Module Catalog

Elite Graduate Program

“Biomedical Neuroscience”

(M.Sc.)

Technical University of Munich

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Module description: Molecular Neuroscience

Module number:	ME BmN 001
Module name (Ger.):	Molekulare Neurowissenschaften
Module name (Eng.):	Molecular Neuroscience
Module level:	Master
Abbreviation:	MNs
Duration:	1
Frequency:	WS
Language:	English
Credits:	5

Workload

Total hours:	150
Contact hours:	60
Self-study hours:	90

Coursework and Examination Requirements:

Description of coursework and examination requirements:

There will be a written exam (60 min) consisting of free text and multiple choice questions. In this exam it will be tested whether the students understand the function of brain cells at the molecular level. Furthermore in this exam the students have to apply their knowledge about modern methods, like protein purification, cloning strategies and immunoblots by describing experimental strategies to given tasks at a theoretical level.

Repeat examination in following semester:	yes
Repeat examination at end of semester:	yes

Description:

(Recommended) Prerequisites:	none

Learning outcomes:

The focus of this module is to understand a) the function of the brain on the molecular level and b) modern biochemical and molecular biological tools used in science. After this module the students have essential knowledge in neurobiochemistry, including neurons and glial cells and a detailed knowledge about membrane biophysics and important signaling pathways and receptors in the nervous system. They are able to apply this knowledge in problem-solving tasks on a theoretical level .Furthermore, they have an overview about experimental strategies to detect proteins with key functions in the nervous system. Finally, they are able to develop strategies to answer scientific questions, by choosing the appropriate techniques and by planning suitable experiments for example to detect, purify, and analyze a specific intracellular protein.

Teaching/Learning methods:

Teaching will be performed in a three step process for each topic of the module. The first step is preparatory build-up of knowledge by eLearning using the method “Just-in-Time-teaching”. After that consolidation of the knowledge will be achieved in face-to-face focus seminars with experts and finally there will be application of the knowledge in problem-solving application tutorials. Activating learning methods like peer instruction are used to design learner-centered lessons.

Content:

The specific topics in this module are:

- Neurobiochemistry of neurons and glial cells.
- Major receptors and signaling pathways in the nervous system.

- Protein synthesis, modification, aggregation and degradation.
- Membrane biophysics.
- Relevant analytical techniques for neuroscience research, like mass spectrometry, immunoblots, organelle and protein purification.

Media:
eLearning platform, power-point presentations, white board

Module coordinator:

First name:	Stefan
Last name:	Lichtenthaler

Course:

Type:	Lecture/Seminar
Title:	Molecular Neuroscience
Hrs per week per semester	4
Lecturer (first name and last name):	Stefan Lichtenthaler and others

Module description: Cellular Neuroscience

Module number:	ME BmN 002
Module name (Ger.):	Zelluläre Neurowissenschaften
Module name (Eng.):	Cellular neuroscience
Module level:	Master
Abbreviation:	CNs
Duration:	1
Frequency:	WS
Language:	English
Credits:	5

Workload

Total hours:	150
Contact hours:	60
Self-study hours:	90

Coursework and Examination Requirements:

Description of coursework and examination requirements:

The written module examination (60 min.) consists of free text and multiple choice questions and tests whether the students understand the general cell biology of the nervous system. Furthermore in this exam the students have to apply their knowledge to answer questions related to different model organisms used in the context of cellular neuroscience.

Repeat examination in following semester:	yes
Repeat examination at end of semester:	yes

Description:

(Recommended) Prerequisites:	none

Learning outcomes:

The students understand the general cell biology of the cells of the nervous system, including neurons and glia. They are able to explain the structure and function of the different cell types and their subcellular structures. Furthermore, they understand the principles and mechanisms of signal transduction and communication between the cells in the nervous system. After successful completion of the module, students are able to apply the content covered to problems in the context of Cellular Neuroscience.

Teaching/Learning methods:

Teaching will be performed in a three step process for each topic of the module. The first step is preparatory build-up of knowledge by eLearning using the method “Just-in-Time-teaching”. After that consolidation of the knowledge will be achieved in face-to-face focus seminars with experts and finally there will be application of the knowledge in problem-solving application tutorials. Activating learning methods like peer instruction are used to design learner-centered lessons.

Content:

The specific topics in this module are:

- Basic of neuronal cell biology.
- Physiology of different types of neurons and glial cells.
- Modern approaches to neuronal cell biology – methods and model organisms.
- Mechanisms of neuronal signaling and communication

Media:

eLearning platform, power-point presentations, white board

Module coordinator:

First name:	Helmuth
Last name:	Adelsberger

Course:

Type:	Lecture/Seminar
Title:	Cellular neuroscience
Hrs per week per semester	4
Lecturer (first name and last name):	Helmuth Adelsberger and others

Module description: Neuroanatomy and Neuropathology

Module number:	ME BmN 003
Module name (Ger.):	Neuroanatomie und Neuropathologie
Module name (Eng.):	Neuroanatomy and Neuropathology
Module level:	Master
Abbreviation:	NaNP
Duration:	1
Frequency:	WS
Language:	English
Credits:	5

Workload

Total hours:	150
Contact hours:	60
Self-study hours:	90

Coursework and Examination Requirements:

Description of coursework and examination requirements:

There will be a written exam (60 min) in which the students have to answer question in free text and multiple choice format. Passing this exam requires understanding of the anatomy and histology of the central nervous system with reference to disease processes. Furthermore the students have to apply their knowledge by answering to questions regarding the principles to generate and analyze disease models at a theoretical level, like the generation of transgenic mice.

Repeat examination in following semester:	yes
Repeat examination at end of semester:	yes

Description:

(Recommended) Prerequisites:	none

Learning outcomes:

After this module the students know the cell biological, histological and anatomic basis of neurological disease pathogenesis. They have a basic understanding of neuropathology and understand the strategies and techniques used to model disease from cells to vertebrate organisms. Furthermore they know examples of sensory information processing and plasticity mechanisms

Teaching/Learning methods:

Teaching will be performed in a three step process for each topic of the module. The first step is preparatory built-up of knowledge by eLearning using the method “Just-in-Time-teaching”. After that consolidation of the knowledge will be achieved in face-to-face focus seminars with experts and finally there will be application of the knowledge in problem-solving application tutorials. Activating learning methods like peer instruction are used to design learner-centered lessons.

Content:

The specific topics in this module are:

- Gross and fine anatomy of the nervous system of vertebrates.
- Basic principle of neuropathology.
- Disease modelling: Principles and approaches.
- Insights into plasticity mechanisms and processing of sensory information

Media:

eLearning platform, power-point presentations, white board

Module coordinator:

First name:	Thomas
Last name:	Misgeld

Course:

Type:	Lecture/Seminar
Title:	Neuroanatomy and Neuropathology
Hrs per week per semester	4
Lecturer (first name and last name):	Thomas Misgeld and others

Module description: Molecular biology and –omics approaches

Module number:	ME BmN 004
Module name (Ger.):	Molekularbiologie und –omik Technologien
Module name (Eng.):	Molecular biology and –omics approaches
Module level:	Master
Abbreviation:	MoA
Duration:	1
Frequency:	WS
Language:	English
Credits:	5

Workload

Total hours:	150
Contact hours:	60
Self-study hours:	90

Coursework and Examination Requirements:

Description of coursework and examination requirements:

During the course the students have to demonstrate that they understand modern biochemical and molecular biology methods like amplification of plasmid DNA, construction of viral expression systems and others. For this they have to perform 6 – 12 practical tasks in which they have to apply the suitable methods to study proteins in the nervous system and analyze the results of their experimental work. Appropriate performance in these tasks is the requirement to pass the course.

Repeat examination in following semester:	yes
Repeat examination at end of semester:	yes

Description:

(Recommended) Prerequisites:	none

Learning outcomes:

After this module the students understand the principles of biochemical analysis and handling of biological macromolecules, in particular proteins and DNA, but also RNA. Typical methods include electrophoresis, immunoblots and amplification/digestion of plasmid DNA. In addition the students know the function of mass spectrometers and examples of applications for protein analytics. The students also understand how to overexpress and how to switch off (knock-down/knock-out) genes and proteins in cell lines and primary cells from the nervous system, including the use of viral systems for optogenetics and genetically encoded activity sensors. Furthermore, the students are able to culture a mammalian cell line. At the end of the course the students know the strengths and limitations of the different methods used to detect biological macromolecules.

Teaching/Learning methods:

Teaching in the course will be performed by a combination of theoretical parts giving insights in the technical and conceptual principle of different methods to detect and study biological macromolecules and a hands-on training in the laboratory. In this practical part the students will do protein and DNA analytics and apply them to standard experiments. The course structure of the theoretical part is designed by the method “Just-in-Time-teaching”. Activating learning methods like peer instruction are used to design learner-centered lessons.

Content:

The specific topics in this module are:

- Basis of mammalian cell culture

- Handling, analysis and amplification of plasmid DNA
- Protein analytics including immunoblots
- Viral expression systems
- Methods for sample preparation for mass spectrometric analysis

Media:
eLearning platform, hands-on training, power-point presentations, white board, script

Module coordinator:

First name:	Stefan
Last name:	Lichtenthaler

Course:

Type:	Practical course
Title:	Molecular biology and –omics approaches
Hrs per week per semester	4
Lecturer (first name and last name):	Stefan Lichtenthaler and others

Module description: Microscopy of nervous system structure

Module number:	ME BmN 005
Module name (Ger.):	Strukturelle Mikroskopie des Nervensystems
Module name (Eng.):	Microscopy of nervous system structure
Module level:	Master
Abbreviation:	MNSS
Duration:	1
Frequency:	WS
Language:	English
Credits:	5

Workload

Total hours:	150
Contact hours:	60
Self-study hours:	90

Coursework and Examination Requirements:

Description of coursework and examination requirements:

During this course the students have to demonstrate that they understand the basis of optics, wide field and fluorescence microscopy, as well as the physics and applications of clinical imaging modalities. They have to apply the gained knowledge to assemble and use the equipment for basic optical experiments, for different microscopes (wide field, fluorescence and confocal laser scanning) and the processing and labeling of biological tissues in 6-12 practical tasks.

Appropriate performance in these tasks is the requirement to pass the course.

Repeat examination in following semester:	yes
Repeat examination at end of semester:	yes

Description:

(Recommended) Prerequisites:	none

Learning outcomes:

After this module the students know the principles of conventional optics and of wide-field microscopy. Furthermore they are able to explain the basis of conventional, fluorescence and laser scanning microscopy and to use these systems for scientific purposes. This includes the different options for excitation and detection of fluorescence. The students are also able to process biological tissues and to perform important histological techniques, e.g. immunohistochemistry and in situ hybridization.

Teaching/Learning methods:

Teaching in the course will be performed by a combination of theoretical parts giving insights in the technical principles of basic optics and different methods of light microscopy and a hands-on training in the laboratory. Furthermore the students will have a theoretical and practical training in histological methods. In the theoretical parts “Just in Time teaching” and activating learning methods like peer instruction are used to design learner-centered lessons.

Content:

The specific topics in this module are:

- Basic optics and wide-field microscopy
- Fluorescence and confocal scanning microscopy
- Systems for excitation and detection of fluorescence signals
- Preparation and fixation of biological tissues

- Histological techniques

Media:

eLearning platform, hands-on training, power-point presentations, white board, script

Module coordinator:

First name:	Thomas
Last name:	Misgeld

Course:

Type:	Practical course
Title:	Microscopy of nervous system structure
Hrs per week per semester	4
Lecturer (first name and last name):	Thomas Misgeld and others

Module description: Scientific Practice

Module number:	ME BmN 006
Module name (Ger.):	Wissenschaftliche Praxis Teil 1: Wissenschaftliche Denkweisen und Methoden Teil 2: Wissenschaftliche Ethik, Projektplanung und Dissemination
Module name (Eng.):	Scientific Practice Part I: Scientific Thinking and methods Part II: Scientific Ethics, Project planning and dissemination
Module level:	Master
Abbreviation:	SP
Duration:	2
Frequency:	WS (Part I) / SS (Part II)
Language:	English
Credits:	4
Workload	
Total hours:	120
Contact hours:	30
Self-study hours:	90

Coursework and Examination Requirements:

Description of coursework and examination requirements:

The module has two parts. It is assessed through **one oral exam** at the end of part II. Passing this exam requires a detailed knowledge and an overview of the relations between the topics of the module. The students should demonstrate that they understand the concepts covered and that they are able to answer questions by transferring their knowledge.

Repeat examination in following semester:	yes
Repeat examination at end of semester:	yes

Description:

(Recommended) Prerequisites:	none

Learning outcomes:

Upon successful completion of the seminar "Scientific Practice" students are able…

- to elaborate upon the basic scientific concepts like experiment, induction, deduction, hypothesis, falsification, model, theory, empirical science, deductive science.
- to describe problems which can be dealt with through science and to outline problem solving strategies and heuristic principles to solve these problems.
- to understand quality criteria of scientific research (i. e. validity , reliability, objectivity).
- to describe and apply methodological principles of various disciplines in natural sciences and humanities and to explain differences and distinctive features.
- to explain potentials and limitations of scientific enquiry.
- to analyze scientific argumentation and to evaluate own and other research in a critical manner.
- to understand principles and rules of good scientific practice.
- to reflect and discuss principles of research ethics.

- to describe major steps in planning a scientific project.
- to apply principles of presenting, communicating and disseminating science.
- to apply principles of good scientific writing.

Teaching/Learning methods:
The seminar is characterized by a mixture of lectures, interactive single and group work activities and established didactical methods like think pair share, peer instruction, group discussion et cetera. For some topics, the *teaching/learning method* just in time teaching is used.

Content:
The purpose of this course is to train students in key aspects of scientific practice. The main topics represent key competencies for professional scientific work, like principles of scientific enquiry, general problem solving strategies, good scientific practice, principles of project planning, strategies for scientific communication and dissemination and ethical principles as the overarching issue. Oftentimes, these competencies are developed indirectly through scientific practice. However, in this course, these transferable skills are the main educational objectives that students focus upon. This module connects its topics towards issues covered in other modules in the MSc BMNS program. In this way, the module supplements and connects the other modules, highlights different topics and hence fosters the development of a more differentiated picture.
The module is divided in two parts. The first part of the module focuses on scientific thinking and methods. The second part focuses on ethical and pragmatic aspects of planning and performing a scientific project.

Media:
Visual media, film; reader, PowerPoint, whiteboard, flipchart; exercise sheets, Moodle

Module coordinator:

First name:	Michael
Last name:	Brunnhuber

Course:

Type:	Seminar
Title:	*Scientific Practice*
Hrs per week per semester	1
Lecturer (first name and last name):	Michael Brunnhuber, Martin Gartmeier and others

Module description: Life & Science

Module number:	ME BmN 007
Module name (Ger.):	Leben & Wissenschaft – Kultur- und geisteswissenschaftliche Studien für die Neuro- und Lebenswissenschaften
Module name (Eng.):	Life & Science – Cultural Studies and Humanities for the Neuro- and Life Sciences
Module level:	Master
Abbreviation:	LaS
Duration:	2
Frequency:	WS (Part I) / SS (Part II)
Language:	English
Credits:	6
Workload	
Total hours:	180
Contact hours:	30
Self-study hours:	150

Coursework and Examination Requirements:

Description of coursework and examination requirements:

This module is assessed through four written tasks. Every student has to write two position papers and two comments, one of each in each of the two seminars.

Each position paper has about 5.000 characters and refers to the topic of the coming session. It must be submitted to teachers and peers at least one week in advance to the coming session, in which it will be part of the classroom discussion. To fulfil this task students have to show a thorough study of the respective topic and contribute a single-handed personal statement and an opening question for the classroom discussion.

Each comment has about 15.000 characters and has to refer to the topic of the past session. It must be submitted to teachers and peers at least two weeks after this past session. To fulfil this task students have to give a short summary of the past session as well as a single-handed personal statement concerning the results of this session based on a self-critical awareness of their own position and perspective.

Each of the two position papers represents 20% of the final grade, each of the two comments 30%.

Repeat examination in following semester:	no
Repeat examination at end of semester:	yes

Description:

(Recommended) Prerequisites:	none

Learning outcomes:

Upon successful completion students are able

- to identify the differences and interrelations between individual, cultural, social and scientific knowledge
- to compare and outline different and ambiguous perceptions and conceptions of e.g. “truth” and “science”, “consciousness” and “perception”, “life” and “being”
- to understand how varying personal, natural, cultural, social-political, economical, technical and linguistic conditions and factors affect the generation of knowledge and its results
- to analyze the possible personal, cultural, social-political, economical and environmental consequences of scientific actions and results

- to deconstruct established forms of knowledge, standard (scientific) thinking and text-book operations as well as paradigms, implicit presupposition and convictions of what e.g. “truth”, “consciousness” or ”life” is and/or has to be
- to monitor and reflect their own position and perspective as well as their personal and professional development
- to discuss challenging topics in a well-considered and open minded manner

Teaching/Learning methods:

Every session of the two seminars has at least one certain theoretical and/or artistic impulse (text, image, film or else) as its starting and its focal point. The students are encouraged to closely examine the impulse(s) at home as preparation for the session. During the session the students will discuss the impulse(s) and the results of their examinations with their peers and teachers and will further be stimulated through a certain reflective or creative task to develop a personal statement regarding the topic of the session. Finally the students bring their statements up for an open discussion.

Content:

This module aims at supplementing the personal and professional development of the students with a far-reaching critical understanding of both science and life, in order to cultivate a well-considered and responsible professional identity. Therefore it is divided into two seminars:

(I) ‘What is (Life) Science?’ focuses on the terms, conditions and consequences of scientific observation and scientific knowledge taking into consideration epistemological, historical, cultural, social-political, anthropological and technical aspects. Students will observe, reconstruct and reflect scientific “findings” and lines of reasoning and thereby analyze the crucial factor of human subjectivity in any emergence of human knowledge.

(II) ‘What is Life?’ focuses on the very subject of all life sciences by using primarily literary fiction, art pieces and film scenes as vivid impulses for challenging bioethical questions and ambiguous perceptions and conceptions of "life". Students will analyze and outline these challenges and ambiguities and develop and discuss their own answers and solutions while taking into account the many differences "life" is composed of.

Media:

Visual media, film; reader, PowerPoint, whiteboard, flipchart; exercise sheets

Module coordinator:

First name:	Daniel
Last name:	Teufel

Course:

Type:	Seminar
Title:	*Life & Science – Cultural Studies and Humanities for the Neuro- and Life Sciences*
Hrs per week per semester	1
Lecturer (first name and last name):	Daniel Teufel and others

Module description: Lab visits I-IV

Module number:	ME BmN 008
Module name (Ger.):	Laborbesuche I-IV
Module name (Eng.):	Lab visits I-IV
Module level:	Master
Abbreviation:	LV
Duration:	3
Frequency:	WS/SS
Language:	English
Credits:	4

Workload

Total hours:	120
Contact hours:	112
Self-study hours:	8

Coursework and Examination Requirements:

Description of coursework and examination requirements:

The students have to hand in 4 written reports with a length of 2-4 pages including figures. With this reports the students demonstrate that they gained deeper knowledge of specific techniques used in neuroscience, like fluorescence imaging or electrophysiology.

Repeat examination in following semester:	yes
Repeat examination at end of semester:	*yes*

Description:

(Recommended) Prerequisites:	none

Learning outcomes:

After this module the students have detailed knowledge of different modern methods in neuroscience, including application examples and limitations. Furthermore they are able to choose appropriate methods to address specific scientific questions.

Teaching/Learning methods:

The students will have intensive hands on training under close supervision of experienced scientists. The scientists will teach the students in both theory and practice of the specific methods they have chosen.

Content:

The students select the laboratories for their visits according to their individual preferences and interests by direct interaction with the group leaders. These choices define the specific methods in which they will gain theoretical and practical experience. During their stays the students will be integrated in the groups and participate in lab meetings and other scientific events.

Media:

practical lab work, hands-on training, scientific literature, eLearning platform

Module coordinator:

First name:	Helmuth
Last name:	Adelsberger

Course:

Type:	Lab visits
Title:	Lab visits I-IV
Hrs per week per semester	2

Lecturer (first name and last name):	Helmuth Adelsberger and others

Module description: Systems and Behavior

Module number:	ME BmN 009
Module name (Ger.):	Systemische Neurowissenschaften und Verhalten
Module name (Eng.):	Systems and Behavior
Module level:	Master
Abbreviation:	SaB
Duration:	1
Frequency:	SS
Language:	English
Credits:	5

Workload

Total hours:	150
Contact hours:	60
Self-study hours:	90

Coursework and Examination Requirements:

Description of coursework and examination requirements:

There will be a written exam (60 min) consisting of free text and multiple choice questions. In this exam it will be tested whether the students understand the development of different brain structures and the generation of connectivity. Furthermore, they have to understand modern methods to study brain activity strategies to analyze the phenotype of control and disease model systems.

Repeat examination in following semester:	yes
Repeat examination at end of semester:	yes

Description:

(Recommended) Prerequisites:	none

Learning outcomes:

They are able to explain how during development this diversity of cell types arises, how cells connect to form circuits to build and maintain a plastic nervous system. The students can also describe how such insights arose from the study of model organisms, and they can explain methods and principles of neurodevelopmental biology. Furthermore, they have an overview about strategies to study impairments of normal brain function in animal models.

Teaching/Learning methods:

Teaching will be performed in a three step process for each topic of the module. The first step is preparatory build-up of knowledge by eLearning using the method “Just-in-Time-teaching”. After that consolidation of the knowledge will be achieved in face-to-face focus seminars with experts and finally there will be application of the knowledge in problem-solving application tutorials. Activating learning methods like peer instruction are used to design learner-centered lessons.

Content:

The specific topics in this module are:

- Principles of neuronal development.
- Formation and reorganization of neuronal connections
- Functional connectivity in local networks.
- Comparative analysis of cell biological and developmental models.

Media:

eLearning platform, power-point presentations, white board

Module coordinator:

First name:	Leanne
Last name:	Godinho

Course:

Type:	Lecture/Seminar
Title:	Systems and behavior
Hrs per week per semester	4
Lecturer (first name and last name):	Leanne Godinho and others

Module description: Pathophysiology of circuits and systems

Module number:	ME BmN 010
Module name (Ger.):	Systemische- und Netzwerkpathophysiologie
Module name (Eng.):	Pathophysiology of circuits and systems
Module level:	Master
Abbreviation:	PCS
Duration:	1
Frequency:	SS
Language:	English
Credits:	5

Workload

Total hours:	150
Contact hours:	60
Self-study hours:	90

Coursework and Examination Requirements:

Description of coursework and examination requirements:

In the written exam (60 min) consisting of free text and multiple choice questions it will be tested whether the students understand the pathophysiology of selected neuropsychiatric diseases and all modern methods like electrophysiology, computer tomography, magnetic resonance imaging and others to study neuronal circuits in health and disease. Furthermore they have to apply this knowledge to describe strategies to analyze model systems of disease as well as human patients.

Repeat examination in following semester:	yes
Repeat examination at end of semester:	yes

Description:

(Recommended) Prerequisites:	none

Learning outcomes:

After this module the students have a detailed knowledge about methods and strategies to study mechanisms of neuropsychiatric disorders from the cellular to the network level. Furthermore they know the principles and applications of most commonly used techniques, i.e. optical imaging techniques as well as EEG, CT, MRI and PET. The students are able to choose the appropriate method for the study of animal models of neuropsychiatric diseases, like Alzheimer´s and Parkinsons´s disease.

Teaching/Learning methods:

Teaching will be performed in a three step process for each topic of the module. The first step is preparatory built-up of knowledge by eLearning using the method “Just-in-Time-teaching”. After that consolidation of the knowledge will be achieved in face-to-face focus seminars with experts and finally there will be application of the knowledge in problem-solving application tutorials. Activating learning methods like peer instruction are used to design learner-centered lessons.

Content:

The specific topics in this module are:

- Structure and function of the intrinsic brain connectivity.
- Methods for the analysis of the pathophysiology of neuropsychiatric disorders from cells to circuits, with special focus on cutting-edge technologies
- In-depth study of selected neuropsychiatric disorders.

Media:

eLearning platform, power-point presentations, white board

Module coordinator:

First name:	Arthur
Last name:	Konnerth

Course:

Type:	Lecture/Seminar
Title:	Pathophysiology of circuits and systems
Hrs per week per semester	4
Lecturer (first name and last name):	Arthur Konnerth and others

Module description: Nervous system disorders and treatment

Module number:	ME BmN 011
Module name (Ger.):	Erkrankungen des Nervensystems
Module name (Eng.):	Nervous system disorders and treatment
Module level:	Master
Abbreviation:	NSD
Duration:	1
Frequency:	SS
Language:	English
Credits:	5

Workload

Total hours:	150
Contact hours:	60
Self-study hours:	90

Coursework and Examination Requirements:

Description of coursework and examination requirements:

There will be a written exam (60 min) consisting of free text and multiple choice questions in which the students have to answer questions about the molecular mechanisms, diagnosis and molecular imaging of neurological diseases. Passing the exam requires detailed knowledge in these topics and the application of it in translational strategies and disease models in neuroscience, including established and emerging approaches to treat neurological diseases.

Repeat examination in following semester:	yes
Repeat examination at end of semester:	yes

Description:

(Recommended) Prerequisites:	none

Learning outcomes:

The focus of this module is to understand the pathophysiological changes and the molecular mechanisms of neurological disorders. After this module the students know the molecular basis, the neuropathology, the clinical manifestation, the diagnostic tools and the possibilities and limits of therapeutic interventions of neurological diseases. They gain detailed knowledge about the different neuroimmunological, neurodegenerative and neuropsychiatric disorders and how such diseases can be modeled in animal models for mechanistic insight. This module also teaches the translational principle of applying basic science research to human subjects and moving discoveries and knowledge into initial clinical testing.

Teaching/Learning methods:

Teaching will be performed in a three step process for each topic of the module. The first step is preparatory build-up of knowledge by eLearning using the method “Just-in-Time-teaching”. After that consolidation of the knowledge will be achieved in face-to-face focus seminars with experts and finally there will be application of the knowledge in problem-solving application tutorials. Activating learning methods like peer instruction are used to design learner-centered lessons.

Content:

The specific topics in this module are:

- Molecular mechanisms of neurological disorders.
- Genetics, neuropathology, imaging, and clinical manifestation of nervous system diseases.
- Current treatments and emerging strategies to treat neurological diseases.

- Animal models for neurological diseases.
- The translational principle of connecting basic science and clinical application.

Media:
eLearning platform, power-point presentations, white board

Module coordinator:

First name:	Mikael
Last name:	Simons

Course:

Type:	Lecture/Seminar
Title:	Nervous system disorders and treatment
Hrs per week per semester	4
Lecturer (first name and last name):	Mikael Simons and others

Module description: Computational analysis and modelling

Module number:	ME BmN 012
Module name (Ger.):	Datenanalyse und Modellierung
Module name (Eng.):	Computational analysis and modelling
Module level:	Master
Abbreviation:	CAM
Duration:	1
Frequency:	SS
Language:	English
Credits:	5

Workload

Total hours:	150
Contact hours:	60
Self-study hours:	90

Coursework and Examination Requirements:

Description of coursework and examination requirements:

The exam consists of practical tasks. To demonstrate that they are able to apply MATLAB as a tool to problems in the context of biological signals -the students have to design and execute MATLAB-based analyses and presentations, as well as the implementation of statistical tests, based on 6 - 12 chosen problems.

Repeat examination in following semester:	yes
Repeat examination at end of semester:	yes

Description:

(Recommended) Prerequisites:	none

Learning outcomes:

After this module, the students will be able to use MATLAB as the programming language to develop software routines for the analysis of different types of biological signals. This includes electrophysiological as well as imaging data. Furthermore they will have a detailed knowledge in descriptive and analytical statistics.

Teaching/Learning methods:

Teaching will be performed in a three step process for each topic of the module. The first step is preparatory build-up of knowledge by eLearning. Next, the consolidation of the knowledge will involve face-to-face focus seminars with experts and, moreover, practical application of the knowledge in problem-solving tutorials. The focus of this course is to train students in bio-mathematical methods and strategies, to enable them to develop quantitative analysis strategies and to identify the optimal presentation formats. After an optional refreshing course in basic mathematics and statistics, the focus will be an intense training in the use of MATLAB, as a common platform for the analysis of scientific data. In relation to specific experimental examples, the students will be trained to improve their use of statistical methods. Finally, they will obtain insights into basic aspects of bioinformatics.

Content:

The specific topics in this module are:

- Use of MATLAB as the programming language
- Development of MATLAB scripts for the analysis of scientific data including electrophysiological and imaging data
- Bioinformatics
- Descriptive and analytical statistics
- Selection of appropriate statistic tests for the planning of scientific experiments
- Interpretation of statistics in scientific literature

Media:

eLearning platform, Computer programming, power-point presentations, white board, script

Module coordinator:

First name:	Ruben
Last name:	Portugues

Course:

Type:	Practical course
Title:	Computational analysis and modeling
Hrs per week per semester	4
Lecturer (first name and last name):	Ruben Portugues and others

Module description: Neuroimaging and electrophysiology

Module number:	ME BmN 013
Module name (Ger.):	Neurobildgebung und Elektrophysiologie
Module name (Eng.):	Neuroimaging and electrophysiology
Module level:	Master
Abbreviation:	NE
Duration:	1
Frequency:	SS
Language:	English
Credits:	5

Workload

Total hours:	150
Contact hours:	60
Self-study hours:	90

Coursework and Examination Requirements:

Description of coursework and examination requirements:

The students show that they understand technical principles and the use of equipment for recording of biological signals with electrical and optical methods, as well as of clinically applicable imaging modalities by performing 6-12 practical tasks.

Appropriate performance in these tasks is the requirement to pass the course.

Repeat examination in following semester:	yes
Repeat examination at end of semester:	yes

Description:

(Recommended) Prerequisites:	none

Learning outcomes:

After this module the students understand the principles of electronic circuits and their application to detect neuronal activity on the cellular as well as on the network level. In addition they know the function of semiconductors and examples for applications. The students also understand how standard equipment for the detection of electrical biological signals works and how to use them. Furthermore know the function and application of the most commonly used imaging systems with a focus on different techniques for in vivo detection of brain activity. Furthermore, the students are able to apply calcium imaging in different animal models, as this is one of the most widely used modality of functional in vivo imaging in experimental settings. They also study, how such imaging can be combined with clinically applicable neuroimaging techniques. At the end of the course, the students know the strengths and limitations of the different methods used to detect biological signals.

Teaching/Learning methods:

Teaching in the course will be performed by a combination of theoretical parts giving insights in the technical and conceptual principle of different methods to detect biological signals and a hands-on training in the laboratory. In this practical part the students have to assemble own electrical devices and to use existing systems. To learn optional applications of them they will perform standard experiments. In the theoretical parts “Just in Time teaching” and activating learning methods like peer instruction are used to design learner-centered lessons.

Content:

The specific topics in this module are:

- Basis of electronic circuits and assembly of filters

- Use of equipment for the recording of electrical signals from single cells and networks (i.e. electroencephalogram, amplifiers for extracellular and patch-clamp recordings)
- Methods for calcium and voltage-sensitive dye imaging of neuronal activity on the cellular and population level (i.e. two-photon imaging, CCD-camera and optic fiber based recording)
- Clinically applicable imaging modalities

Media:

eLearning platform, hands-on training, power-point presentations, white board, script

Module coordinator:

First name:	Helmuth
Last name:	Adelsberger

Course:

Type:	Practical course
Title:	Neuroimaging and electrophysiology
Hrs per week per semester	4
Lecturer (first name and last name):	Helmuth Adelsberger and others

Module description: Qualifying colloquium

Module number:	ME BmN 014
Module name (Ger.):	Qualifizierungskolloquium
Module name (Eng.):	Qualifying colloquium
Module level:	Master
Abbreviation:	QC
Duration:	1
Frequency:	WS
Language:	English
Credits:	2
Workload	
Total hours:	60
Contact hours:	30
Self-study hours:	30

Coursework and Examination Requirements:

Description of coursework and examination requirements:

The qualifying colloquium is assessed through a 30min presentation (including handout) followed by a 15min discussion. To pass this colloquium students have to prove that they can incorporate the outcomes of the module "Scientific practice" and of the module "Life & Science – Cultural Studies and Humanities for the Neuro- and Life Sciences" into their upcoming master thesis and perform an understandable presentation for their peers.

Repeat examination in following semester:	no
Repeat examination at end of semester:	yes

Description:

(Recommended) Prerequisites:	Module: "Scientific practice ", Module: "Life & Science – Cultural Studies and Humanities for the Neuro- and Life Sciences"

Learning outcomes:

Upon successful completion of this qualifying colloquium students are able

- to monitor and reflect their own projects as well as the project of their peers in the light of professional scientific project management and self-critical life sciences
- to explain and illustrate their projects to their teachers and peers
- to discuss own projects as well as the projects of their peers in an constructive and open minded manner.

Teaching/Learning methods:

The first sessions of the qualifying colloquium will be a recollection of the two premised modules. After that every session has at least one and at most two students presenting their own projects to their teachers and peers preparing a 30min presentation as well as a corresponding handout. After the presentation there will be at least 15min feedback and further discussion.

Content:

As preparation for the master thesis and in addition to the final master-colloquium all students have to present the concept of their master project to their peers and teachers and thereby focus primarily on all aspects of the two transferable skills and professional competence modules. The purpose of this colloquium is to verify the personal and professional development of each student as measured by the

way they present themselves as future neuro-scientists and by the way they approach, explain and contextualize their upcoming master project.

Media:

PowerPoint, whiteboard, flipchart;

Module coordinator:

First name:	Daniel
Last name:	Teufel

Course:

Type:	Colloquium
Title:	Qualifying colloquium
Hrs per week per semester	2
Lecturer (first name and last name):	Daniel Teufel and others

Module description: Lab rotation I

Module number:	ME BmN 015
Module name (Ger.):	Laborrotation I
Module name (Eng.):	Lab rotation I
Module level:	Master
Abbreviation:	LRI
Duration:	1
Frequency:	WS
Language:	English
Credits:	12

Workload

Total hours:	360
Contact hours:	240
Self-study hours:	120

Coursework and Examination Requirements:

Description of coursework and examination requirements:

To pass the module the students have to demonstrate that they are able to plan and execute a defined experimental project in the field of biomedical neuroscience, like cloning of a viral expression vector by performing a literature search and by selecting and applying the appropriate methods. The students have to summarize the project at the end of the module in an oral presentation of 20 minutes.

Repeat examination in following semester:	yes
Repeat examination at end of semester:	*yes*

Description:

(Recommended) Prerequisites:	none

Learning outcomes:

After this module the students are be able to define circumscribed scientific questions, including planning of the experiments, selecting and applying the appropriate methods as well as evaluation and presentation of the acquired data. In addition they are also able to perform a detailed literature research. The focus of this module is the identification of scientific questions and to learn how to design an experiment on the background of the existing literature and the available experimental tools.

Teaching/Learning methods:

During the stay in the group the students will become familiar with the techniques used in the institute to address specific scientific questions. This will be achieved by rotation through different labs in the institute in which the lab rotation is performed. The students will be fully integrated in the group and supported to perform their scientific projects. This includes literature search, discussion of the related scientific background, instructions to perform the experimental work and the evaluation of the own data. Regular meetings with the instructors will be held to guide the students to the lab rotations. Furthermore they will participate in journal clubs, progress reports and scientific discussions with the other group members.

Content:

The students choose the focus of the lab rotation according to their interests. Besides teaching specific experimental skills a major goal of the rotation is to train the students in doing literature search and in selecting experimental strategies to solve scientific questions.

Media:

practical lab work, hands-on training, scientific literature, eLearning platform

Module coordinator:

First name:	Helmuth
Last name:	Adelsberger

Course:

Type:	Lab rotation
Title:	Lab rotation I
Hrs per week per semester	16
Lecturer (first name and last name):	Helmuth Adelsberger and others

Module description: Lab rotation II

Module number:	ME BmN 016
Module name (Ger.):	Laborrotation II
Module name (Eng.):	Lab rotation II
Module level:	Master
Abbreviation:	LRII
Duration:	1
Frequency:	WS
Language:	English
Credits:	12

Workload

Total hours:	360
Contact hours:	240
Self-study hours:	120

Coursework and Examination Requirements:

Description of coursework and examination requirements:

To pass the module the students have to demonstrate that they are able to transfer a defined scientific project into experiments and to execute them, like preparation and analysis of protein samples from nerve cells. Furthermore they have to be able to evaluate and analyze the data they gained by the experiments. The students have to summarize the project at the end of the module in an oral presentation of 20 minutes.

Repeat examination in following semester:	yes
Repeat examination at end of semester:	*yes*

Description:

(Recommended) Prerequisites:	Lab rotation I

Learning outcomes:

After this module the students are able to plan circumscribed scientific questions and to identify the most applicable methods to gain a maximum of scientific data. Furthermore they know how to evaluate the data and to apply the appropriate statistical methods. The focus of this module is on the transfer of a planned project into suitable experiments and to evaluate the gained data.

Teaching/Learning methods:

The students will be fully integrated in the group and supported to perform their scientific projects. This includes literature search, discussion of the related scientific background, instructions to perform the experimental work and the evaluation of the own data. Regular meetings with the instructors will be held to guide the students to the lab rotations. Furthermore they will participate in journal clubs, progress reports and scientific discussions with the other group members.

Content:

The students choose the focus of the lab rotation according to their interests. Besides teaching specific experimental skills a major goal of the rotation is to provide the students with the knowledge to design and perform scientific projects and to evaluate scientific data.

Media:

practical lab work, hands-on training, scientific literature, eLearning platform

Module coordinator:

First name:	Helmuth
Last name:	Adelsberger

Course:

Type:	Lab rotation
Title:	Lab rotation II
Hrs per week per semester	16
Lecturer (first name and last name):	Helmuth Adelsberger and others

Module description: Master´s Thesis and Colloquium

Module number:	ME BmN 017
Module name (Ger.):	Masterarbeit und Kolloquium
Module name (Eng.):	Master´s Thesis and Colloquium
Module level:	Master
Abbreviation:	MTC
Duration:	1
Frequency:	SS
Language:	English
Credits:	30

Workload

Total hours:	900
Contact hours:	850
Self-study hours:	50

Coursework and Examination Requirements:

Description of coursework and examination requirements:

In this module the students have to show that they are able to define scientific question and the experimental design in accordance with their mentor. Furthermore they have to perform the necessary experiments and the required analyses. The results will be presented in the form of a written thesis and an oral presentation/examination in a colloquium. A successful completion of the module requires sufficiently high grades of both the thesis and the oral examination.

Repeat examination in following semester:	yes
Repeat examination at end of semester:	yes

Description:

(Recommended) Prerequisites:	none

Learning outcomes:

After this module, the students are able to carry out a scientific project, under appropriate supervision by a mentor. This includes the design and realization of the experimental work, as well as data evaluation. Furthermore, they are able to present their scientific results in written form and in an oral presentation.

Teaching/Learning methods:

To perform this module the students will be supervised by personal mentors guiding them through all steps of the Master´s thesis.

Content:

The specific topics in this module are:

- Literature search and planning of the experiments.
- Choice of the appropriate methods.
- Performing of the planned experiments.
- Data evaluation and statistics.
- Summarizing and presentation of results.

Media:

eLearning platform, scientific literature, practical lab work, hands-on training

Module coordinator:

First name:	Helmuth
Last name:	Adelsberger

Course:

Type:	Scientific work and presentation
Title:	Master´s Thesis and Colloquium
Hrs per week per semester	20
Lecturer (first name and last name):	Helmuth Adelsberger and others