Semester block course over 6 weeks

**Person in charge**

Representatives of elective modules

**Semester-related proofs**

Written research concept (10–20 pages), 1 seminar talk (20 minutes), Production/presentation of 1-2 scientific posters

**Teaching forms**

Project, seminar

**Tuition language**

English

**Module exam**

Module final exam consisting of: none

<table>
<thead>
<tr>
<th>Current Concepts in Neuroscience</th>
<th>Form of teaching</th>
<th>SWH</th>
<th>CP</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Projectwork</td>
<td>Proj</td>
<td>15</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>Weekend seminar</td>
<td>S</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Sum</td>
<td></td>
<td>16</td>
<td>16</td>
<td>3</td>
</tr>
</tbody>
</table>
As part of the Master’s degree, the student works on a problem from the field of neuroscience comprehensively and in depth according to scientific methods. 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.

After successful completion of the Master's thesis, students are able to identify, delimit and explain a research-related scientific problem in a subfield of neuroscience. They will be able to analyze, evaluate or solve it using specialized knowledge and scientific methods. They are able to critically analyze relevant contributions to research and assess their relevance to their own research question. They are able to appropriately present and critically evaluate the results within a given period of time using scientific standards, and to recognize and assess central lines of development in the relevant subfield.

Proof of at least 79 CP

None

MSc Interdisciplinary Neuroscience / FB15

Each semester

1 Semester

Representatives of elective modules

None

Study achievements

English

Graded written work in the form of a Master’s thesis (40–90 Seiten)

the grade is double weighted against the grades of all other modules.

<table>
<thead>
<tr>
<th>INS MA</th>
<th>Masterarbeit</th>
<th>Compulsory module</th>
<th>30 CP = 900 h</th>
<th>30 CP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Contact study</td>
<td>Self study</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>30 SWH / 450 h</td>
<td>450 h</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Teaching forms</th>
<th>Form / duration / content (if applicable)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Masterthesis</td>
<td>Graded written work in the form of a Master’s thesis (40–90 Seiten)</td>
</tr>
<tr>
<td></td>
<td>the grade is double weighted against the grades of all other modules.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Masterarbeit</th>
<th>Form of teaching</th>
<th>SWH</th>
<th>CP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>30</td>
<td>30</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>X</td>
</tr>
</tbody>
</table>
Optional courses in elective A: Basic Neuroscience

<table>
<thead>
<tr>
<th>INS A-0</th>
<th>External elective course “Basic Neuroscience”</th>
<th>Elective course</th>
<th>11 CP = 330 h</th>
<th>11 CP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Contact study</td>
<td>Self study</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>11 SWH / 165 h</td>
<td>165 h</td>
</tr>
</tbody>
</table>

**Content**

This elective course teaches basic methods and techniques in the field of basic neuroscience research. Students work on their own current projects under supervision. The elective course can be offered by departments of Goethe University, by other universities in Germany and abroad as well as by non-university research institutions.

**Learning results / Competence objectives**

The students have knowledge in conducting neurobiological experiments in the field of basic research. They are able to work on scientific questions based on relevant literature.

**Requirements for participating**

none

**Helpful previous knowledge**

none

**Assignment of course (program/department)**

Interdisciplinary Neuroscience / FB 15

**Suitable for other study programs**

Depending on provider

**Times offered**

Depending on provider

**Duration**

Head of study program

**Person in charge**

Regular participation

**Study achievements**

The regulations of the provider of the elective course 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 (20 minutes) and topical literature (20 minutes).

**Teaching forms**

Practical, seminar

**Tuition language**

Depending on provider

**Module exam**

**Module final exam consisting of:**

The regulations of the provider of the elective course are applied. If grading is not scheduled by the provider, the module completion exam shows a graded protocol (10-30 pages).

<table>
<thead>
<tr>
<th>External elective course “Basic Neuroscience”</th>
<th>Form of teaching</th>
<th>SWH</th>
<th>CP</th>
<th>Semester</th>
</tr>
</thead>
</table>
| Practical                                   | P               | 10  | 10 | 1
| Seminar                                    | S               | 1   | 1  | 2
| Sum                                        |                 | 11  | 11 | 3
|                                             |                 |     |    | X


## 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 behavior, working under supervision, and write up the results. The following techniques will be introduced: immunohistochemistry, protein gel electrophoresis, RNA extraction, RT-PCR, densitometry.

## Learning results / Competence objectives

The students have basic knowledge of cell and molecular biology as well as basics in neuroanatomy of the mammalian brain and basics of chronobiological systems biology. They are able to work on scientific questions based on relevant literature.

## Requirements for participating

none

## Helpful previous knowledge

none

## Assignment of course (program/department)

MSC Interdisciplinary Neuroscience / FB 15

## Suitable for other study programs

In the Sumr semester

## Duration

1 Semester (block course over 4 weeks)

## Person in charge

Prof. Erik Maronde

## Semester-related proofs

Proof of participation

regular participation

Study achievements

Seminar: 1 talk (20 minutes) on the results of own experiments, 1 talk (20 minutes) on current literature

## Teaching forms

Practical, seminar

## Tuition language

English

## Module exam

Form / duration / content (if applicable)

Practical: graded protocol (10-30 pages)

<table>
<thead>
<tr>
<th>Clock Mechanisms in Mammalian Neurons and Neuroendocrine Cells</th>
<th>Form of teaching</th>
<th>SWH</th>
<th>CP</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>P</td>
<td>10</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>Seminar</td>
<td>S</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Sum</td>
<td></td>
<td>11</td>
<td>11</td>
<td>X</td>
</tr>
</tbody>
</table>
Content

This course teaches basic methods for studying the nervous system of Caenorhabditis elegans. More general molecular biology methods will be used, genetic methods (crosses, genotyping) as well as simple behavioral assays, without and with the influence of specific agonists for ligand-gated ion channels (nicotinic acetylcholine receptors, GABAA receptors), which are used for general characterization of the function of the neuromuscular synapse. In addition, cell biological methods for expression analysis of transgenes (GFP fusion proteins) or endogenous proteins (via specific antibodies) depending on the genetic background, are part of the standard repertoire of the laboratory. More specific methods used are exogenous stimulation of neurons in C. elegans by light mediated by the transgene expressed photo-activated cation channel channelrhodopsin-2, and electrophysiological recordings from C. elegans muscle cells.

Learning results / Competence objectives

Students have knowledge of standard methods for the analysis of an invertebrate nervous system, genetic methods for crossbreeding, and cell biological and molecular biological methods. They will be able to address scientific questions based on relevant literature.

Requirements for participating

none

Helpful previous knowledge

none

Assignment of course (program/department)          MSC Interdisciplinary Neuroscience / FB 15

Suitable for other study programs

Times offered          Each semester

Duration                1 Semester (block course over 4-6- weeks)

Person in charge        Prof. Alexander Gottschalk

Semester-related proofs

Proof of participation  regular participation

Study achievements      Seminar: 1 talk (20 minutes) on the results of own experiments; Practical: 1 work report (if the final module exam is a written exam).

Teaching forms          Practical, seminar

Tuition language        English

Module exam

Module final exam consisting of:          Form / duration / content (if applicable)

Practical graded protocol (10–30 pages) or written exam (45 mintes)

Neurobiology of the Nematode Caenorhabditis elegans

<table>
<thead>
<tr>
<th>Neurobiology of the Nematode Caenorhabditis elegans</th>
<th>Form of teaching</th>
<th>SWH</th>
<th>CP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>P</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Seminar</td>
<td>S</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Sum</td>
<td></td>
<td>11</td>
<td>11</td>
</tr>
</tbody>
</table>

Semester

<table>
<thead>
<tr>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
</tbody>
</table>

Self study 165 h

Contact study 11 SWH / 165 h
The dopamine system in schizophrenia mouse models
Das Dopaminsystem in Schizophrenie-Mausmodellen

Elective course
11 CP = 330 h
Contact study 11 SWH / 165 h
Self study 165 h

11 CP

Content
The practical covers basic in vivo electrophysiological techniques of the dopaminergic midbrain system and neuronal imaging of dopamine dynamics in the striatum with fiber photometry during behavioural tasks in mice. 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. Parkinson’s disease, schizophrenia, drug addiction). The main focuses are measuring and evaluating neuronal activity and its behavioral and dopamine release correlates. This also includes using statistical evaluation methods. The students learn about the associated stochastic background and how to use the relevant software or how to implement data analysis in Matlab, which involves interdisciplinary cooperation with the BSc/MSc courses in mathematics.

Learning results / Competence objectives
Students will have knowledge to perform electrophysiological, behavioral, and fiber photometric experiments to measure and analyze the electrical activity of dopaminergic neurons and changes in fluorescence that reflect dopamine dynamics in vivo. They can combine in vivo techniques with neuroanatomical and immunohistological analyses. They have knowledge of basic computational modeling of neuronal activity and stochastic description and statistical analysis of recorded time-sequence data. They have an understanding of the molecular pathophysiological relationship between major diseases of the dopaminergic system and the corresponding mouse models, with particular emphasis on schizophrenia.

Requirements for participating
none

Helpful previous knowledge
Matlab knowledge

Assignment of course (program/department)
MSc Interdisciplinary Neuroscience / FB 15

Suitable for other study programs
In the summer semester

Duration
1 Semester (bocd course over 4 weeks)

Person in charge
Dr. Natascha Diamantopoulou/ Prof. Jochen Roep/ Prof. Gaby Schneider

Semester-related proofs
regular participation

Study achievements
Seminar: 1 talk (20 minutes) on the results of own experiments, 1 talk (20 minutes) on current literature

Teaching forms
Practical, seminar

Tuition language
English

Module exam
Module final exam consisting of:
Form / duration / content (if applicable)
Practical: graded protocol (10-30 pages)

The dopamine system in schizophrenia mouse models

<table>
<thead>
<tr>
<th>Form of teaching</th>
<th>SWH</th>
<th>CP</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>P</td>
<td>10</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>Seminar</td>
<td>S</td>
<td>1</td>
<td>X</td>
</tr>
<tr>
<td>Sum</td>
<td></td>
<td>11</td>
<td></td>
</tr>
</tbody>
</table>
Course Manual Master „Interdisciplinary Neuroscience“ 1.8.2023

### INS A-10 Neurophysiology and Behaviour

<table>
<thead>
<tr>
<th>Elective course</th>
<th>Contact study 11 SWH / 165 h</th>
<th>Self study 165 h</th>
<th>11 CP</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 CP = 330 h</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 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 (patchclamp 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.

### Learning results / Competence objectives

The students can plan, carry out and evaluate neurobiological experiments. They have knowledge in the measurement of ionic currents and perform behavioral observations and behavioral quantifications. They are familiar with neuroanatomical methods. They are familiar with approaches to scientific questions and literature work and prepare scientific papers and presentations.

### Requirements for participating

none

### Helpful previous knowledge

none

### Assignment of course (program/department)

MSc Interdisciplinary Neuroscience / FB 15

### Suitable for other study programs

in the summer semester

### Duration

1 Semester (block course over 4 weeks)

### Person in charge

Prof. Bernd Grünewald

### Semester-related proofs

regular participation

### Proof of participation

regular participation

### Study achievements

Seminar: 1 talk (20 minutes) on the results of own experiments, 1 talk (20 minutes) on current literature

### Teaching forms

Practical, seminar

### Tuition language

English

### Module exam

Practical: graded protocol (10-30 pages)

### Module final exam consisting of:

<table>
<thead>
<tr>
<th>Neurophysiology and Behaviour</th>
<th>Form of teaching</th>
<th>SWH</th>
<th>CP</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>P</td>
<td>10</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Seminar</td>
<td>S</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Sum</td>
<td></td>
<td>11</td>
<td>11</td>
<td></td>
</tr>
</tbody>
</table>
The Neurovascular Interface

**Content**

The course provides basic theoretical and experimental knowledge of the cerebrovascular system in embryonic development and under pathological conditions. The research focus is the development and maintenance of the blood-brain barrier (BBB), and its importance for neuronal function. Students will participate in current experiments in the laboratory setting that will contribute to the understanding of the molecular mechanisms of BBB formation. This work may include the following: basic work with transgenic mouse models (various reporter mouse lines for detection of the Wnt signaling pathway, as well as conditional/inducible "gain-" and "loss-of-function" lines), processing of brain tissue for in situ hybridization and immunohistochemistry, Isolation of cortex microcapillaries from mice, transfection and infection techniques of cells, immunofluorescence, confocal and live-cell microscopy, biochemical techniques such as protein gel electrophoresis, western blot and immunoprecipitation.

**Learning results / Competence objectives**

Students know basic techniques of cellular and molecular neurobiology. By the end of the course, they will have gained experience with transgenic mice and/or cells in vitro, and they will have learned how to process brain tissue from mice according to subsequent methods. Students operate in an international environment and are able to communicate and write scientifically in English.

**Requirements for participating**

None

**Helpful previous knowledge**

None

**Assignment of course (program/department)**

MSc Interdisciplinary Neuroscience / FB 15

**Suitable for other study programs**

in the summer semester

**Duration**

1 Semester (block course over 4 weeks)

**Person in charge**

Dr. Stefan Liebner

**Semester-related proofs**

regular participation

**Study achievements**

Seminar: 1 talk (20 minutes) on the results of own experiments, 1 talk (20 minutes) on current literature

**Teaching forms**

Practical, seminar

**Tuition language**

English

**Module exam**

Practical: graded protocol (10-30 pages)

<table>
<thead>
<tr>
<th>The Neuro-Vascular Interface</th>
<th>Form of teaching</th>
<th>SWH</th>
<th>CP</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>P</td>
<td>10</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Seminar</td>
<td>S</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Sum</td>
<td></td>
<td>1</td>
<td>11</td>
<td>X</td>
</tr>
</tbody>
</table>

**Module final exam consisting of:**

Practical: graded protocol (10-30 pages)
Content
The topic of this practical is the control of neuron and glia production by genetic and epigenetic processes. We study this in healthy organisms and in different disease states, with a focus on glial, brain tumors and childhood neurodevelopmental disorders. Depending on the ongoing projects at the time of the course, the course will teach the following skills: bioinformatic analyses of existing genome-wide datasets (ChIP-seq, RNA-seq), culturing and differentiation of cell lines and stem cells (adult neural stem cells, mouse ES cells), qPCR, CRISPR/Cas-based methods for genome modification, retro- and lentiviral gene transfer, immunohistochemistry and microscopy, basic biochemical methods.

Students work as full members of the research group, with supervision, on their own small projects.

Learning results / Competence objectives
Students have hands-on experience with basic as well as some advanced molecular–genetic methods. They have solid knowledge of the regulation of gene expression, different epigenetic modifications on chromatin (e.g. histone modifications, DNA methylation) and stem cell biology. Students will have gained experience in developing and conducting their own research project.

Requirements for participating
none

Helpful previous knowledge
none

Assignment of course (program/department) MSc Interdisciplinary Neuroscience / FB 15

Suitable for other study programs

Times offered in the summer semester

Duration 1 Semester (block course over 4 weeks)

Person in charge Prof. Dorothea Schulte

Semester-related proofs

Proof of participation regular participation

Study achievements Seminar: 1 talk (20 minutes) on the results of own experiments, 1 talk (20 minutes) on current literature

Teaching forms Practical, seminar

Tuition language English

Module exam

Module final exam consisting of:

<table>
<thead>
<tr>
<th>Form of teaching</th>
<th>SWH</th>
<th>CP</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>P</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Seminar</td>
<td>S</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Sum</td>
<td></td>
<td>11</td>
<td>11</td>
</tr>
</tbody>
</table>

Genetics and Epigenetics of Neurogenesis and Gliogenesis

11 CP = 330 h

Contact study 11 SWH / 165 h
Self study 165 h

Elective course
11 CP
<table>
<thead>
<tr>
<th>Course</th>
<th>Elective course</th>
<th>11 CP = 330 h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Contact study</td>
<td>11 SWH / 165 h</td>
</tr>
<tr>
<td>Ableitungen der neuronalen Aktivität in sich frei bewegenden Tieren</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Content
During this event, participants will learn methods for studying neuronal activity in freely moving animals. This will focus on one of two methods (depending on the experiments running in the lab during the time window of the course): extracellular recordings using fixed implanted electrodes or calcium imaging using a miniaturized microscope. Participants will learn to perform behavioral tests in mice, how measurement probes are implanted in the mouse brain using stereotactic surgery, both the theory behind the measurement methods and their use for recording neural activity during behavioral tasks; methods for analyzing neural signals related to mouse behavior; and histological methods to confirm the placement of the measurement probes. The collected and analyzed data will be presented at the end of the practicum.

### Learning results / Competence objectives
Students will have learned animal behavioral training, basic knowledge of techniques for recording and analyzing the neural activity of freely moving animals, and they will be able to address scientific questions based on relevant literature.

### Requirements for participating
**Requirements for participating**

- none

### Helpful previous knowledge

- none

### Assignment of course (program/department)

- MSc Interdisciplinary Neuroscience / FB 15

### Suitable for other study programs

- none

### Times offered

- in the summer semester

### Duration

- 1 Semester (block course over 4 weeks)

### Person in charge

- Dr. Torfi Sigurdsson

### Semester-related proofs

- Proof of participation: regular participation

### Study achievements

- Seminar: 1 talk (20 minutes) on the results of own experiments, 1 talk (20 minutes) on current literature

### Teaching forms

- Practical, seminar

### Tuition language

- English

### Module exam

- Form / duration / content (if applicable)
  - Practical: graded protocol (10-30 pages)

### Recording neuronal activity in freely behaving animals

<table>
<thead>
<tr>
<th>Form of teaching</th>
<th>SWH</th>
<th>CP</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>P</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Seminar</td>
<td>1</td>
<td>1</td>
<td>X</td>
</tr>
<tr>
<td>Sum</td>
<td>11</td>
<td>11</td>
<td>X</td>
</tr>
</tbody>
</table>
This course teaches methods for determining auditory function and hearing loss in laboratory rodents. Exemplary working with animal models, the methods will be used to study the effects of pharmaceuticals and other therapeutic approaches to sensory processing damage such as tinnitus or hearing loss. Emphasis is placed on characterizing these disorders as accurately as possible through behavioral testing. For this purpose, all the necessary steps for carrying out a project are taught: Planning the study, handling animals, determining experimental variables, pharmacological treatment of animals, and data analysis. In parallel to the behavioral tests, basic electrophysiological techniques are taught to determine physiological changes in hearing. Participants will work on their own project under supervision and the results will be presented in a seminar lecture. Important content of the course are: Measurement and analysis of behavioral data, efficient execution of experiments in hearing physiology and statistical evaluation. This will finally lead to a summary of the results in the form of a possible publication. At the end, the individual projects will be presented and discussed in a seminar lecture. In addition, original papers in the field of cognition and hearing will be discussed in a seminar.

Learning results / Competence objectives
The students are able to perform quantitative behavioral tests (handling of animals, analysis of behavioral data, statistical evaluation) and physiological experiments with electrophysiological measurements in minimally invasive preparations. Students have basic knowledge of computer-assisted data analysis, signal processing and the graphical representation of experimental data. They will be able to formulate scientific questions from the current literature and assess the possibilities and limitations of animal models for disturbed brain functions.

Requirements for participating
none

Helpful previous knowledge
none

Assignment of course (program/department) MSc Interdisciplinary Neuroscience / FB15

Suitable for other study programs in the summer semester

Duration 1 Semester (block course over 6 weeks)

Person in charge PD Dr. Bernhard Gaese

Semester-related proofs

Proof of participation regular participation

Study achievements Seminar: 1 talk (20 minutes) on the results of own experiments, 1 talk (20 minutes) on current literature

Teaching forms Practical, seminar

Tuition language English

Module exam Form / duration / content (if applicable)
Module final exam consisting of: Practical: graded protocol (10-30 pages)

<table>
<thead>
<tr>
<th>Auditory Function and Dysfunction: Behavior and Physiology</th>
<th>Form of teaching</th>
<th>SWH</th>
<th>CP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>P</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Seminar</td>
<td>S</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Sum</td>
<td></td>
<td>11</td>
<td>11</td>
</tr>
</tbody>
</table>

Semester

1 2 3 4

X
Content
This course teaches the methods used to study the activity of neurons in processing sensory information, using hearing as an example. Emphasis is placed on the electrophysiology of single neurons in laboratory rodents, both awake and under anesthesia. The activity of neurons is recorded with the aim of understanding acoustically triggered behavior. Cognitive influences (e.g. attention, context dependence) are controlled and taken into account. The participants work on their own project under supervision, the results are presented in a seminar lecture. Important contents are the recording and analysis of neuronal activity with different methods of in-vivo electrophysiology. The subsequent analysis includes modern signal processing techniques, efficient data management of large data sets and statistical analysis. This finally leads to a summary of the results in the form of a possible publication. At the end, the individual projects are presented and discussed in a seminar presentation. In addition, original work in the field of cognition and hearing will be discussed in a seminar.

Learning results / Competence objectives
Students will have experience in performing physiological experiments (handling animals, surgical techniques, recording and analyzing electrophysiological activity of single cells). They can supplement physiological techniques with neuroanatomical and histological staining techniques. They have basic knowledge of behavioral experiment control, computerized data management, signal processing, data analysis, and graphical presentation. They overview the importance of cognitive influences in the processing of sensory information as the basis of behavior and can formulate scientific questions from the current literature.

Requirements for participating
none

Helpful previous knowledge
none

Assignment of course (program/department) MSc Interdisciplinary Neuroscience / FB15

Times offered in the summer semester

Duration 1 Semester (block course over 6 weeks)

Person in charge PD Dr. Bernhard Gaese

Semester-related proofs

Proof of participation regular participation

Study achievements Seminar: 1 talk (20 minutes) on the results of own experiments, 1 talk (20 minutes) on current literature

Teaching forms Practical, seminar

Tuition language English

Module exam

Module final exam consisting of: Form / duration / content (if applicable)
Practical: graded protocol (10-30 pages)

<table>
<thead>
<tr>
<th>Information Processing in the Central Auditory System</th>
<th>Form of teaching</th>
<th>SWH</th>
<th>CP</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>P</td>
<td>10</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>Seminar</td>
<td>S</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Sum</td>
<td></td>
<td>11</td>
<td>11</td>
<td>3/4</td>
</tr>
</tbody>
</table>
Neuronal Basis of Acoustic Communication in Mammals

Content
To understand acoustic communication, it is essential to understand both the mechanisms of sound generation and the neural basis of auditory perception. Accordingly, the practical is based on the broadcaster-receiver approach and is divided into two parts. In the first part, the generation of communication calls in two mammalian species (gerbil, bat) is investigated. Using bioacoustic methods, a vocal alphabet for bats and gerbils will be defined. In the second part, the "receiver" properties of neurons in the auditory cortex of the gerbil will be investigated with the main goal of understanding how behaviorally relevant sound stimuli are processed. At the beginning of each of the two parts of the practical, the theoretical knowledge necessary for the experiments will be provided in the form of lectures and discussions. An introduction to statistics and Matlab relevant to the practical will also be given. The results are to be summarized in the form of a scientific paper and presented in the form of a seminar talk.

Learning results / Competence objectives
(1) Understanding of basic concepts of bioacoustics, sound propagation, and acoustic measurement techniques using various microphone systems and analog-to-digital converters.
(2) Measurement and analysis of important parameters of sound events (frequency, duration, intensity).
(3) Learning of surgical techniques for cortical measurement data collection
(4) Understanding important concepts in neuroscience, e.g.: Action potential, local field potential, receptive field, cortex topography, "spike clustering", neuronal oscillations.
(5) Test hypotheses using basal statistical tests (normal distribution tests, parametric and non-parametric t-tests, analysis of variance (ANOVA)).

Requirements for participating
none

Helpful previous knowledge
none

Assignment of course (program/department)
Interdisciplinary Neuroscience / FB15

Suitable for other study programs

Times offered
in the summer semester

Duration
1 Semester (block course over 5 weeks)

Person in charge
Dr. Julio Hechavarria

Semester-related proofs
Proof of participation regular participation

Study achievements
Seminar: 1 talk (20 minutes) on the results of own experiments, 1 talk (20 minutes) on current literature

Teaching forms
Practical, seminar

Tuition language
English

Module exam
Form / duration / content (if applicable)
Practical: graded protocol (10-30 pages)

Neuronal Basis of Acoustic Communication in Mammals

<table>
<thead>
<tr>
<th>Form of teaching</th>
<th>SWH</th>
<th>CP</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>P</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>Seminar</td>
<td>S</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Sum</td>
<td></td>
<td>11</td>
<td>11</td>
</tr>
</tbody>
</table>

IN A-19
Elective course
11 CP (insg.) = 330 h
11 SWH / 165 h
Self study 165 h
11 CP
Content

The practical provides basic theoretical and experimental knowledge in the field of cellular, molecular and systemic neurobiology in mouse and zebrafish. Students work on their own projects under supervision and present the results in the form of a lecture. In another lecture they present an original paper from the thematic area of their projects. They learn how to write a scientific paper by designing a protocol of results accordingly. The practical is divided into two units. The first part includes the following work: Basic techniques of mouse genetics, processing of brain tissue for immunohistochemistry, basics of working with neuronal cell cultures including generation of primary neuronal, astrocytic or endothelial cell cultures, immuno fluorescent microscopy, confocal microscopy and biochemical techniques including protein gel electrophoresis and western blot. In the second part of the practical, students are introduced to basic genetic techniques used in zebrafish research. This includes learning molecular biology and histology methods, using various microscopes, manipulating zebrafish embryos, and performing simple behavioral tests.

Learning results / Competence objectives

Students will have experience in basic techniques of cellular, molecular and systemic neurobiology. They can independently perform sterile work on cultured cells, independent work on fluorescence microscope and stereomicroscope, basic zebrafish work such as handling embryos and genetic techniques, and computational analysis of laboratory data and image files. Students will operate in an international environment and will be able to present and communicate their results in English.

Requirements for participating

none

Helpful previous knowledge

none

Assignment of course (program/department) MSc Interdisciplinary Neuroscience / FB 15

Suitable for other study programs

none

Times offered

in the summer semester

Duration

1 Semester (block course over 4 weeks)

Person in charge

Prof. Amparo Acker-Palmer, Dr. Bettina Kirchmaier

Semester-related proofs

regular participation

Study achievements

Seminar: 1 talk (20 minutes) on the results of own experiments, 1 talk (20 minutes) on current literature

Teaching forms

Practical, seminar

Tuition language

English

Module exam

Form / duration / content (if applicable)

Practical: graded protocol (10-30 pages)

<table>
<thead>
<tr>
<th>Cellular, molecular and systemic neurobiology in mouse and zebrafish</th>
<th>Form of teaching</th>
<th>SWH</th>
<th>CP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>P</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Seminar</td>
<td>S</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Sum</td>
<td></td>
<td>11</td>
<td>11</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Semester</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact study</td>
<td>11 SWH / 165 h</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self study</td>
<td>165 h</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The goal of this course is to introduce students to optogenetics and "fiber photometry" techniques used in animals while performing behavioral tasks. Students will learn how to perform chronic surgery for virus injections and fiber optic cable implantations, as well as behavioral tasks and optogenetic experiments. Furthermore, they learn how to register calcium signals using "fiber photometry" and then analyze them in relation to animal behavior. The optogenetic manipulations and calcium measurements are mainly performed in the midbrain dopamine system while the animals perform specific behavioral tasks such as reward learning paradigms.

**Learning results / Competence objectives**
Students know the basics in performing behavioral tasks, as well as optogenetics and calcium recording experiments with freely behaving animals. They can design experiments to test specific hypotheses. They operate in an international environment and can present and communicate their results in English.

**Requirements for participating**
none

**Helpful previous knowledge**
none

**Assignment of course (program/department)**
MSc Interdisciplinary Neuroscience / FB15

**Suitable for other study programs**
in the summer semester

**Person in charge**
Dr. Sevil Duvarci

**Semester-related proofs**
 regular participation

**Teaching forms**
Practical, seminar

**Tuition language**
English

**Module exam consisting of:**
Form / duration / content (if applicable)
Practical: graded protocol (10-30 pages)

<table>
<thead>
<tr>
<th>Optogenetics and calcium recordings in freely behaving animals</th>
<th>Form of teaching</th>
<th>SWH</th>
<th>CP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>P</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Seminar</td>
<td>S</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Sum</td>
<td></td>
<td>11</td>
<td>11</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Semester</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Course Manual Master „Interdisciplinary Neuroscience“

### Content

The practical course provides basic theoretical and experimental knowledge in the field of neurodegenerative and vascular diseases. The practical course includes cellular and molecular aspects addressed in the model organism mouse. These include the following work: Basic techniques of mouse genetics and experimental OR methods, processing of brain tissue for immunohistochemistry, basics of working with primary cell cultures, immunofluorescence microscopy, confocal microscopy, and biochemical techniques. Primary cell culture experiments are used to analyze techniques such as phagocytosis efficiency of different cell types. Immunohistochemistry is used to analyze cell specific markers in different disease states. Microscopy allows us to record the cellular and systemic events. The data obtained will be further analyzed by the students, thus teaching them how to use image processing and analysis software. In addition, students will have the opportunity to observe surgical methods such as experimental stroke surgery and in vivo 2-photon microscopy.

### Learning results / Competence objectives

Students will be familiar with the basic techniques used in the study of neurodegenerative diseases, among others. The different methods allow to ask targeted questions. Accordingly, the students can assess the advantages and disadvantages of different model systems. The students operate in an international environment and are able to present and communicate their results in English.

### Requirements for participating

- none

### Helpful previous knowledge

- none

### Assignment of course (program/department)

- MSc Interdisciplinary Neuroscience / FB 15

### Suitable for other study programs

- none

### Times offered

- Each semester

### Duration

- 1 Semester (block course over 4 weeks)

### Person in charge

- Prof. Jasmin Hefendehl

### Semester-related proofs

- Proof of participation: regular participation

### Study achievements

- Seminar: 1 talk (20 minutes) on the results of own experiments and on current literature

### Teaching forms

- Practical, seminar

### Tuition language

- English

### Module exam

- Form / duration / content (if applicable)
  - Practical: graded protocol (10-30 pages)

### Module final exam consisting of:

<table>
<thead>
<tr>
<th>Cellular and molecular mechanisms in neurovascular disorders</th>
<th>Form of teaching</th>
<th>SWH</th>
<th>CP</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>P</td>
<td>10</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>Seminar</td>
<td>S</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Sum</td>
<td></td>
<td>11</td>
<td>11</td>
<td>X</td>
</tr>
</tbody>
</table>

1. 2. 3. 4.
Deciphering brain activity during natural behaviour in real time

People often can't multitask - but their brains can! Cognitive processes such as learning and attention are often represented simultaneously in the same brain areas. Previous studies have focused predominantly on how each of these processes affects neuronal activity in isolation. In contrast, in our lab we are investigating how neurons simultaneously represent such cognitive processes and whether these are evolutionarily conserved or vary between species. To this end, we are conducting parallel experiments in monkeys and mice. These animals are trained to perform naturalistic foraging tasks in a virtual environment, while we record the activity of large neuronal populations in their visual system. Different tasks will be offered depending on when the practical begins, including mouse/monkey behavioral training, Matlab/Python programming, psychophysics in humans, virtual reality (VR) experiments, and in vivo electrophysiology.

Learning results / Competence objectives

Students will be familiar with all the techniques required for in vivo electrophysiology: handling animals (mice and/or monkeys), training the animals to perform a natural task in a virtual environment, surgeries to implant electrodes, and electrophysiological recordings from these electrodes as the animals perform their task. In addition, students are able to perform VR psychophysics on human subjects, and are given their own data analysis project to learn Matlab/Python programming. Students are in an international environment and are able to present and communicate their results in English.

Requirements for participating

none

Helpful previous knowledge

none

Assignment of course (program/department) MSc Interdisciplinary Neuroscience / FB 15

Suitable for other study programs

MSc Interdisciplinary Neuroscience / FB 15

Times offered

Each semester

Duration

1 Semester (block course over 4-6 weeks)

Person in charge

Dr. Martha Havenith / Dr Marieke Schölvinck

Semester-related proofs

regular participation

Study achievements

Seminar: 1 talk (20 minutes) on the results of own experiments and on current literature

Teaching forms

Practical, seminar

Tuition language

English

Module exam

Form / duration / content (if applicable)

Module final exam consisting of: Practical: graded protocol (10-30 pages)

Deciphering brain activity during natural behaviour in real time

<table>
<thead>
<tr>
<th>Form of teaching</th>
<th>SWH</th>
<th>CP</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>P</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Seminar</td>
<td>S</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Sum</td>
<td></td>
<td>11</td>
<td>11</td>
</tr>
</tbody>
</table>

1 CP = 330 h

Contact study 11 SWH / 165 h
Self study 165 h

Module exam consisting of: Practical: graded protocol (10-30 pages)
**Neuroscience of Navigation and Self-Motion**

**Elective course**

<table>
<thead>
<tr>
<th>Form of teaching</th>
<th>SWH</th>
<th>CP</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>P</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>Seminar</td>
<td>S</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Sum</td>
<td></td>
<td>11</td>
<td>1</td>
</tr>
</tbody>
</table>

**Content**

We interact with the world by moving and navigating through it whenever we walk into our kitchen or explore a new shopping mall; and whenever we drive a car or climb a mountain path. The research group is studying the circuits in the brain responsible for sensing how our bodies move, controlling balance, and navigating the world. Neural derivations are performed on small, squirrel-sized monkeys called marmosets in experiments where they can sit on moving platforms or move freely in natural cages. We are a computational laboratory, and develop models of self-motion perception based in particular on the Bayesian formalism. Students learn the techniques of extracellular recordings and neural data analysis, motion and navigation science, and theoretical and systems neuroscience, and can then conduct an in-depth research project in one of the lab's topics: Navigation (head-directional cell system), intrinsic motion (vestibular system), cerebellar physiology, Bayesian modeling.

**Learning results / Competence objectives**

Students are familiar with systems neuroscience techniques: chronic implant design and operation; neural spiking data and LFP analysis; 3D motion tracking and analysis, robotic platform programming. They have also become familiar with one of the scientific areas of the lab: navigation, self-motion sensing, cerebellar physiology, Bayesian modeling. Students are in an international environment and are able to present and communicate their results in English.

**Requirements for participating**

none

**Helpful previous knowledge**

Basic knowledge of Matlab programming.

Lab projects are typically focused on motion science, data analysis, and modeling, so a basic knowledge of algebra and statistics is helpful.

**Assignment of course (program/department)**

MSc Interdisciplinary Neuroscience / FB 15

**Suitable for other study programs**

Each semester

**Duration**

1 Semester (block course over 4 weeks)

**Person in charge**

Dr. Jean Laurens

**Semester-related proofs**

**Proof of participation**

regular participation

**Study achievements**

Seminar: 1 talk (20 minutes) on the results of own experiments and on current literature

**Teaching forms**

Practical, seminar

**Tuition language**

English

**Module exam**

**Form / duration / content (if applicable)**

Practical: graded protocol (10-30 pages)
**Analysis of Social Networks**

This practical will provide an introduction into bioacoustics, neuroethology, and machine learning. Participants will have the opportunity to be involved in projects studying the interaction between vocal communication and cooperation, using the naked mole-rat as a model species. Students will have the opportunity to collect and analyze vocalization data using programs in Python and R and to develop machine learning tools for characterizing acoustic features of different vocalization types. Additionally, students will have the opportunity to participate in behavioral studies of naked mole-rats in a wide range of cooperative assays.

**Learning results / Competence objectives**

Students will be able to use Python modules to analyze bioacoustics and neuronal data, as well as design and perform basic behavioral tests.

**Requirements for participating**

none

**Helpful previous knowledge:**

Proficiency in Python, knowledge of Matlab and R

**Assignment of course (program/department)**

Interdisciplinary Neuroscience / faculty 15

**Times offered**

Winter Semester

**Duration**

1 semester (block course over 4 weeks)

**Person in charge**

Dr. Alison Barker

**Teaching forms**

Practical, seminar

**Tuition language**

English

**Module exam**

Form / duration / content (if applicable)

Module final exam consisting of:

Practical: Graded protocol (10-30 pages)

**Analysis of Social Networks**

<table>
<thead>
<tr>
<th>Teaching forms</th>
<th>SWH</th>
<th>CP</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>P</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Seminar</td>
<td>S</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Sum</td>
<td></td>
<td>11</td>
<td>11</td>
</tr>
</tbody>
</table>
**Content**

The goal of the internship is to provide an introduction into the mechanistic study of instinctive behaviours using modern systems neuroscience techniques, such as *in vivo* neural activity recordings and manipulation experiments in ethologically-relevant behavioural tasks in mice, as well as molecular, cellular and circuit-level analyses *in vitro*. We focus our analysis on evolutionarily conserved circuits in the rodent midbrain that are critically involved in the initiation and execution of instinctive behaviours, such as escape from predators and hunting of crickets. Depending on the projects in progress at the time of the module, the course will give an introduction to the following methods: recordings, manipulations and analysis of instinctive behaviours, stereotaxic surgeries, patch-clamp recordings *in vitro*, immunohistochemical analyses. Students work as full members of the research group, with supervision, on their own small projects embedded within a group member’s research focus.

**Learning results / Competence objectives**

Students will gain practical and theoretical experience with basic as well as advanced methods from neuroethology and systems neuroscience, including behavioural experiments, neurophysiological methods such as patch clamp recordings, stereotactic injections, neuronal manipulations *in vivo* and *in vitro*, and immunohistochemical analyses. Students gain experience in developing and conducting their own research question, programming in Python and will be exposed to work with laboratory animals (Mus musculus).

**Requirements for participating**

none

**Helpful previous knowledge:**

Basic knowledge of Python (or another programming language), willingness to work with lab mice.

**Assignment of course (program/department)**

Interdisciplinary Neuroscience / faculty 15

**Suitable for other study programs**

**Times offered**

Each semester

**Duration**

1 semester (block course over 4-6 weeks)

**Person in charge**

Dr. Vanessa Stempel

**Semester-related proofs**

Regular participation

**Study achievements**

Seminar: 1 seminar talk (20 min) on experimental results, 1 seminar talk (20 min) on current publications

**Teaching forms**

Practical, seminar

**Tuition language**

English

**Module exam**

Form / duration / content (if applicable)

Practical: Graded protocol (10-30 pages)

**Module final exam consisting of:**

- **Instinctive Behaviour Circuits**
  - Teaching forms: SWH
  - CP
  - Semester

<table>
<thead>
<tr>
<th></th>
<th>Teaching forms</th>
<th>SWH</th>
<th>CP</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>P</td>
<td>10</td>
<td>10</td>
<td>X</td>
</tr>
<tr>
<td>Seminar</td>
<td>S</td>
<td>1</td>
<td>1</td>
<td>X</td>
</tr>
<tr>
<td>Sum</td>
<td></td>
<td>11</td>
<td>11</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
</tbody>
</table>

**Practical**
**Optional courses in elective B: Clinical Neuroscience**

<table>
<thead>
<tr>
<th>INS B-0</th>
<th>Externe Wahlpflichtveranstaltung „Klinische Neurowissenschaften“</th>
<th>Elective course</th>
<th>11 CP = 330 h</th>
<th>11 CP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Contact study</td>
<td>Self study</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>11 SWH / 165 h</td>
<td>165 h</td>
</tr>
</tbody>
</table>

**Content**

The elective course teaches basic methods and techniques in the field of clinical neuroscience. Students work on their own projects under supervision. The elective course can be offered by departments of Goethe University, by other universities in Germany and abroad as well as by non-university research institutions.

**Learning results / Competence objectives**

The students have knowledge in conducting neuroscientific investigations in the field of clinical research. They are able to work on scientific questions based on relevant literature.

**Requirements for participating**

none

**Helpful previous knowledge**

none

**Assignment of course (program/department)**

MSc Interdisciplinary Neuroscience / FB 15

**Suitable for other study programs**

According to the provider

**Times offered**

Depending on provider

**Duration**

Depending on provider

**Person in charge**

Head of study program

**Semester-related proofs**

Regular participation

**Study achievements**

The regulations of the provider of the elective course 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 (20 minutes) and topical literature (20 minutes).

**Teaching forms**

Practical, seminar

**Tuition language**

Depending on provider

**Module exam**

**Module final exam consisting of:**

The regulations of the provider of the elective course are applied. If grading is not scheduled by the provider, the module completion exam shows a graded protocol (10-30 pages).

<table>
<thead>
<tr>
<th>External elective course “Clinical Neuroscience”</th>
<th>Form of teaching</th>
<th>SWH</th>
<th>CP</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>P</td>
<td>10</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Seminar</td>
<td>S</td>
<td>1</td>
<td>1</td>
<td>X</td>
</tr>
<tr>
<td>Sum</td>
<td></td>
<td>11</td>
<td>11</td>
<td></td>
</tr>
</tbody>
</table>
INS B-2
Physiology and Pharmacology of Inflammatory Response

Physiology und Pharmakologie von Entzündungsreaktionen

Elective course

11 CP = 330 h

<table>
<thead>
<tr>
<th></th>
<th>Contact study</th>
<th>Self study</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>11 SWH / 165 h</td>
<td>165 h</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>11 CP</td>
<td></td>
</tr>
</tbody>
</table>

Content

The practical course teaches basic methods for the investigation of mechanisms of inflammation. In particular, animal and cell culture models are applied and new approaches for possible therapies are investigated by means of knock-out or pharmacological intervention. Students work on their own projects under supervision. Experiments include, depending on the project, behavioral experiments with mice, tissue preparations, cultivation and stimulation of cells, processing of materials to protein and RNA, PCR and Western blot analyses, immunostaining of tissue sections.

Learning results / Competence objectives

Students will have competencies in several of the following: Behavioral observations of experimental animals and presentation of different models of inflammation, preparation of tissues for immunohistochemistry and Western blot, preparation of neuronal cell cultures, familiarization with in vitro cell culture models to study the pharmacology of inflammatory mechanisms, measurement of inflammatory mediators in cell culture models. Students are able to work on scientific questions based on relevant literature.

Requirements for participating

none

Helpful previous knowledge

none

Assignment of course (program/department)

MSc Interdisciplinary Neuroscience / FB 15

Suitable for other study programs

none

Times offered

in the summer semester

Duration

1 Semester (block course over 4 weeks)

Person in charge

Prof. Dr. Ellen Niederberger

Semester-related proofs

Proof of participation

regular participation

Study achievements

Seminar: 1 talk (20 minutes) on the results of own experiments and on current literature

Teaching forms

Practical, seminar

Tuition language

English

Module exam

Form / duration / content (if applicable)

Practical: graded protocol (10-30 pages)

Module final exam consisting of:

<table>
<thead>
<tr>
<th>Physiology and Pharmacology of Inflammatory Response</th>
<th>Form of teaching</th>
<th>SWH</th>
<th>CP</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>P</td>
<td>10</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Seminar</td>
<td>S</td>
<td>1</td>
<td>1</td>
<td>X</td>
</tr>
<tr>
<td>Sum</td>
<td></td>
<td>11</td>
<td>11</td>
<td></td>
</tr>
</tbody>
</table>

30
## Content
Practical and seminar provide an interdisciplinary overview of plastic changes in the hippocampus. The course will focus on questions concerning morphological and physiological changes of hippocampal neurons after CNS damage or neuronal overexcitation, cellular network dynamics and molecular mechanisms of hippocampal plasticity and homeostasis. The organotypic slice culture model of the hippocampus is used to scientifically investigate the underlying molecular and cell biological processes. The goal is to learn various techniques to study hippocampal plasticity, including optogenetic and pharmacological manipulation of cellular activity, live cell imaging, immunocytochemistry, patch clamp, and methods in molecular biology. Students will learn appropriate techniques in the context of their own project, perform their own experiments under instruction, and present their results in a seminar. The weekly seminars will train students to work with scientific publications, multiple models and methods and discuss the translation of results to clinical applications in the field of neurological diseases using examples and original papers.

## Learning results / Competence objectives
The students have knowledge in the basics of electrophysiological and anatomical work, in the preparation of organotypic section cultures and in confocal microscopy. They are able to work on scientific questions based on relevant literature.

## Requirements for participating
none

## Helpful previous knowledge
Experience working experimentally in a "wet lab".

## Assignment of course (program/department)
MSc Interdisciplinary Neuroscience / FB 15

## Suitable for other study programs

## Times offered
Each semester

## Duration
1 Semester (block course over 4-6 weeks)

## Person in charge
Dr. Tijana Radic, Dr. Tassilo Jungenitz, Prof. Thomas Deller

## Semester-related proofs

### Proof of participation
regular participation

### Study achievements
Seminar: 1 talk (20 minutes) on the results of own experiments, 1 talk (20 minutes) on current literature, 1 work report (if the final module exam is a written exam)

## Teaching forms
Practical, seminar

## Tuition language
English

### Module final exam consisting of
Practical: graded protocol (10-30 pages) or written exam (45 minutes)

## Form / duration / content (if applicable)

<table>
<thead>
<tr>
<th>Plasticity in Hippocampus – Morphology, Physiology, and Clinical Relevance</th>
<th>Form of teaching</th>
<th>SWH</th>
<th>CP</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>P</td>
<td>10</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>Seminar</td>
<td>S</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Sum</td>
<td></td>
<td>11</td>
<td>11</td>
<td></td>
</tr>
</tbody>
</table>
### Content

In the practical course, experiments are performed using the following methodological approaches: Cultivation of neuronal cells (primary cells and neuronal cell lines), induction of ischemia in vitro (OGD; oxygen-glucose deprivation), application of other stress stimuli in vitro, determination of neuronal cell death and neuroprotection by cytokines and pharmaceuticals, visualization of proteins and other substances in the cell by fluorescence and laser scanning microscopy, transcriptional stress responses in neurons, and transfection techniques and live cell imaging.

### Learning results / Competence objectives

Students have knowledge of cell culture techniques and molecular biology techniques in experimental neuroscience and knowledge of anesthesia and surgical approaches in animal experimentation. They are able to address scientific questions against the background of relevant literature.

### Requirements for participating

none

### Helpful previous knowledge

none

### Assignment of course (program/department)

MSc Interdisciplinary Neuroscience / FB 15

### Suitable for other study programs

<table>
<thead>
<tr>
<th>Semester-related proofs</th>
<th>Proof of participation</th>
<th>regular participation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study achievements</td>
<td>Seminar: 1 talk (20 minutes) on the results of own experiments, 1 talk (20 minutes) on current literature</td>
<td></td>
</tr>
</tbody>
</table>

### Teaching forms

Practical, seminar

### Tuition language

English

### Module exam

Module final exam consisting of:

| Form / duration / content (if applicable) | Practical: graded protocol (10-30 pages) |

<table>
<thead>
<tr>
<th>Brain Damage and Neuroprotection</th>
<th>Form of teaching</th>
<th>SWH</th>
<th>CP</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P</td>
<td>10</td>
<td>10</td>
<td>1 2 3 X</td>
</tr>
<tr>
<td>Seminar</td>
<td>S</td>
<td>1</td>
<td>1</td>
<td>4 X</td>
</tr>
<tr>
<td>Sum</td>
<td></td>
<td>11</td>
<td>11</td>
<td></td>
</tr>
</tbody>
</table>

### Brain Damage and Neuroprotection Table

<table>
<thead>
<tr>
<th>Form of teaching</th>
<th>SWH</th>
<th>CP</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>P</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Seminar</td>
<td>S</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Sum</td>
<td></td>
<td>11</td>
<td>11</td>
</tr>
</tbody>
</table>
### Content
In the practical course, neurological problems in children are examined. Special emphasis is placed on developmental neurological examination in the first year of life, applied neurophysiology in childhood, neuropediatric pathology including epilepsy syndromes, and neurotraumatology.

### Learning results / Competence objectives
The students have become familiar with standard methods of clinical neuropediatrics. They acquire experience in dealing with patients and the classification of typical clinical pictures. They are able to deal with scientific questions based on the relevant literature.

### Requirements for participating
- none

### Helpful previous knowledge
- Basic knowledge of German language

### Assignment of course (program/department)
MSc Interdisciplinary Neuroscience / FB 15

### Suitable for other study programs

### Times offered
- In the winter semester

### Duration
- 1 Semester (block course over 4 weeks)

### Person in charge
- Prof. Matthias Kieslich

### Semester-related proofs
- Regular participation

### Study achievements
- Seminar: 1 talk (20 minutes) on the results of own experiments, 1 talk (20 minutes) on current literature

### Teaching forms
- Practical, seminar

### Tuition language
- English

### Module exam
#### Module final exam consisting of:
- Form / duration / content (if applicable)
  - Practical: graded protocol (10-30 pages)

<table>
<thead>
<tr>
<th>Clinical Paediatric Neurology</th>
<th>Form of teaching</th>
<th>SWH</th>
<th>CP</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>P</td>
<td>10</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>Seminar</td>
<td>S</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Sum</td>
<td></td>
<td>11</td>
<td>11</td>
<td>X</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
</tbody>
</table>

### Module exam
#### Module final exam consisting of:
- Form / duration / content (if applicable)
  - Practical: graded protocol (10-30 pages)
Content
The practical course introduces the basics of image analysis, image interpretation and the preparation of findings in examinations of the CNS (cerebral and spinal) with imaging procedures in neuroradiology. The following procedures are used: magnetic resonance imaging (MRI) of the head and spine, computed tomography (CT) of the skull and spine, digital cerebral and spinal subtraction angiography (DSA), as well as introduction to the basics of interventional neuroradiological procedures.

In addition, the practical course teaches theoretical / physical principles of the individual examination modalities in neuroradiology with emphasis on magnetic resonance imaging. The following will be covered: physical principles of MRI / image formation, sequences and sequence parameters of MRI, diffusion and perfusion weighted MRI imaging, tractography (fiber tracking), functional MRI (fMRI), nuclear spin spectroscopic examinations (MR spectroscopy).

Depending on the project, (co-) authorship in a publication may also be possible and encouraged.

Learning results / Competence objectives
The students have knowledge of neuroanatomy (cerebral/spinal) as well as of the cranial skeleton and the spine and basic knowledge of the relevant neurological diseases. They also have basic knowledge of the indication of neuroradiological examinations, image formation and image interpretation as well as the assignment to individual typical clinical pictures.

They are able to deal with scientific questions based on relevant literature.

Requirements for participating
None

Helpful previous knowledge
Basic knowledge of German language

Assignment of course (program/department)
MSc Interdisciplinary Neuroscience / FB 15

Suitable for other study programs

Times offered
Each semester

Duration
1 Semester (block course over 4-6 weeks)

Person in charge
Prof. Weidauer, Prof. Hattingen, Dr. Polkowski

Semester-related proofs

Proof of participation
regular participation

Study achievements
Seminar: 1 talk (20 minutes) on the results of own experiments, 1 talk (20 minutes) on current literature

Teaching forms
Practical, seminar

Tuition language
English

Module exam

Module final exam consisting of:

<table>
<thead>
<tr>
<th>Clinical Neuroimaging</th>
<th>Form of teaching</th>
<th>SWH</th>
<th>CP</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>P</td>
<td>10</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>Seminar</td>
<td>S</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Sum</td>
<td></td>
<td>11</td>
<td>11</td>
<td>3, 4</td>
</tr>
</tbody>
</table>

Form / duration / content (if applicable)
Practical: graded protocol (10-30 pages)
Content
The practical provides knowledge of the most important objective and subjective audiometric measurement techniques for the differential diagnosis of hearing disorders. Sound and speech audiometry as well as the application of otoacoustic emissions, impedance audiometry, and different techniques of brainstem audiometry (BERA, CERA, ASSR, MMN) are used. The treatment of hearing impairment with implantable hearing aids and cochlear implants is demonstrated in practical use. The use of intraoperative electrophysiological conduction techniques will be demonstrated.

An own current project is determined within the scope of the course, which is to be worked on by the students under guidance. The results are to be presented in a lecture. Another lecture is scheduled to present original work in the field of electrophysiological stimulation/derivation of auditory potentials. Main topics are: Psychoacoustic measurements of auditory perception during electrical stimulation by cochlear implants, investigation of new rejection techniques for frequency-specific diagnosis of hearing disorders, creation of software protocols for data acquisition and stimulus generation.

Learning results / Competence objectives
The students are able to perform psychoacoustic experiments and measurement of acoustically evoked potentials, and have basic knowledge of audiometry as well as basic knowledge of the function of hearing implants. They are able to work on scientific questions based on relevant literature.

Requirements for participating
none

Helpful previous knowledge
none

Assignment of course (program/department) MSc Interdisciplinary Neuroscience / FB 15

Suitable for other study programs

Times offered Each semester

Duration 1 Semester (block course over 4 weeks)

Person in charge Prof. Uwe Baumann

Semester-related proofs

Proof of participation regular participation

Study achievements Seminar: 1 talk (20 minutes) on the results of own experiments, 1 talk (20 minutes) on current literature

Teaching forms Practical, seminar

Tuition language English

Module exam Form / duration / content (if applicable)

Module final exam consisting of: Practical: graded protocol (10-30 pages)

<table>
<thead>
<tr>
<th>Clinical Auditory Neuroscience</th>
<th>Form of teaching</th>
<th>SWH</th>
<th>CP</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>P</td>
<td>10</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>Seminar</td>
<td>S</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Sum</td>
<td></td>
<td>11</td>
<td>11</td>
<td>X</td>
</tr>
</tbody>
</table>

1 2 3 4
Content

The goal of this practical is to introduce students to a range of experimental techniques for the study of psychiatric disorders. In doing so, they will be able to participate in a wide range of translational projects. These include cell culture techniques for functional evaluation of candidate genes previously identified in large cohorts and behavioral analysis of mice that have been pharmacologically treated or genetically modified (e.g., viral gene transfer, gene knockout). Following such experiments, a series of immunohistochemical and histological characterizations will be performed. In addition, there is an opportunity to gain insight into neural imaging techniques (e.g., functional magnetic resonance imaging, electroencephalography, and magnetoencephalography) for detecting abnormalities of neural processing and coordination in psychiatric disorders.

Learning results / Competence objectives

Students will have knowledge of a range of commonly used molecular and behavioral methods for analyzing psychiatric disorders and will be able to design their own experiments using the knowledge thus acquired. In addition, a series of seminars (and optional participation in case presentations) will provide students with basic knowledge regarding these disorders, particularly affective disorders, anxiety disorders, schizophrenia, and attention-deficit/hyperactivity disorder.

Requirements for participating

none

Helpful previous knowledge

none

Assignment of course (program/department) MSc Interdisciplinary Neuroscience / FB 15

Suitable for other study programs

Times offered Each semester

Duration 1 Semester (block course over 6 weeks)

Person in charge Prof. David Slattery

Semester-related proofs

Proof of participation regular participation

Study achievements Seminar: 1 talk (20 minutes) on the results of own experiments, 1 talk (20 minutes) on current literature

Teaching forms Practical, seminar

Tuition language English

Module exam

Module final exam consisting of:

Form / duration / content (if applicable)

Practical: graded protocol (10-30 pages)

<table>
<thead>
<tr>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
</tr>
<tr>
<td>P</td>
</tr>
<tr>
<td>S</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
The goal of this practical is for students to learn the basics of experimental techniques for studying genetic variants in human neural progenitor cells and to be able to apply them independently. These techniques include cell culture methods for culturing and neuronal differentiation, genomic editing of sequences (CRISPR/Cas9 techniques), and fluorescence and luciferase assays for functional analysis. Specifically, techniques for the production of cerebral organoids and iNeurons can be learned. Following genetic modification of cell lines, a series of immunohistochemical, functional and morphological assays will be applied and evaluated. In addition, insights into the basics of transcriptome and genome analysis can be gained.

Learning results / Competence objectives
The students have knowledge of the current molecular and cell biological methods for the analysis of human neurons and can plan and perform their own experiments with the knowledge thus acquired. At the end, students will have the necessary know-how to use human neural progenitor cells, or human stem cells and their derivatives as an effective model for psychiatric disorders. In addition, in a series of seminars, also in close collaboration with adult psychiatry, students are given the basic knowledge regarding underlying disorders such as autism spectrum disorder, attention deficit/hyperactivity syndrome, or social behavior disorder.

Requirements for participating
none

Helpful previous knowledge
Cell culture experience

Assignment of course (program/department) MSc Interdisciplinary Neuroscience / FB 15

Suitable for other study programs

Times offered
Each semester

Duration
1 Semester (block course over 6 weeks)

Person in charge
Prof. Andreas Chiocchetti

Semester-related proofs

Proof of participation
regular participation

Study achievements
Seminar: 1 talk (20 minutes) on the results of own experiments, 1 talk (20 minutes) on current literature

Teaching forms
Practical, seminar

Tuition language
English

Module exam

Module final exam consisting of:
Form / duration / content (if applicable)
Practical: graded protocol (10-30 pages)

<table>
<thead>
<tr>
<th>Neurobiological human cell models</th>
<th>Form of teaching</th>
<th>SWH</th>
<th>CP</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>P</td>
<td>10</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>Seminar</td>
<td>S</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Sum</td>
<td></td>
<td>11</td>
<td>11</td>
<td>X</td>
</tr>
</tbody>
</table>

X X
Content
The goal of the practical is to provide students with insight into the analysis of magnetic resonance imaging (MRI) data of the human brain. This will include analysis of MRI data from individuals with autism spectrum disorder (ASD) compared to control groups in terms of different anatomical features of the human brain, such as cortex thickness, surface area, or gyrification index. Statistical analyses are performed based on regions of the brain defined based on a brain atlas. Common programs and software for the analysis of MRI data are used. There is also an opportunity to gain insight into neural imaging techniques and data management. Students will also gain knowledge of how structural MRI data is used to determine differences in neuroanatomy of psychiatric disorders such as ASD.

Learning results / Competence objectives
Students will be able to use common programs and software to analyze MRI data and will have acquired basic knowledge of Autism Spectrum Disorder and other psychiatric disorders as appropriate. They are able to perform their own analyses of a data set in the form of statistical evaluations using R and/or Matlab, visualize and present the results.

Requirements for participating
none

Helpful previous knowledge
Basic knowledge in MatLab and R

Assignment of course (program/department) MSc Interdisciplinary Neuroscience / FB 16

Suitable for other study programs

Times offered in the summer semester

Duration 1 Semester (block course over 6 weeks)

Person in charge Prof. Christine Ecker

Semester-related proofs

Proof of participation regular participation

Study achievements Seminar: 1 talk (20 minutes) on the results of own experiments, 1 talk (20 minutes) on current literature

Teaching forms Practical, seminar

Tuition language English

Module exam

Module final exam consisting of: Form / duration / content (if applicable)
Practical: graded protocol (10-30 pages)

Neuroimaging Biomarkers in Psychiatry | Form of teaching | SWH | CP | Semester |
---|---|---|---|---|
Practical | P | 10 | 10 | 1
Seminar | S | 1 | 1 | 2
Sum | | 11 | 11 | 3 | 4 | X |
**Course Manual Master „Interdisciplinary Neuroscience“**

**INS B-13**

**Translational Neuro-Oncology Research**

<table>
<thead>
<tr>
<th>Elective course</th>
<th>11 CP = 330 h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact study</td>
<td>11 SWH / 165 h</td>
</tr>
<tr>
<td>Self-study</td>
<td>165 h</td>
</tr>
</tbody>
</table>

### Content

During this practical, students have the opportunity to be involved in ongoing research projects in the field of translational, neuro-oncological research. This includes both participation in routine laboratory workflows and the development of an independent scientific project within the conceptual orientation of the "Translational Neuro-Oncology" working group.

The routine laboratory processes include the generation of 3D cultures, so-called tumor organoids, based on surgical tissue from patients suffering from brain tumors. These organoids are routinely characterized on several molecular levels to ensure the preservation of the histopathological, (epi-)genetic and transcriptional features of the primary parental tumours. We are also using these tumor organoids as a preclinical model for our exploratory drug profiling workflow to eventually improve personalized medicine approaches and therapeutic options for cancer patients. Furthermore, we are generating patient-derived orthotopic xenografts (PDOXs) by intracortical implantation of the tumor organoids into immunodeficient mice. These PDOXs enable long-term propagation of patient tumors and are clinically relevant patient avatars for precision oncology studies.

Additionally, we have a strong interest in recapitulating early brain tumor evolution by sequential oncogenic editing of the genome of human induced pluripotent stem cells (hiPSCs). Cerebral organoids, so-called "mini-brains", are used to grow hiPSC-derived brain tumors within a physiologically relevant 3D brain microenvironment. This model allows us to study the impact of specific mutations on tumor metabolism and to test new treatment strategies ex vivo.

### Learning results / Competence objectives

After completing the internship, the students have gained theoretical knowledge and hands-on experience in the field of neuro- and cellular molecular biology including basic techniques of cellular model system development and, to a limited extent, of applied molecular biology. The students will be able to describe their purposes and apply them in practice.

Basic techniques include the generation of brain tumor organoids from fresh tumor tissue, the cultivation of human brain tumor cell lines, working with hiPSCs and associated cerebral organoid cultures, and the practical use of various cellular assays. The standard techniques, taught in this internship, include the quantification of invasive cells, the measurement of proliferation behavior, the detection of tumorigenicity via colony formation and survival, as well as live cell imaging of 2D and 3D cell cultures and compound screenings in a medium-throughput manner. Array-based DNA methylation analysis, CRISPR-Cas based (epi)genome modification and the associated basic molecular biological methods and bio-informatic analyzes represent more specialized methods depending on the particular scientific project and are not necessarily always taught in this practical. Students will work on their own scientific project with the help and guidance of experienced scientists. They will be able to independently develop a patient-oriented, translational research hypothesis and how to design experiments to validate it. The students have acquired skills and knowledge in order to deal with advanced topics in cell, molecular and neurobiology as well as related disciplines, and will be able to evolve them independently.

### Requirements for participating

None

**Helpful previous knowledge:**
Experience with sterile cultivation of cell lines is an advantage

**Assignment of course (program/department)**
MSC Interdisciplinary Neuroscience / FB 15

**Suitable for other study programs**

**Times offered**
Each semester

**Duration**
1 Semester (block course 6 weeks)

**Person in charge**
Dr. Ann-Christin Hau

**Semester-related proofs**

<table>
<thead>
<tr>
<th>Proof of participation</th>
<th>Regular participation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study achievements</td>
<td>Seminar: 1 seminar talk (20 minutes) on literature, 1 seminar talk (20 minutes) on the research project</td>
</tr>
</tbody>
</table>

**Teaching forms**
Practical, seminar

**Tuition language**
English and/or German

**Module exam**
Form / duration / content (if applicable)
### Module final exam consisting of:

<table>
<thead>
<tr>
<th>Translational Neuro-Oncology Research</th>
<th>Teaching forms</th>
<th>SWH</th>
<th>CP</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>P</td>
<td>10</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Seminar</td>
<td>S</td>
<td>1</td>
<td>1</td>
<td>X</td>
</tr>
<tr>
<td>Sum</td>
<td></td>
<td>11</td>
<td>11</td>
<td>X</td>
</tr>
</tbody>
</table>

Practical: Graded protocol (10-30 pages)
Optional courses in elective C: Cognitive and Theoretical Neuroscience

<table>
<thead>
<tr>
<th>INS C-0</th>
<th>Elective course</th>
<th>11 CP = 330 h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extern</td>
<td>Cognitive and</td>
<td>Contact study</td>
</tr>
<tr>
<td>Elective</td>
<td>theoretical</td>
<td>11 SWH / 165 h</td>
</tr>
<tr>
<td>Course</td>
<td>Neuroscience</td>
<td>11 CP</td>
</tr>
<tr>
<td>“Cognitive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>and</td>
<td></td>
<td></td>
</tr>
<tr>
<td>theoretical</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neuroscience”</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Content**

The course teaches basic methods and techniques in the field of cognitive or/and theoretical neuroscience. Students work on their own current projects under supervision and present the results in the form of a seminar presentation. The course can be offered by departments of Goethe University, by other universities in Germany and abroad as well as by non-university research institutions.

**Learning results / Competence objectives**

Students gain knowledge in conducting neuroscientific investigations in the field of cognitive neuroscience or/and knowledge in computer-based modeling of neurobiological questions. They are able to address scientific questions based on relevant literature.

**Requirements for participating**

none

**Helpful previous knowledge**

none

**Assignment of course (program/department)**

MSc Interdisciplinary Neuroscience / FB 15

**Suitable for other study programs**

Depending on provider

**Times offered**

Depending on provider

**Duration**

Depending on provider

**Person in charge**

Head of study program

**Semester-related proofs**

**Proof of participation**

regular participation

**Study achievements**

The regulations of the provider of the elective course 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 (20 minutes) and topical literature (20 minutes).

**Teaching forms**

Practical, seminar

**Tuition language**

Depending on provider

**Module exam**

**Form / duration / content (if applicable)**

The regulations of the provider of the elective course are applied. If grading is not scheduled by the provider, the module completion exam shows a graded protocol (10-30 pages).

**External elective course “Cognitive and theoretical Neuroscience”**

<table>
<thead>
<tr>
<th>Form of teaching</th>
<th>SWH</th>
<th>CP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>P</td>
<td>10</td>
</tr>
<tr>
<td>Seminar</td>
<td>S</td>
<td>1</td>
</tr>
<tr>
<td>Sum</td>
<td></td>
<td>11</td>
</tr>
</tbody>
</table>

**Semester**

1 2 3 4

X
Elective course

11 CP = 330 h

<table>
<thead>
<tr>
<th>Contact study</th>
<th>Self study</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 SWH / 165 h</td>
<td>165 h</td>
</tr>
</tbody>
</table>

Content

The practical course teaches basic techniques of non-invasive research of human cognitive functions. This includes behavioral studies or measurements of brain activity using electro/magnetoencephalography (EEG/MEG) or functional magnetic resonance imaging (fMRI). After a theoretical introduction to the methodological principles and the research question, students conduct their own experiments on questions of perception, attention or working memory. They will be made aware of the advantages and disadvantages of the respective research method and learn the basic evaluation steps. The questions to be worked on are based on current projects in the Institute of Medical Psychology.

Learning results / Competence objectives

The students have basic knowledge of the design and implementation of cognitive experiments in humans. They are familiar with behavioral or psychophysiological methods (fMRI, EEG, MEG) and are able to address scientific questions based on relevant literature.

Requirements for participating

none

Helpful previous knowledge

Basic knowledge in cognitive psychology

Assignment of course (program/department)

MSc Interdisciplinary Neuroscience / FB 15

Suitable for other study programs

in the summer semester

1 Semester (block course over 4 weeks)

Prof. Jochen Kaiser

Semester-related proofs

regular participation

Study achievements

Seminar: 1 talk (20 minutes) on the results of own experiments, 1 talk (20 minutes) on current literature

Teaching forms

Practical, seminar

Tuition language

English

Module exam

Form / duration / content (if applicable)

Practical: graded protocol (10-30 pages)

Non-Invasive Methods in Human Cognition Research

<table>
<thead>
<tr>
<th>Form of teaching</th>
<th>SWH</th>
<th>CP</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>P</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>Seminar</td>
<td>S</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Sum</td>
<td></td>
<td>11</td>
<td></td>
</tr>
</tbody>
</table>

42
Virtual Hippocampus – Introduction to Computational Neuroscience

<table>
<thead>
<tr>
<th>Elective course</th>
<th>11 CP (insg.) = 330 h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact study</td>
<td>11 SWH / 165 h</td>
</tr>
<tr>
<td>Self study</td>
<td>165 h</td>
</tr>
</tbody>
</table>

**Content**

The practical provides an overview of computational modeling of neural systems with particular emphasis on modeling of hippocampal neurons and networks. The course is an introduction to computational neuroscience, which studies the brain at different levels (from synapses and dendrites to neurons and neural circuits) using computer models. The goal is to learn standard techniques for the formation, management, and use of models that are closely linked to experimental data, especially those involving hippocampal cells with complex anatomical and biophysical properties. Planned computational experiments (in silico) include large-scale network simulations in biophysically realistic and data-driven models of the hippocampus, and single-cell simulations in morphologically reconstructed neurons in the hippocampus. The relevance of computational models to understanding brain function will be discussed using examples from recent research articles.

**Learning results / Competence objectives**

The students have basic knowledge of compartment and network modeling. They can use NEURON (software for biologically motivated simulations of neurons and networks of neurons, http://www.neuron.yale.edu/neuron) and are able to address scientific questions based on relevant literature.

**Requirements for participating**

None

**Helpful previous knowledge**

Programming experience

**Assignment of course (program/department)**

MSc Interdisciplinary Neuroscience / FB15

**Suitable for other study programs**

None

**Times offered**

Each semester

**Duration**

1 Semester (block course over 4 weeks)

**Person in charge**

Prof. Dr. Peter Jedlicka

**Semester-related proofs**

Regular participation

**Study achievements**

Seminar: 1 talk (20 minutes) on the results of own experiments, 1 talk (20 minutes) on current literature

**Teaching forms**

Practical, seminar

**Tuition language**

English

**Module exam**

Form / duration / content (if applicable)

Practical: graded protocol (10-30 pages) or programming task (1-30 pages)

**Virtual Hippocampus – Introduction to Computational Neuroscience**

<table>
<thead>
<tr>
<th>Form of teaching</th>
<th>SWH</th>
<th>CP</th>
<th>Semester 1</th>
<th>Semester 2</th>
<th>Semester 3</th>
<th>Semester 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>P</td>
<td>10</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seminar</td>
<td>S</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sum</td>
<td></td>
<td>11</td>
<td>11</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Content

The practical gives an insight into the research of the neuronal basis of higher cognitive performance on the basis of current projects in the area of working memory, language processing, movement perception or executive control, as well as partly also their development in children of primary school age. Depending on the current research projects, the practical course enables the students to participate in neurocognitive studies (fNIRS, fMRI, EEG, behavioral measurements) as well as in the field of data processing of neurophysiological data. The aim is to learn the theoretical background of the projects as well as the collection, analysis and interpretation of the corresponding data. In doing so, students are encouraged to work independently and to carry out parts of the study themselves.

## Learning results / Competence objectives

Students are familiar with cognitive and neurocognitive models as well as experimental psychological methods, and are familiar with the basics of collecting and analyzing neurocognitive data. They are able to address scientific questions based on relevant literature.

## Requirements for participating

None

## Helpful previous knowledge

Basic knowledge in Matlab, Python oder other programming skills

## Assignment of course (program/department)

MSc Interdisciplinary Neuroscience / FB15

## Suitable for other study programs

None

## Times offered

in the summer semester

## Duration

1 Semester (block course over 4 weeks)

## Person in charge

Prof. Christian Fiebach

## Proof of participation

regular participation

## Study achievements

Seminar: 1 talk (20 minutes) on the results of own experiments or on current literature

## Teaching forms

Practical, seminar

## Tuition language

English

## Module exam

Form / duration / content (if applicable)

Practical: graded protocol (10-30 pages)

### Module final exam consisting of:

<table>
<thead>
<tr>
<th>Cognitive Neuroscience – Higher Cognitive Functions</th>
<th>Form of teaching</th>
<th>SWH</th>
<th>CP</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>P</td>
<td>10</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Seminar</td>
<td>S</td>
<td>1</td>
<td>1</td>
<td>X</td>
</tr>
<tr>
<td>Sum</td>
<td></td>
<td>11</td>
<td>11</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
</tbody>
</table>

| Course Manual Master „Interdisciplinary Neuroscience“ | 1.8.2023 |
### Content

The practical introduces students to neural networks (cortical and subcortical) that are important for cognitive and sensorimotor processing. One focus is on the study of hemispheric lateralization, particularly with respect to language processing and motor control of hand movements. Another part of the group is concerned with the translation of the findings into immediate patient care, e.g. using closed-loop control.

Healthy volunteers and patients are studied with respect to their behavioral responses and using electro- and magnetoencephalographic techniques. In addition, electrocorticographic data are collected from patients during brain surgery or stereo-EEG in epilepsy patients.

Students become familiar with the methods used and acquire knowledge of the organizing principles of neuronal networks. Students will be assigned to a current project, will participate in data collection and/or analysis, and will attend weekly seminars.

### Learning results / Competence objectives

Students are familiar with the collection and evaluation of data sets from imaging procedures or neurophysiological experiments on healthy control subjects and patients and are able to address scientific questions based on relevant literature.

### Requirements for participating

- None

### Helpful previous knowledge

- Programming knowledge in Python and/or Matlab

---

<table>
<thead>
<tr>
<th>INS C-8 Systems Neuroscience – Sensorimotor and cognitive networks</th>
<th>Elective course</th>
<th>11 CP (insg.) = 330 h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensomotorische und kognitionstragende Netzwerke</td>
<td>Contact study 11 SWH / 165 h</td>
<td>Self study 165 h</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>The practical introduces students to neural networks (cortical and subcortical) that are important for cognitive and sensorimotor processing. One focus is on the study of hemispheric lateralization, particularly with respect to language processing and motor control of hand movements. Another part of the group is concerned with the translation of the findings into immediate patient care, e.g. using closed-loop control. Healthy volunteers and patients are studied with respect to their behavioral responses and using electro- and magnetoencephalographic techniques. In addition, electrocorticographic data are collected from patients during brain surgery or stereo-EEG in epilepsy patients. Students become familiar with the methods used and acquire knowledge of the organizing principles of neuronal networks. Students will be assigned to a current project, will participate in data collection and/or analysis, and will attend weekly seminars.</td>
</tr>
</tbody>
</table>

### Learning results / Competence objectives

Students are familiar with the collection and evaluation of data sets from imaging procedures or neurophysiological experiments on healthy control subjects and patients and are able to address scientific questions based on relevant literature.

### Requirements for participating

None

### Helpful previous knowledge

Programming knowledge in Python and/or Matlab

---

<table>
<thead>
<tr>
<th>Assignment of course (program/department)</th>
<th>MSc Interdisciplinary Neuroscience / FB15</th>
</tr>
</thead>
</table>

### Suitable for other study programs

Each semester

<table>
<thead>
<tr>
<th>Duration</th>
<th>1 Semester (Block course over 4-6 weeks)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Person in charge</th>
<th>PD Dr. Christian Kell</th>
</tr>
</thead>
</table>

### Semester-related proofs

- Proof of participation: regular participation
- Study achievements: Seminar: 1 talk (20 minutes) on the results of own experiments, 1 talk (20 minutes) on current literature

### Teaching forms

- Practical, seminar
- English

### Module exam

<table>
<thead>
<tr>
<th>Form / duration / content (if applicable)</th>
<th>Practical: graded protocol (10-30 pages)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Systems Neuroscience – Sensorimotor and cognitive networks</th>
<th>Form of teaching</th>
<th>SWH</th>
<th>CP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>P</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Seminar</td>
<td>S</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Sum</td>
<td></td>
<td>11</td>
<td>11</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Semester</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

---

45
Computational neuroanatomy – quantitative analysis and modelling

Content

Based on neuroanatomical data obtained thanks to state-of-the-art developments in microscopy technology and neurogenetic techniques, models are created with a focus on dendritic and axonal interactions. Image processing techniques and quantitative analysis methods are applied in the computer to digitize anatomical components from the microscopy images. The digital form then allows measured geometric properties to be assigned biophysical principles. For example, time-lapse methods can be used to observe and measure the precise assembly of neurons into circuits during development. The structure of dendrites and axons then allows conclusions to be drawn about the interconnection and functioning of circuits in the nervous system. The laws learned from this are then tested in simple quantitative models. This course on computational neuroanatomy thus bridges the gap between data analysis and the design of a scientific theory using simple computer models.

Learning results / Competence objectives

The participants are able to deal scientifically with biological data using quantitative methods (incl. use of Matlab). Furthermore, they will be able to create simple models that are strongly related to the biological data. The projects will be approaches from current research topics of the group.

Requirements for participating

None

Helpful previous knowledge

Programming skills (e.g. Python, Matlab, Java)

Assignment of course (program/department)

MSc Interdisciplinary Neuroscience / FB15

Suitable for other study programs

Each semester

Duration

1 Semester (block course over 4 weeks)

Person in charge

Dr. Hermann Cuntz

Semester-related proofs

Proof of participation

Regular participation

Study achievements

Seminar: 1 talk (20 minutes) on the results of own experiments, 1 talk (20 minutes) on current literature

Teaching forms

Practical, seminar

Tuition language

English

Module exam

Form / duration / content (if applicable)

Practical: graded protocol (10-30 pages) or programming task (1-30 pages)

Computational neuroanatomy – quantitative analysis and modelling

<table>
<thead>
<tr>
<th>Form of teaching</th>
<th>SWH</th>
<th>CP</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>P</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>Seminar</td>
<td>S</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Sum</td>
<td></td>
<td>11</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CP</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
</tr>
</tbody>
</table>

11 CP (insg.) = 330 h

Contact study

11 SWH / 165 h

Self study

165 h
The practical provides an introduction to the development and implementation of computational models of neural networks and the modeling of neural plasticity mechanisms. The course is a hands-on introduction to core computational neuroscience methods that use computational models to study the workings of the brain at various levels. Standard neuron models and network architectures are programmed and analyzed by the students themselves. The focus is on the role of plasticity mechanisms, their influence on network dynamics, and their role in learning processes. The possibilities and limitations of computer models for understanding brain function are discussed using examples from the literature.

Learning results / Competence objectives
The students have knowledge in programming computer models of neuron networks, as well as of different plasticity mechanisms and learning processes. They are able to work on a scientific problem against the background of relevant literature.

Requirements for participating
Please consult with the person in charge before applying regarding prior experience.

Helpful previous knowledge
Programming skills 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 of linear algebra, probability, differential equations, numerical methods.

Assignment of course (program/department)
MSc Interdisciplinary Neuroscience / FB15

Suitable for other study programs
in the summer semester

Duration
1 Semester (block course over 4 weeks)

Person in charge
Prof. Dr. Jochen Triesch

Semester-related proofs
regular participation

Study achievements
Seminar: 1 talk (20 minutes) on the results of own experiments

Teaching forms
Practical, seminar

Tuition language
English

Module exam

<table>
<thead>
<tr>
<th>Module final exam consisting of:</th>
<th>Form / duration / content (if applicable)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>Practical: graded protocol (10-30 pages) or programming task (1-30 pages)</td>
</tr>
<tr>
<td>Seminar</td>
<td></td>
</tr>
<tr>
<td>Sum</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Computational Modeling of Neuronal Plasticity</th>
<th>Form of teaching</th>
<th>SWH</th>
<th>CP</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>P</td>
<td>10</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Seminar</td>
<td>S</td>
<td>1</td>
<td>1</td>
<td>X</td>
</tr>
<tr>
<td>Sum</td>
<td></td>
<td>11</td>
<td>11</td>
<td></td>
</tr>
</tbody>
</table>

1 2 3 4
Content

This practical provides an introduction to hands-on research in human cognitive science, also known as cognitive psychology. In particular, participants will have the opportunity to gain hands-on experience designing, programming, conducting, and analyzing experiments in the areas of visual attention, scene perception, and memory.

Depending on current research projects in the Scene Grammar Lab, students may participate in neurocognitive studies using EEG, eye tracking (both stationary and using mobile ET glasses), and/or psychophysical methods. The goal of the seminar is to acquire theoretical background knowledge on the projects, as well as practical skills such as data collection and analysis, and interpretation of the results.

Learning results / Competence objectives

Students have acquired the theoretical background knowledge in the areas of attention, perception, and memory, as well as learned methods of experimental psychology, basics of collecting and analyzing (neuro)cognitive data, how to perform basic statistical analyses, and how to write a scientific article.

Requirements for participating

none

Helpful previous knowledge

Basic knowledge of Matlab/Python and statistical data analysis with "R".
Further useful information can also be found on the website: www.SceneGrammarLab.com.

Assignment of course (program/department)

MSc Interdisciplinary Neuroscience / FB 15

Suitable for other study programs

In the winter semester

Duration

1 Semester (block course over 6 weeks)

Person in charge

Prof. Melissa Vo

Semester-related proofs

regular participation

Proof of participation

Seminar: 1 talk (20 minutes) on the results of own experiments

Study achievements

Practical, seminar

Teaching forms

English

Tuition language

Module exam

Form / duration / content (if applicable)

Practical: graded protocol (10-30 pages) or project report (10-30 pages)

Cognitive Psychology – Attention, Perception & Memory

Form of teaching

SWH

CP

Semester

1

2

3

4

Practical

P

10

10

Seminar

S

1

1

Sum

11

11

Contact study

11 SWH / 165 h

Self study

165 h

11 CP
Content

Our brain is highly plastic and undergoes dynamic changes across the lifespan. These developmental changes are reflected in modifications of cognitive functions, such as learning and memory. In our lab, we are interested in how the human brain and cognitive systems develop throughout the lifespan, particularly in how age-related neurocognitive changes influence the way we learn and extract regularities from the environment and our ability to create memories of unique experiences.

For this, we conduct experiments in which we test participants of different age groups, using cognitive tasks designed to tap into specific processes involved in learning and memory. Depending on the stage of the experiment that you will work on, you may get experience in programming cognitive tasks, Matlab/Python/R programming, processing of behavioural/neuroimaging data, and/or conducting statistical/computational model analyses.

Learning results / Competence objectives

Students will be familiar with various techniques used to collect experimental human data: cognitive tasks to collect behavioral data from participants, neuroimaging data while participants are performing tasks, and/or computer modeling of participant data. In addition, students will be able to design and program cognitive tasks, and have learned various methods for data analysis, for which they will use Matlab/Python/R programming. Students have worked in an international environment and are able to present and communicate their results in English.

Requirements for participating

none

Helpful previous knowledge

none

Assignment of course (program/department)

MSc Interdisciplinary Neuroscience / FB 15

Suitable for other study programs

Each semester

Duration

1 Semester (Block course over 4 weeks full-day, or 8 weeks half-day)

Person in charge

Prof. Dr. Yee Lee Shing

Semester-related proofs

Proof of participation: regular participation

Study achievements

Seminar: 1 talk (20 minutes) on the results of own experiments and on current literature

Teaching forms

Practical, seminar

Tuition language

English

Module exam

Form / duration / content (if applicable)

Practical: graded protocol (10-30 pages)

Module final exam consisting of:

<table>
<thead>
<tr>
<th>Developmental cognitive neuroscience</th>
<th>Form of teaching</th>
<th>SWH</th>
<th>CP</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>P</td>
<td>10</td>
<td>10</td>
<td>X</td>
</tr>
<tr>
<td>Seminar</td>
<td>S</td>
<td>1</td>
<td>1</td>
<td>X</td>
</tr>
<tr>
<td>Sum</td>
<td></td>
<td>11</td>
<td>11</td>
<td></td>
</tr>
</tbody>
</table>

49
Content
Our lab studies basic human cognitive processes such as attention and working memory and how these cognitive processes affect our basic perception of the world. Consequently, most of this work uses the human visual system as the basis for such questions because the visual system is well defined and it can be imaged in humans using non-invasive imaging techniques such as fMRI. In this course, students will work with members of the lab to define a research project. Possible research projects could range from designing and programming experiments to collecting behavioral and/or neuroimaging data (EEG or MEG) to using computational techniques to analyze these data. The analysis of fMRI data is also possible.

Learning results / Competence objectives
Students are familiar with the many aspects of cognitive neuroscience research. They have learned about both cognition (e.g., attention, working memory, etc.) and the visual system (e.g., retinotopic organization in cortex, tuning properties of early sensory neurons, etc.) and computational approaches (e.g., multivariate analysis, simulations, etc.). They have experience with all techniques used in the laboratory including fMRI, MEG, psychophysics, data analysis, and computational modeling. Students operate in a close and very international environment, with ample opportunity to perfect both their social and scientific communication skills in English.

Requirements for participating

Helpful previous knowledge
Programming skills (Matlab oder Python)

Assignment of course (program/department) Interdisciplinary Neuroscience / FB 15

Suitable for other study programs

Times offered Each semester

Duration 1 Semester (block course over 4 weeks)

Person in charge Dr. Rosanne Rademaker

Teaching forms
Practical, seminar

Tuition language English

Module exam consisting of:

Cognitive and perceptual processes in the human brain

<table>
<thead>
<tr>
<th>Form of teaching</th>
<th>SWH</th>
<th>CP</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>P</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Seminar</td>
<td>S</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Sum</td>
<td></td>
<td>11</td>
<td>11</td>
</tr>
</tbody>
</table>

Module final exam consisting of:

Form / duration / content (if applicable)
Practical: graded protocol (10-30 pages)
Optional courses in elective D: Applied Aspects of Neuroscience

<table>
<thead>
<tr>
<th>INS D-0</th>
<th>External Elective Course “Applied Aspects of Neuroscience”</th>
<th>Elective course</th>
<th>11 CP = 330</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Contact study</td>
<td>Self study</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11 SWH / 165 h</td>
<td>165 h</td>
</tr>
</tbody>
</table>

Content
This elective course teaches basic methods and techniques in applied areas of neuroscience. Students work on their own projects under supervision and present the results in the form of a seminar presentation. The course can be offered by departments of Goethe University, by other universities in Germany and abroad as well as by non-university research institutions.

Learning results / Competence objectives
Students have knowledge in conducting scientific investigations in the field of applied neuroscience. They are able to work on scientific questions against the background of relevant literature.

Requirements for participating
none

Helpful previous knowledge
none

Assignment of course (program/department) Interdisciplinary Neuroscience / FB 15

Suitable for other study programs

Times offered
Depending on provider

Duration
Depending on provider

Person in charge
Head of study program

Semester-related proofs

Proof of participation
regular participation

Study achievements
The regulations of the provider of the elective course 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 (20 minutes) and topical literature (20 minutes).

Teaching forms
Practical, seminar

Tuition language
Depending on provider

Module exam

Module final exam consisting of:

<table>
<thead>
<tr>
<th>External elective course “Applied Aspects of Neuroscience”</th>
<th>Form of teaching</th>
<th>SWH</th>
<th>CP</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Practical</td>
<td>P</td>
<td>10</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Seminar</td>
<td>S</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Sum</td>
<td></td>
<td>11</td>
<td>11</td>
<td></td>
</tr>
</tbody>
</table>
The course includes the components seminar, practical & excursion. In the seminar, basic aspects and current topics of zoo biology are taught at the beginning using original papers, which are presented by the students in a lecture and then discussed. The excursions to different zoos and the research practical at the Opel Zoo serve to deepen theoretical foundations. Emphasis is placed on ecological, physiological and ethological research contexts. Other topics include: Historical development of zoos, zoos & species conservation, population biology & breeding programs in zoos, animal husbandry (nutrition, behavior, enrichment, community husbandry), veterinary basics, organization and structural development, enclosure design and planning, educational work in zoos. The methodological approach to the practical course components includes, depending on the chosen content focus, classical and modern methods of behavioral research, laboratory activities (microscopic and physiological examinations), imaging techniques (e.g. thermographic measurements with infrared cameras or video analyses with high-speed cameras).

### Learning results / Competence objectives

The students have knowledge in basic contents of zoo biology (behavioral research in zoos, enrichment, animal husbandry, species protection aspects) and in the application of modern imaging techniques (thermography, high-speed cameras). They have methodological knowledge to conduct behavioral studies and are able to address scientific questions against the background of relevant literature.

### Requirements for participating

none

### Helpful previous knowledge

none

### Assignment of course (program/department)

MSc Interdisciplinary Neuroscience / FB15

### Times offered

in the summer semester

### Duration

1 Semester (block course over 5 weeks)

### Person in charge

Prof. Paul Dierkes

### Module exam

Form / duration / content (if applicable)

Practical: graded protocol (10-30 pages)

### Teaching forms

Seminar, Practical, Excursion

### Tuition language

English

<table>
<thead>
<tr>
<th>Behavioral Biology in Zoos</th>
<th>Form of teaching</th>
<th>SWH</th>
<th>CP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>P</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Seminar</td>
<td>S</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Exkursion</td>
<td>Ex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sum</td>
<td></td>
<td>11</td>
<td>11</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Semester</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

52
### Content

Courses from all departments of Goethe University can be credited. Courses from the departments of Computer Science and Mathematics (FB12), Biochemistry, Chemistry and Pharmacy (FB14), Biosciences (FB15), Philosophy and Historical Sciences (FB8), Psychology and Sports Sciences (FB5) seem to be particularly suitable. The module can also be from other universities in Germany and abroad. Alternatively, a business or research practical (4-6 weeks) can be carried out in a university or non-university research institution or company.

### Learning results / Competence objectives

See description of the selected module

### Requirements for participating

none

### Helpful previous knowledge

none

### Assignment of module (program / department)

Interdisciplinary Neuroscience / FB 15

### Suitable for other study programs

Times offered

Depending on provider

### Duration

Depending on provider

### Person in charge

Head of study program

### Semester-related proofs

Proof of participation

regular participation

### Study achievements

The regulations of the provider of the course are applied. If grading is not scheduled by the provider, the module completion exam shows a graded protocol (10-30 pages).

### Teaching forms

Practical, Übung, Vorlesung, Seminar, Exkursion

### Tuition language

Je nach Anbieter

### Module exam

Module final exam consisting of:

The regulations of the provider of the course are applied. If grading is not scheduled by the provider, the module completion exam shows a graded protocol (10-30 pages).

### Free-choice studies

<table>
<thead>
<tr>
<th>Form of teaching</th>
<th>SWH</th>
<th>CP</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical, tutorial, lecture, seminar, excursion</td>
<td>P, Ü, V, S, Ex</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>Sum</td>
<td></td>
<td>11</td>
<td>X</td>
</tr>
</tbody>
</table>

### Module exam

Form / duration / content (if applicable)

<table>
<thead>
<tr>
<th>Form / duration / content (if applicable)</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

1.8.2023