LUDWIG-
MAXIMILIANS-
UNIVERSITÄT
MÜNCHEN

Fakultät für Biologie

Course Catalog

Masters Degree: Neurosciences (Master of Science, M.Sc.)

(120 ECTS credits)

Based on the Examination Regulations from October 7, 2010

88/430/---/M0/H/2010

Version: 2013-04-30

Table of contents

Abbreviations

CP	Credit Points, ECTS points
ECTS	European Credit Transfer and Accumulation System
h	hours
SS	summer semester
SWS	hours per week per semester/credit hours
WS	winter semester
WP	elective course (*Wahlpflicht*)
P	compulsory course (*Pflicht*)

1. In the descriptions of the individual module units, assigned ECTS credits are designated as follows: ECTS credits that are not listed in parentheses are awarded upon successful completion of the respective graded module exam or graded module unit exam. ECTS credits listed in parentheses are for calculation purposes only; these courses do not entail a graded exam.

2. Designated levels of the courses can be considered as binding or as recommendations, according to the stipulations stated in Appendix 2 in the examination regulations. This is reflected in the terminology used, stating either "designated semester" or "recommended semester", respectively.

3. Please note: The course catalogue serves as an orientation for your course of studies. For detailed regulations, please see the official examination regulations under http://www.gsn.uni-muenchen.de/studies/msc_program/index.html

Contact

Teaching Coordinator Dr. Alexander Kaiser, master-neurosci@lmu.de
Application: http://www.gsn.uni-muenchen.de/prospective_students/how_to_apply

About the Programme of Study

The ***objective*** of these research-oriented studies is to provide an intensive training close to research in order to deepen the student's knowledge, abilities, and skills gained in the core curriculum of the subjects biology, physics, neurocognitive psychology, biochemistry, and other natural sciences as well as to broaden this knowledge in the field of the neurosciences. Building on a good foundation of the molecular and cellular fundamentals of cell biology and neurobiology, the students should develop a deeper understanding of the neuron-neuron interaction, the dynamics of the neuron-glia interaction, and the rules of information transfer in simple and complex networks. These fundamentals should enable the students in the further course of their study to critically deal with questions of neurocognition, neurophilosophy, and the theory of science. The specialist knowledge conveyed also includes the theoretical, method-specific, and experimental fundamentals necessary for scientific work with the aim of promoting the student's aptitude for direct applications, research, and teaching.

The Master's ***examination*** accompanying the studies is the conclusion of the Master's program in neurosciences and qualifies the student professionally. By means of the Master's exam it is determined whether the student gasps the interrelationships of his/her main field of study and can critically evaluate hem, has the ability to apply its scientific methods and knowledge, and has acquired he basic knowledge in this field necessary for transition to professional practice.

Key qualifications are also to be conveyed during the course of this Master's rogram. They include in particular the following:

1. the ability to do research on areas of knowledge and gather information, to
2. evaluate, to consolidate, and to structure the findings,
3. a comprehensive overview of the important areas of knowledge in the relevant
4. special field,
5. systemic / lateral thinking,
6. ability to organize and transfer information,
7. competence in dealing with information and media,
8. techniques of learning and presentation,
9. competence to convey information,
10. ability to work in a team and to communicate. Also from sex-specific
11. viewpoints,
12. language competence,
13. computer literacy.

The course of study will be conducted in ***English***.

This course catalogue is composed of three major sections:

1. Schematic Figures of the course of study plan, time tables for semester 1 &2 and a shortlist of all modules including semester, SWS and ECTS information
2. List of modules including description
3. Catalogue of individual courses including course instructors, decription of course contents, qualification goals and other.

Figure 1: Course of Studies Plan

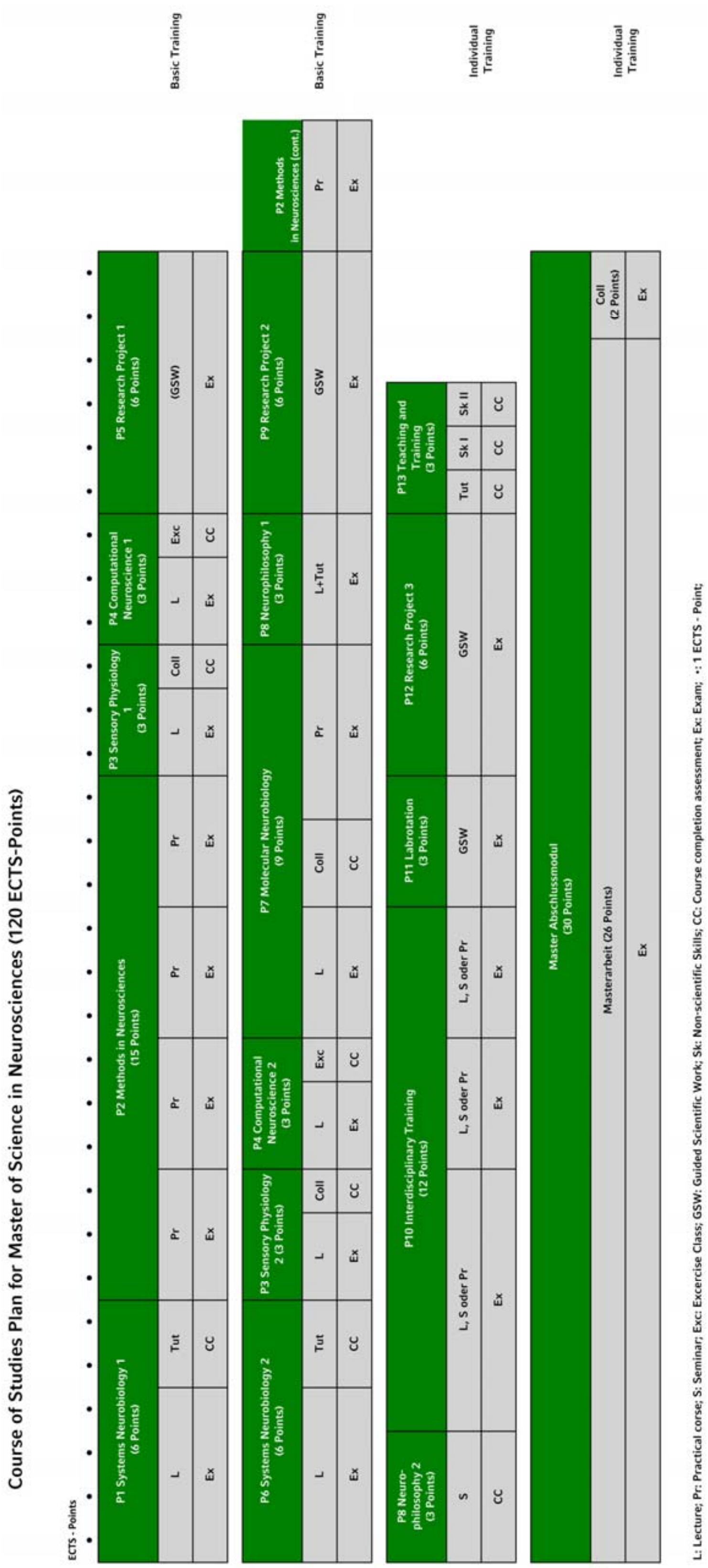

Figure 2: Basic Schedules for Semester 1 and 2

Basic Schedule MSc Winter 2012/13 (1st semester)

LMU München ENB Master of Neuroscience

Time	Monday	Tuesday	Wednesday	Thursday	Friday
8:00			8.30-10.00h: Lecture General Sensory Physiology, GSN Course Room D00.003		
9:00	9.00-10.30h: Lecture Fundamentals in Neurobiology, Biocenter B01.019	9.30-11.00h: Tutorial Fundamentals in Neurobiology, Biocenter B00.051		9.00-10.30h: Lecture Fundamentals in Neurobiology, Biocenter B01.019	9.00-10.30h: Lecture Modelling of Cellular Physiology Biocenter B01.019
10:00					
11:00	Mo-Fri 11.00-18.00h: Practical Courses in Neurobiology 15.10.-26.10.: Comparative Neuroanatomy (Wullimann et al.), Biocenter C00.027/C00.031 29.10.-09.11.: Neuroanatomy and Neurohistology (Kaiser et al.), Biocenter D00.021 19.11.-30.11.: Neurophysiology (Chagnaud et al.), Biocenter C00.027/C00.031 03.12.-14.12.: Psychophysics (Wiegrebe et al.), Biocenter C00.005				
12:00					
13:00					
14:00					
15:00					
16:00					
17:00					
18:00					
19:00	MCN/BCCN/GSN/GRK Lectures, see announcements Biocenter B01.019 (optional)	18.00-19.30h: Seminars in Neuro-biology (optional), Biocenter C00.013		18.00-19.30h: Excercise Class Computational Neuroscience C00.005 (after Xmas Mon 14.00-15.30h)	
20:00					

Basic Schedule MSc Summer 2013 (2nd semester)

LMU München ENB Master of Neuroscience

Time	Monday	Tuesday	Wednesday	Thursday	Friday
8:00					
8:30					
9:00	9.00-10.30h: Lecture Development and Higher Neural Functions Biocenter D00.003	9.00-13.00: Lecture and Tutorial Neurophilosophy, LMU Biocenter D00.003		9.00-10.30h: Lecture Development and Higher Neural Functions Biocenter D00.003	This day is suitable for: Studies, Research Projects, Mentoring, etc.
9:30					
10:00					
10:30	10.45-12.15h: Lecture Audition and Communication, Biocenter D00.003		10.30-12.30h: Lecture Statistical Models and Data Analysis, Biocenter G00.001		
11:00				11.00-12.30h, Tutorial for Lecture Development and Higher Neural Functions, Biocenter B00.051	
11:30					
12:00					
12:30					
13:00					
13:30				13.30-15.00h: Lecture Molecular Neurobiology, Biocenter D00.003	
14:00	14.00-15.00h: Excercise Class Statistical Models and Data Analysis, Biocenter D00.003				
14:30					
15:00					
15:30				15.30-17.00h: Seminar: Molecular Neurobiology, Biocenter D00.003	
16:00	MCN/BCCN/GSN/GRK Lectures, see announcements Biocenter B01.019				
16:30					
17:00					
17:30				17.30-19.00h: Lecture Clinical Neuroscience	
18:00					
18:30					
19:00					
19:30					
20:00					

Note additional courses: Practical Course Methods in Molecular Neurobiology; Various Courses in Modul Interdisciplinary Training; Practical Course Repetion of Basic Calculus, Biocenter

Figure 3: Shortlist of Modules

WS2010	Modul	Modul part	Course as in study regulations	Type of Course	Semester	SWS	ECTS
1. Semester	***P1 Systems Neurobiology 1***	P 01.1	Lecture Fundamentals in Neurobiology	Lecture	1	4	4
		P 01.2	Tutorial Fundamentals in Neurobiology	Tutorial	1	1	2
	P2 Methods in Neuroscience	P 02.1	Practical course Comparative Neuroanatomy	Practical course	1	3	3
		P 02.2	Practical course Neuroanatomy and Neurohistology	Practical course	1	3	3
		P 02.3	Practical course Neurophysiology	Practical course	1	3	3
		P 02.4	Practical course Psychophysics	Practical course	1	3	3
		P 02.5	Practical course Special methods in Neurosciences	Practical course	(1)	3	3
	P3 Sensory Physiology 1	P 03.1	Lecture General Sensory Physiology	Lecture	1	2	2
		P 03.2	Colloquium General Sensory Physiology	Colloquium	(1)	1	1
	P4 Computational Neuroscience 1	P 04.1	Lecture Modelling of Cellular Physiology	Lecture	1	2	2
		P 04.2	Exercise class Modelling of Cellular Physiology	Excercise class	1	2	1
	P5 Research Project 1	P 05.1	Research Project 1 - Systems Neurobiology	Guided scientific work	(1)	6	6
2. Semester	***P6 Systems Neurobiology 2***	P 06.1	Lecture Development and Higher Neural Functions	Lecture	2	4	4
		P 06.2	Tutorial Development and Higher Neural Functions	Tutorial	2	1	2
	P3 Sensory Physiology 2	P 03.3	Lecture Audition and Communication	Lecture	2	2	2
		P 03.4	Colloquium Audition and Communication	Colloquium	(2)	1	1
	P4 Computational Neuroscience 2	P 04.2	Lecture Statistic Models and Data Analysis	Lecture	2	2	2
		P 04.2	Excercise class Statistic Models and Data Analysis	Excercise class	2	2	1
	P7 Molecular Neurobiology	P 07.1	Lecture Molecular Neurobiology	Lecture	2	2	3
		P 07.2	Colloquium Molecular Neurobiology	Colloquium	2	2	2
		P 07.3	Practical course Methods in Molecular Neurobiology	Practical course	2	9	4
	P8 Neurophilosopy 1	P 08.1	Lecture and Tutorial Neurophilosophy	Lecture	2	2	3
	P9 Research Project 2	P 09.1	Research Project 2 - Molecular Neurobiology	Guided scientific work	(2)	6	6
3. Semester	***P8 Neurophilosopy 2***	P 08.2	Neurophilosophic Seminar	Seminar	(3)	2	3
	P10 Interdisciplinary Training	P 10.1	Interdisciplinary training 1	All	(3)	9	6
		P 10.2	Interdisciplinary training 2	All	(3)	6	3
		P 10.3	Interdisciplinary training 3	All	(3)	6	3
	P11 Labrotation	P 11.1	Laboratory internship	Supervised lab work	(3)	4	3
	P12 Research Project 3	P 12.1	Research Project 3 - Neurosciences	Guided scientific work	3	9	6
	P13 Teaching and Training	P 13.1	Tutoring for beginners	Tutor activity	(3)	1	1
		P 13.2	Non-scientific skills I	Workshop	(3)	1	1
		P 13.3	Non-scientific skills II	Workshop	(3)	1	1
4.S.	***P14 Master´s degree module***	P 14.1	Master thesis	Master thesis	4		28
		P 14.2	Colloquium master thesis	Colloquium	4	1	2

Modul: P 1 Systems Neurobiology I

Classification in program	Masters Degree: Neurosciences (Master of Science, M.Sc.)

Assigned module categories

Course type	Required course	Rotation	Class attendance	Preparation	ECTS
Lecture	P 1.1 Fundamentals in Neuroscience (Lecture)	WS	60 h (4 SWS)	60 h	(4)
Tutorial	P 1.2 Fundamentals in Neuroscience (Tutorial)	WS	15 h (1 SWS)	45 h	(2)

This module is comprised of 6 ECTS points. Class attendance is 5 SWS; total time, including preparation time is about180 hours.

Type of module	Compulsory module with required courses.
Elective guidelines	None
Entry requirements	None
Level	Recommended semester: 1
Duration	The module spans 1 semester.
Content	Content is an introduction to fundamental principles in Neuroscience. Contents of the lecture are e.g. (1) electrophysiology, (2) synapses and networks, (3) motor systems, (4) cognitive neuroscience, and (5) neuroethology. Content of the tutorial is a guided augmentation in topics of the lecture by senior students of the MSc. Neurosciences program including discussions and test exams.
Qualification goals	After successfully completing this module, students will have an insight in fundamental principles in neurosciences and are able to reproduce the covered topics.
Form of assessment	Written exam or oral exam or scientific protocol.
Grading	The module is graded according to the lecture grade in the module
Pass/fail conditions for ECTS credits	ECTS credits are awarded for individual courses according to successful completion; module completion is dependent on successful completion of individual elements.
Responsible person	Prof. George Boyan, PhD

Language	English
Other information	Detailed schedule of topics and dates and lecture handouts are available at the LMU Online directory and accessible for registered students.

Modul: P 2 Methods in Neuroscience

Classification in program	Masters Degree: Neurosciences (Master of Science, M.Sc.)

Assigned module categories

Course type	Required course	Rotation	Class attendance	Preparation	ECTS
Practical	P 2.1 Comparative Neuroanatomy	WS	45 h (3 SWS)	45 h	3
Practical	P 2.2 Neuroanatomy and Neurohistology	WS	45 h (3 SWS)	45 h	3
Practical	P 2.3 Neurophysiology	WS	45 h (3 SWS)	45 h	3
Practical	P 2.4 Psychophysics	WS	45 h (3 SWS)	45 h	3
Practical	P 2.5 Special methods in Neurosciences	WS and SS	45 h (3 SWS)	45 h	3

This module is comprised of 15 ECTS points. Class attendance is 15 SWS; total time, including preparation time is about450 hours.

Type of module	Compulsory module with required courses.
Elective guidelines	Courses P 2.1 – P 2.4 are compulsory, course P 2.5 is elective (see course contents for P 2.5)
Entry requirements	None
Level	Recommended semester for P2.1-P2.4: 1 Recommended semester for P2.5: 2
Duration	The module spans 2 semesters.
Content	Contents of this module are fundamental methods in neuroscience such as comparative neuroanatomy, neurohistology, psychophysics and neurophysiology.
Qualification goals	In this module students shall be introduced to and obtain practice in classical methods, project work, and analysis and presentation of data in systems neurobiology.
Form of assessment	Written exam or oral exam or scientific protocol or oral presentation or essay, or (oral presentation and essay).
Grading	The module is graded according to the average of the grades of the 5 course modules.
Pass/fail conditions for ECTS credits	ECTS credits are awarded for individual courses according to successful completion; module completion is dependent on successful completion of individual elements.

Responsible person	Dr. Alexander Kaiser
Language	English
Other information	Detailed course information is provided for each course in advance as PDF-File per email.

Modul: P 3 Sensory Physiology

Classification in program	Masters Degree: Neurosciences (Master of Science, M.Sc.)

Assigned module categories

Course type	Required course	Rotation	Class attendance	Preparation	ECTS
Lecture	P 3.1 Sensory Physiology I (Lecture)	WS	30 h (2 SWS)	30 h	2
Colloquium	P 3.2 Sensory Physiologie (Colloquium)	WS and SS	15 h (1 SWS)	15 h	1
Lecture	P 3.3 Audition and Communication (Lecture)	SS	30 h (2 SWS)	30 h	2
Colloquium	P 3.4 Audition and Communication (Colloquium)	WS and SS	15 h (1 SWS)	15 h	1

This module is comprised of 6 ECTS points. Class attendance is 6 SWS; total time, including preparation time is about180 hours.

Type of module	Compulsory module with required courses.
Elective guidelines	None
Entry requirements	None
Level	Recommended semester: 1-2
Duration	The module spans 2 semesters.
Content	Content of this module is an introduction to the sensory systems.
Qualification goals	Goal of this module is to mediate fundamentalknowledge on anatomy and function of the sensorysystems.
Form of assessment	Written exam or oral exam or scientific protocol or oral presentation or essay, or (oral presentation and essay).
Grading	The module is graded according to lecture grades
Pass/fail conditions for ECTS credits	ECTS credits are awarded for individual courses according to successful completion; module completion is dependent on successful completion of individual elements.
Responsible person	Prof. Dr. Oliver Behrend
Language	English
Other information	Detailed schedule of topics and dates and lecture handouts are available at the LMU Online directory and accessible for

registered students.

Modul: P 4 Computational Neuroscience

Classification in program	Masters Degree: Neurosciences (Master of Science, M.Sc.)

Assigned module categories

Course type	Required course	Rotation	Class attendance	Preparation	ECTS
Lecture	P 4.1 Modelling of Cellular Physiology (Lecture)	WS	30 h (2 SWS)	30 h	(2)
Excercise class	P 4.2 Modelling of Cellular Physiology (Excercise class)	WS	30 h (2 SWS)	0 h	(1)
Lecture	P 4.3 Statistical models and data analysis (Lecture)	SS	30 h (2 SWS)	30 h	(2)
Excercise class	P 4.4 Statistical models and data analysis (Excercise class)	SS	30 h (2 SWS)	0 h	(1)

This module is comprised of 6 ECTS points. Class attendance is 8 SWS; total time, including preparation time is about180 hours.

Type of module	Compulsory module with required courses.
Elective guidelines	None
Entry requirements	None
Level	Recommended semester: 1-2
Duration	The module spans 2 semesters.
Content	Contents of this module are stochastic variables, information theory, stochastic processes, linear algebra and non-linear differential equations. Goal of this module is an understanding of statistics of continuous variables, of basic principles of linear algebra and of simple non-linear dynamical systems.
Qualification goals	Goal of this module is an understanding of statistics of continuous variables, of basic principles of linear algebra and of simple non-linear dynamical systems.
Form of assessment	Written exam or oral exam or scientific protocol or oral presentation or essay, or (oral presentation and essay).
Grading	The module is graded according to lecture grades
Pass/fail conditions for ECTS credits	ECTS credits are awarded for individual courses according to successful completion; module completion is dependent on successful completion of individual elements.

Responsible person	Prof. Dr. Christian Leibold
Language	English
Other information	

Modul: P 5 Research Project 1

Classification in program	Masters Degree: Neurosciences (Master of Science, M.Sc.)

Assigned module categories

Course type	Required course	Rotation	Class attendance	Preparation	ECTS
Guided scientific work	P 5.1 Research Project - Systems Neurobiologie	WS and SS	90 h (6 SWS)	90 h	(6)

This module is comprised of 6 ECTS points. Class attendance is 6 SWS; total time, including preparation time is about180 hours.

Type of module	Compulsory module with required courses.
Elective guidelines	The students choose a lab and research topic based on their own interest. It is recommended to study the research expertise of faculty members as available on our homepage: http://www.mcn.uni-muenchen.de/members
Entry requirements	None
Level	Recommended semester: 1
Duration	The module spans 1 semester.
Content	Content of this research project is guided work on a scientific question from the field of systems neurobiology.
Qualification goals	Goal of this research project is gaining practice in elementary skills of scientific working and good laboratory practice.
Form of assessment	Scientific protocol.
Grading	The module is graded according to the scientific protocol.
Pass/fail conditions for ECTS credits	ECTS credits are awarded for individual courses according to successful completion; module completion is dependent on successful completion of individual elements.
Responsible person	Members of the faculty of the Graduate School of Systemic Neurosciences
Language	English
Other information	

Modul: P 6 Systemic Neurobiology II

Classification in program	Masters Degree: Neurosciences (Master of Science, M.Sc.)

Assigned module categories

Course type	Required course	Rotation	Class attendance	Preparation	ECTS
Lecture	P 6.1 Development and higher neuronal funktions (Lecture)	SS	60 h (4 SWS)	60 h	(4)
Tutorial	P 6.2 Development and higher neuronal funktions (Tutorial)	SS	15 h (1 SWS)	45 h	(2)

This module is comprised of 6 ECTS points. Class attendance is 5 SWS; total time, including preparation time is about180 hours.

Type of module	Compulsory module with required courses.
Elective guidelines	None
Entry requirements	None
Level	Recommended semester: 2
Duration	The module spans 1 semester.
Content	Content is an introduction to fundamental principles in Neuroscience. Contents of the lecture are e.g. (1) neuroanatomy & evolution of the nervous system, (2) neurogenesis, regeneration & stem cells, (3) hormones & the nervous system, (4) translational neuroscience, and (5) clinical neuroscience. Content of the tutorial is a guided augmentation in topics of the lecture by senior students of the MSc. Neurosciences program including discussions and test exams.
Qualification goals	After successfully completing this module, students will have an insight in fundamental principles in neurosciences and are able to reproduce the covered topics.
Form of assessment	Written exam or oral exam or scientific protocol or oral presentation or essay or oral presentation and essay.
Grading	The module is graded according to the lecture grade.
Pass/fail conditions for ECTS credits	ECTS credits are awarded for individual courses according to successful completion; module completion is dependent on successful completion of individual elements.
Responsible person	Prof. Dr. Oliver Behrend

Language	English
Other information	Detailed schedule of topics and dates and lecture handouts are available at the LMU Online directory and accessible for registered students.

Modul: P 7 Molecular Neurobiology

Classification in program	Masters Degree: Neurosciences (Master of Science, M.Sc.)

Assigned module categories

Course type	Required course	Rotation	Class attendance	Preparation	ECTS
Lecture	P 7.1 Molecular and cellular neurobiology (Lecture)	SS	30 h (2 SWS)	60 h	3
Colloquium	P 7.2 Current topics in molecular neurobiology (Colloquium)	SS	30 h (2 SWS)	30 h	2
Practical	P 7.3 Methods in molecular Neurobiology	SS	135 h (9 SWS)	0 h	4

This module is comprised of 9 ECTS points. Class attendance is 13 SWS; total time, including preparation time is about270 hours.

Type of module	Compulsory module with required courses.
Elective guidelines	None
Entry requirements	None
Level	Recommended semester: 2
Duration	The module spans 1 semester.
Content	Contents of this module are molecular mechanisms of neurogenesis, neuronal differentiation, circuit formation, synaptogenesis, signal transduction and plasticity.
Qualification goals	Goal of this module is to obtain secure fundamental knowledge in theory and methods of molecularneurobiology.
Form of assessment	Written exam or oral exam or scientific protocol. or oral presentation or essay or oral presentation and essay.
Grading	The module is graded.
Pass/fail conditions for ECTS credits	ECTS credits are awarded for individual courses according to successful completion; module completion is dependent on successful completion of individual elements.
Responsible person	Dr. Archana Mishra, Prof. Dr. Rüdiger Klein
Language	English
Other information	Detailed schedule of topics and dates and lecture handouts are available at the LMU Online directory and accessible for

registered students.

Modul: P 8 Neurophilosophy

Classification in program	Masters Degree: Neurosciences (Master of Science, M.Sc.)

Assigned module categories

Course type	Required course	Rotation	Class attendance	Preparation	ECTS
Lecture	P 8.1 Neurophilosophy (Lecture)	SS	30 h (2 SWS)	60 h	3
Seminar	P 8.2 Neurophilosophic seminar	WS and SS	30 h (2 SWS)	60 h	3

This module is comprised of 6 ECTS points. Class attendance is 4 SWS; total time, including preparation time is about180 hours.

Type of module	Compulsory module with required courses.
Elective guidelines	None
Entry requirements	None
Level	Recommended semester: 2
Duration	The module spans 2 semesters.
Content	Contents of this module are: (I) Philosophy of Mind (Perception, Language, Cognition, Consciousness, Mind-Body-Problem); (II) Anthropology (Ethics, Free Will and Responsibility, Determinism); (III) Philosophy of Science (Methodology, Theory and Experience, Explanation, Reductionism); (IV) Neuroscience and the History of Ideas.
Qualification goals	Goal of this module is gaining knowledge of central neurophilosophical questions and methods; Capability to analyze, critically discuss, and work out well-reasoned positions in the field of neurophilosophy, both in systematic and historical perspectives.
Form of assessment	Oral presentation or essay or (oral presentation and essay).
Grading	The module is graded according to the oral presentation or essay or both.
Pass/fail conditions for ECTS credits	ECTS credits are awarded for individual courses according to successful completion; module completion is dependent on successful completion of individual elements.
Responsible person	Prof. Dr. Stephan Sellmaier
Language	English

Other information

Modul: P 9 Research Project 2

Classification in program	Masters Degree: Neurosciences (Master of Science, M.Sc.)

Assigned module categories

Course type	Required course	Rotation	Class attendance	Preparation	ECTS
Guided scientific work	P 9.1 Research Project - Molecular and cellular neurobiology	WS and SS	90 h (6 SWS)	90 h	(6)

This module is comprised of 6 ECTS points. Class attendance is 6 SWS; total time, including preparation time is about180 hours.

Type of module	Compulsory module with required courses.
Elective guidelines	The students choose a lab and research topic based on their own interest. It is recommended to study the research expertise of faculty members as available on our homepage: http://www.mcn.uni-muenchen.de/members
Entry requirements	None
Level	Recommended semester: 2
Duration	The module spans 1 semester.
Content	Content of this research project is guided working on a scientific question from the field of molecular or cellular neurobiology.
Qualification goals	Goal of this research project is gaining practice in elementary skills of scientific working and good laboratory practice.
Form of assessment	Scientific protocol.
Grading	The module is graded according to the scientific protocol.
Pass/fail conditions for ECTS credits	ECTS credits are awarded for individual courses according to successful completion; module completion is dependent on successful completion of individual elements.
Responsible person	Members of the faculty of the Graduate School of Systemic Neurosciences
Language	English
Other information	

Modul: P 10 Interdisciplinary Training

Classification in program	Masters Degree: Neurosciences (Master of Science, M.Sc.)

Assigned module categories

Course type	Required course	Rotation	Class attendance	Preparation	ECTS
Lecture oder Colloquium oder Practical oder Exkursion oder Excercise class oder Seminar	P 10.1 Interdisciplinary Training 1	WS and SS	135 h (9 SWS)	45 h	6
Lecture oder Colloquium oder Practical oder Exkursion oder Excercise class oder Seminar	P 10.2 Interdisciplinary Training 2	WS and SS	90 h (6 SWS)	0 h	3
Lecture oder Colloquium oder Practical oder Exkursion oder Excercise class oder Seminar	P 10.3 Interdisciplinary Training 3	WS and SS	90 h (6 SWS)	0 h	3

This module is comprised of 12 ECTS points. Class attendance is 21 SWS; total time, including preparation time is about360 hours.

Type of module	Compulsory module with required courses.
Elective guidelines	The students select courses from a changing list of courses on their own interest. The available courses are listed in the LMU online directory (LSF).

Entry requirements	None
Level	Recommended Semester: 3
Duration	The module spans 1 semester.
Content	Contents of this module are additional theoretical and practical skills in the scientific field of individual interest and interdisciplinary discussions.
Qualification goals	In this module the student will learn to focus his or her own scientific profile. 3Furthermore the students gain practice integrating insights from different fields on a common topic and enhance their ability to take part in interdisciplinary discussions.
Form of assessment	Written exam or oral exam or scientific protocol. or oral presentation or essay or oral presentation and essay.
Grading	The module is graded.
Pass/fail conditions for ECTS credits	ECTS credits are awarded for individual courses according to successful completion; module completion is dependent on successful completion of individual elements.
Responsible person	Members of the faculty of the Graduate School of Systemic Neurosciences
Language	English
Other information	

Modul: P 11 Lab rotation

Classification in program	Masters Degree: Neurosciences (Master of Science, M.Sc.)

Assigned module categories

Course type	Required course	Rotation	Class attendance	Preparation	ECTS
Guided scientific work	P 11.1 Laboratory practical	WS and SS	60 h (4 SWS)	30 h	(3)

This module is comprised of 3 ECTS points. Class attendance is 4 SWS; total time, including preparation time is about90 hours.

Type of module	Compulsory module with required courses.
Elective guidelines	The students choose a research group based on their own interest in methods and research topics. It is recommended to study the research expertise of faculty members as available on our homepage: http://www.mcn.uni-muenchen.de/members
Entry requirements	None
Level	Recommended semester: 3
Duration	The module spans 1 semester.
Content	Content of this module is participating in the lab of a participating lecturer.
Qualification goals	Goal of this module is getting to know every day labwork.
Form of assessment	Scientific protocol.
Grading	The module is graded according to the scientific protocol.
Pass/fail conditions for ECTS credits	ECTS credits are awarded for individual courses according to successful completion; module completion is dependent on successful completion of individual elements.
Responsible person	Members of the faculty of the Graduate School of Systemic Neurosciences
Language	English
Other information	

Modul: P 12 Research Project 3

Classification in program	Masters Degree: Neurosciences (Master of Science, M.Sc.)

Assigned module categories

Course type	Required course	Rotation	Class attendance	Preparation	ECTS
Guided scientific work	P 12.1 Research Project - Neurosciences	WS and SS	135 h (9 SWS)	45 h	(6)

This module is comprised of 6 ECTS points. Class attendance is 9 SWS; total time, including preparation time is about180 hours.

Type of module	Compulsory module with required courses.
Elective guidelines	The students choose a lab and research topic based on their own interest. It is recommended to study the research expertise of faculty members as available on our homepage: http://www.mcn.uni-muenchen.de/members
Entry requirements	None
Level	Recommended semester: 3
Duration	The module spans 1 semester.
Content	Content of this research project is guided working on an elective scientific question. The topic is to be chosen together with the mentors.
Qualification goals	Goal of this research project is gaining practice in general skills of scientific working and good laboratory practice. In the end the student shall be able to denominate a novel question of scientific interest.
Form of assessment	Scientific protocol.
Grading	The module is graded according to the scientific protocol.
Pass/fail conditions for ECTS credits	ECTS credits are awarded for individual courses according to successful completion; module completion is dependent on successful completion of individual elements.
Responsible person	Members of the faculty of the Graduate School of Systemic Neurosciences
Language	English
Other information	

Modul: P 13 Teaching and Training

Classification in program Masters Degree: Neurosciences (Master of Science, M.Sc.)

Assigned module categories

Course type	Required course	Rotation	Class attendance	Preparation	ECTS
Tutorial	P 13.1 Tutoring for Beginners (Tutorial activity)	WS and SS	15 h (1 SWS)	15 h	(1)
Workshop	P 13.2 Non-scientific skills I	WS and SS	15 h (1 SWS)	15 h	(1)
Workshop	P 13.3 Non-scientific skills II	WS and SS	15 h (1 SWS)	15 h	(1)

This module is comprised of 3 ECTS points. Class attendance is 3 SWS; total time, including preparation time is about90 hours.

Type of module	Compulsory module with required courses.
Elective guidelines	The tutorial is mandatory. The Non-Scientific Skills workshops are announced on our homepage: http://www.gsn.uni-muenchen.de/seminars_events/workshops
Entry requirements	None
Level	Recommended semester: 3
Duration	The module spans 1 semester.
Content	Contents of this module are specialized complementary skills e.g. teaching as well as social, lingual and time management skills.
Qualification goals	The goal of this module is to prepare the student for different career demands.
Form of assessment	Oral exam.
Grading	None
Pass/fail conditions for ECTS credits	ECTS credits are awarded for individual courses according to successful completion; module completion is dependent on successful completion of individual elements.
Responsible person	Dr. Alexander Kaiser
Language	English
Other information	

Modul: P 14 Masters Degree Module

Classification in program	Masters Degree: Neurosciences (Master of Science, M.Sc.)

Assigned module categories

Course type	Required course	Rotation	Class attendance	Preparation	ECTS
Masters thesis	P 14.1 Masters thesis	SS	-	840 h	28
Colloquium	P 14.2 Colloquium Masters thesis	SS	15 h (1 SWS)	45 h	2

This module is comprised of 30 ECTS points. Class attendance is 1 SWS; total time, including preparation time is about900 hours.

Type of module	Compulsory module with required courses.
Elective guidelines	The students choose a lab and research topic based on their own experience and interest. It is recommended to study the research expertise of faculty members as available on our homepage: http://www.mcn.uni-muenchen.de/members
Entry requirements	Successfull participation in modules P 1 to P 12
Level	Recommended semester: 4
Duration	The module spans 1 semester.
Content	Contents of this module is preparing writing the master thesis and participating in a specialized, topic related colloquium..
Qualification goals	The goal of this module is transferring acquired theoretical and methodical knowledge to a given scientific question and to independently interpret individually gained data. Furthermore students shall be able to competently participate and lead discussions
Form of assessment	Thesis and oral exam
Grading	The module is graded according to the thesis and colloquium.
Pass/fail conditions for ECTS credits	ECTS credits are awarded for individual courses according to successful completion; module completion is dependent on successful completion of individual elements.
Responsible person	Members of the faculty of the Graduate School of Systemic Neurosciences
Language	English

Other information

Course Contents

P 1 Systems Neurobiology I

Course Type: Lecture	**P 1.1 Fundamentals in Neuroscience I** Person responsible for course/ Instructor: George Boyan
Course content:	The course consists of 27 two-hour lectures and covers: basic principles of electrophysiology, an overview over synaptic interactions and neuromodulators, current ideas on neuronal networks (9lectures); an introduction to motor systems (5 lectures); cognitive neuroscience (5 lectures); neuroethology (8 lectures). The lecture is given twice weekly (4 SWS) and requires a final written exam.
Qualification Goals:	Students obtain the fundamental knowledge required to participate in further specialized courses in the neurosciences. Students are equipped with the basic knowledge prerequisite to participating in theoretical and practical experiments. The students are proficient in the contents of the course and are able to depict basic principles and transfer their knowledge in an exam situation. Students participating in the accompanying tutorial gain a deeper understanding of the material covered in the lectures and in addition are prepared for the final exam.
Course Type: Tutorial	**P 1.2 Fundamentals in Neuroscience I** Person responsible for course/ Instructor: George Boyan
Course content:	The tutorial is given by senior students of the program in MSc. Neurosciences once a week and accompanies the lecture (2 SWS). Topics of the lecture are discussed regarding to student suggestions and test exams are prepared by the senior students.
Qualification Goals:	Students participating in the accompanying tutorial gain a deeper understanding of the material covered in the lectures and in addition are prepared for the final exam.

P 2 Methods in Neuroscience

Course Type: Practical course	**P 2.1 Comparative Neuroanatomy** Mario F Wullimann
Course content:	Short description (1-5 sentences) of the material covered in the course. This two-week course includes a series of lectures in the morning followed by a practical course for the rest of the day during the first week. Topics in the first week are: 1-Early neural development and the vertebrate head, 2-sensory organs, 3-hearing, 4-brain development and general neuroanatomy, 5- comparative anatomy of the telencephalon. Selected whole specimens or stained brain tissue sections will be studied. The second week consists of seminars on important comparative neuroanatomical topics presented by the students. The remainder of this week is devoted to the preparation of a written essay on a selected functional neuroanatomical topic.
Qualification Goals:	General goals for the course (approx. 4 sentences), putting it in a context for future work or academic career. What general proficiency, abilities, expertise, professional and/or social competence can be achieved in the courses? The course provides general background knowledge on brain development and adult brain organization which forms a basis for more specialized courses. In addition to a group presentation of the results of a study object each day of the first week, focused talks on assigned topics as well as a written essay during the second week fom three integrated requirements. These integrated activities together with individual comments will enable the students to use neuroanatomical vocabulary in spoken and written form.
Course Type: Practical course	**P 2.2 Neuroanatomy and Neurohistology** Person responsible for course/ Instructor: Dr. Alexander Kaiser
Course content:	In this basic methods course in Neuroscience he students get familiar with (i) the anatomy of the insect nervous system with an emphasis on the brain and (ii) the general structure of the central nervous system of mammals plus selected neuronal systems with the main focus on the auditory system, the visual system and the hippocampal formation. A maximum of 12 students will work in groups of 2-3 in practical and analytical projects. Firsthand students are introduced to classical staining methods and the use of brain atlases. The hands-on methods include fixation, sectioning, immunohistochemical staining, fluorescence microscopy and confocal fluorescence microscopy with brain preparations. Analysis of triple stained sections includes expert usage of visual analysis software. Finally, students will report and discuss the results of their research projects with slide presentations.
Qualification Goals:	The aim of this practical course is to provide: 1. Theoretical and practical knowledge of classical and immunohistochemical anatomical methods, including triple-labeling with fluorescent markers. 2. Knowledge of the principal components and structures of the brain of insects and mammals.

	3. Practical skills in identifying of selected brain structures and neuronal components of the mammalian brain using a stereotactic atlas. 4. Practical skills in identifying and analyzing different classes of neurons and glia cells using specifically-labeled brain series. 5. Transfer of theoretical knowledge from accompanying lectures and seminars to brain preparations. Students will obtain skills for future lab work, in particular in preparation for Research Projects and their master thesis. Students will be trained in good general lab practice, including standard safety procedures, precise handling of chemicals and instruments, conscientious documentation of lab procedures. Furthermore students are asked to practice critical evaluation and interpretation of their data as a basis for careful and relevant conclusions.
Course Type: Practical course	**P 2.3 Neurophysiology** Person responsible for course/ Instructor: Chagnaud/ Leibold
Course content:	In this practical course the basics of intracellular recordings using sharp electrodes will be taught using theoretical and extensive hands-on experience. Physiological experiments will be complemented with simulations in the NEURON environment. Students will generate their own preparation of leech ganglia and record intracellularly from different neurons types. The results will be discussed and interpreted at different neuronal levels ranging from single ion channels to cell-cell interactions. Students will be given research projects which they will conduct independently. The lab entails 6 SWS and students will be required to present their results at a seminar.
Qualification Goals:	The goal of this practical course is to get students to transfer theoretical knowledge to practical applications. Students will obtain skills for future lab work, in particular in preparation for their masters or PhD thesis. Students will be trained in good general lab practice, including standard safety procedures, precise handling of chemicals and instruments, conscientious documentation of lab procedures. Furthermore students are asked to practice critical evaluation and interpretation of data as a basis for careful and relevant conclusions.
Course Type: Practical course	**P 2.4 Psychophysics** Person responsible for course/ Instructor: Lutz Wiegrebe
Course content:	The practical covers a range of psychophysical methods and their applications in sensory physiology. Specifically, experiments are conducted of visual, auditory, vestibular and tactile perception and cross modal interactions. Moreover, participants are instructed on how to design and execute their own experiments with supervision from a range of experienced scientists with neurobiology and psychology background. Participants are introduced to basic procedure of psychophysical methods (such as method of constant stimuli, method of limits etc.), as well as several advanced methods (e.g. staircase methods, adaptive methods). Those psychophysical methods are taught and combined with empirical experiments, which will be covered in practical studies in various modalities, including vestibular, auditory, visual, and tactile senses, as well as multi-modalities.

	The practical work entails 5 SWS, and requires a detail experimental design and data analysis, and a final presentation. The work can be conduced in a small group (2-3 participants) together.
Qualification Goals:	Students get familiarised with different psychophysical methods. Students can learn basic knowledge of psychophysics and classic psychophysical methods. Students are able to transfer learned psychophysical methods to various practical applications. Students get in-depth understanding of perceptual processes and some insight into the underlying neurophysiology. Students obtain skills for future lab work, in particular in implementing psychophysical experiments. Students practice critical evaluation and interpretation of data as a basis for careful and relevant conclusions. In working in small groups as a team (2-3 persons), it can foster good teamwork, cooperation, communication skills, as well as organizational skills.
Course Type: Practical Course	**P 2.5 Neuronal circuits in the rodent olfactory bulb explored by patch clamping and two-photon Ca2+ imaging** Person responsible for course/ Instructor: Dr. Veronica Egger
Course content:	The olfactory bulb, a multi-layered sensory input area, is well suited to explore neuronal function at the cellular and network level. Mitral cells, the principal neurons of the olfactory bulb, will be characterized using basic electrophysiological techniques such as patch clamp recordings in whole cell mode and extracellular synaptic stimulation in acute brain slices. In the second half of the practical course, the acquired techniques will be taken further to perform two-photon laser scan calcium imaging both at the single-cell and population level. Finally, the recorded mitral cells will be processed histochemically, allowing the students to experience a broad range of relevant neuroscientific mehtods. Duration of course: 2 weeks including detailed lab report.
Qualification Goals:	Students will get a thorough impression on a range of neurophysio-logical lab techniques, helping them to decide on their masters thesis topic. Students can apply theoretical and practical knowledge about neuro-science to approach biological questions in a particular sensory system. Students practice critical evaluation and interpretation of data as a basis for careful and relevant conclusions. Students also get to present their data in a written report, including a well-founded introduction to the topic, documentation, interpretation and discussion of the results. This lab report serves to introduce students for writing of own scientific texts, in particular theses and publications.
Course Type: Practical course	**P 2.5 Patch-clamp course: Fundamentals in synaptic transmission** Person responsible for course/ Instructor: Felix Felmy
Course content:	For practical course: “Fundamentals in synaptic transmission” participants are introduced whole-cell patch clamp recordings from visually identified neurons in the acute brain slice preparation as well as to live calcium imaging methods. Emphasis is placed on the relevance

	and hands-on practice with these in vitro techniques. The course aims to introduce the field of synaptic transmission and synaptic information flow in neurons. The lab entails 3 ECTS, and requires a detailed lab report according to excellent scientific practice.
Qualification Goals:	Students are introduced to the field of synaptic transmission Students are introduced to the in vitro brain slice technique and general electrophysiology Students obtain skills for future lab work, in particular in preparation for their master's thesis. Students are motivated to work independent on challenging experiments.
Course Type: Practical course	**P 5.5 Practical Methods in functional Imaging: fMRI & PET** Instructors: Virginia L. Flanagin, Thomas Stephan
Course content:	Participants are given the necessary basic physics knowledge of how magnetic resonance imaging (MRI) and positron emission tomography (PET) works, principles of image reconstruction for both methods the principles of the blood-oxygenated level dependent signal, as well as basic and advanced analysis techniques. Participants then have hands-on experience with the current analysis techniques and with designing imaging experiments. The practical is 8 hours daily for 2 weeks and requires the completion of the analysis as well as a written exam at the end.
Qualification Goals:	General goals for the course (approx. 4 sentences), putting it in a context for future work or academic career. What general proficiency, abilities, expertise, professional and/or social competence can be achieved in the courses? Students will be able to conduct and analyse a basic fMRI or PET experiment independently by the end of the course. Students should be able critically review relevant literature and interpret current findings in relation to their own work. Students are trained in safety procedures and ethical considerations as they apply to neuroimaging on humans and animals. Students should have a grasp on the theoretical underpinnings of magnetic resonance imaging, the source of both the general and the functional signal and understand how image reconstruction is done. Students have the opportunity to work in groups and to develop their own experiments, gaining a deeper understanding of the scientific method.
Course Type: Practical Course	**P 2.5 Receptors and transporters in the rodent auditory brainstem explored by patch-clamping and immunohistochemistry.** Person responsible for course/ Instructor: Dr. Cornelia Kopp-Scheinpflug
Course content:	The course provides 1) an introduction into receptors and transporters in the central nervous system, 2) basics in patch-clamping and 3) histological and immunocytochemical methods. The course consists of a three lectures and 2 week lab practical (6 hours/day) and requires regular attendance.
Qualification Goals:	General goals for the course putting it in a context for future work or academic career. What general proficiency, abilities, expertise,

	professional and/or social competence can be achieved in the courses? Students will learn to prepare acute brain slices of the rodent brainstem and use voltage-clamp and current-clamp recordings to investigate receptors and transporters in the auditory brainstem. Namely, they will record excitatory and inhibitory synaptic currents from the auditory brainstem as well as determine the influence of transporters such as KCC2 on the receptor currents. In addition, they will conduct immunohistological staining and colocalizations of receptors and transporters in the brainstem. Students obtain the fundamental knowledge required to learn to apply similar methods in research projects and their Masters thesis.
Course Type: Practical course	**P 2.5 Practical Course Auditory Electrophysiology** Dr. Michael Pecka
Course content:	This course offers practical training in performing in vivo extracellular recordings in the mammalian auditory brainstem and midbrain. Participants will be able to observe various firing properties of individual neurons in response to acoustic stimulation and will learn to decipher the functional circuits underlying these neuronal properties. Emphasis is placed on the relevance and hands-on practice with this fundamental neuro-physiological technique, on gaining detailed knowledge of the ascending auditory system and on the interpretation of data. The course entails 3 SWS, and requires a concise lab report according to excellent scientific practice.
Qualification Goals:	General goals for the course (approx. 4 sentences), putting it in a context for future work or academic career. What general proficiency, abilities, expertise, professional and/or social competence can be achieved in the courses? Students are able to closely follow the instructions given to carefully carry out intricate surgery on living tissue. The practical experience gained in this course will provide essential insight for working in the field of systemic and - in particular - auditory neurosicence. Students practice critical evaluation and interpretation of neuronal response properties to obtain detailed knowledge about neuronal coding strategies and to deduce neuronal circuit design. Students can apply theoretical and practical knowledge to approach neuroscientific questions in independent work.
Course Type: Practical course	**P 2.5 Practical course extra-and intracellular recordings of single and multi-units.** Person responsible for course/ Instructor: Hans Straka/Boris Chagnaud
Course content:	Participants are introduced to step-by-step procedures for recording intra and extracellularly from amphibian semi intact preparations. Students will learn how to generate such preparations, how to record neuronal activity using sharp and suction electrodes and how to analyze the acquired data. Emphasis is placed on the relevance and hands-on practice with these electrophysiological techniques, and interpretation and presentation of data. The lab entails 6 SWS, and requires a lab report and a short presentation according to excellent scientific practice.
Qualification Goals:	The goal of this practical course is to get students to transfer theoretical knowledge to practical applications. Students will obtain skills for future

	lab work, in particular in preparation for their bachelor or masters thesis. Students will be well-trained in good general lab practice, including standard safety procedures, precise handling of chemicals and instruments, conscientious documentation of lab procedures. Furthermore students are asked to practice critical evaluation and interpretation of data as a basis for careful and relevant conclusions.

P 3 Sensory Physiology

Course Type: Lecture	**P 3.1 General Sensory Physiology** Person responsible for course/ Instructor: Oliver Behrend
Course content:	The lecture General Sensory Physiology covers the principles of sensory processing, sensory-motor interactions, and the physics of adequate stimuli. A detailed description of the peripheral and central stages of each specific sensory system is accompanied by theoretical concepts of the underlying neuronal processing. The lecture is given weekly (2 SWS) and requires regular attendance and a final exam. The following topics are covered by participating lecturers: -An introduction to principles of invertebrate visual processing in the periphery and CNS, with an emphasis on neuronal substrates and models of motion detection -Fundamentals of visual processing in vertebrates: peripheral transduction, and neuronal representations of visual input across different stages of the central visual pathway -The mechanosensory lateral line system of aquatic animals and its role in the detection, identification and localisation of objects on the water surface or within the water body -Electroreception: peripheral and central properties of independently evolved systems, and the systems' role in object detection, orientation, and communication -The ontogenesis of the vestibular system and general aspects of sensory-motor interaction -Clinical aspects of disorders in the vestibular system of humans -Properties of diverse magnetoreceptive systems -Principles of several chemoreceptive systems, peripheral and central processes of the gustatory and the olfactory system, multimodal interactions -Peripheral and central stages of somatosensory systems, and their function -Mechanisms of pain, and temperature perception
Qualification Goals:	Gain an understanding of the principles of peripheral and central sensory processing, as well as physiological and motor responses, and behavioural consequences The students should be able to outline these basic principles and transfer their knowledge into an exam situation Students will obtain the fundamental knowledge required to participate in further specialized courses of the Master Program and will acquire the basic knowledge prerequisite to physiological research
Course Type: Seminar	**P 3.2 Sound Localisation Colloquium** Person responsible for course/ Instructor: Oliver Behrend
Course content:	Central and peripheral mechanisms aiding the localisation of airborne and underwater sound sources. Animal models are presented and discussed across non-vertebrate and vertebrate clades. The following topics are assigned to participants: -The auditory periphery, as well as central representations of airborne sound, and behavioural sound source localisation data across several

	insect species. -The auditory periphery, as well as central representations of sound, and underwater sound source positions, across several fish species. -The diversity of auditory peripheral structures across amphibians, the central representation of sound, in particular with an emphasis on the localisation of behaviourally relevant vocalisations, and behavioural data -The directional character of the reptilian auditory periphery and its effect on sound localisation performance. -Central mechanisms of sound localisation in birds, including classic publications on neuronal delay lines in chicken. Sound localisation in an avian hearing specialist, the barn owl, and the interdependence of visual and hearing inputs. -A comparison of theoretical concepts of central processing of sound source positions across mammals and birds. -Central representations of interaural intensity differences s and interaural time differences, as predominant cues of the location of sound sources, in the mammalian brain. - Cortical representations of sound sources. -The role of spectral notches and reverberations for sound localisation, as well as the generation of acoustic motion The students independently research the topic using recommended literature and resources, and regularly consult with the instructor. The seminar entails 2 SWS, and requires an approx. 25 minute oral presentation of the topic, and the compilation of a 1 page handout.
Qualification Goals:	Gain an understanding of a variety of mechanisms underlying sound localisation, and of the contextual embedding of localisation behaviour Proficiency in presentation skills with different media, and routine access of library and internet resources. Ability to extract relevant information from current peer-reviewed publications and to present a scientific topic thoroughly and understandably to peers. Gain routine in communication and presentation skills in front of a group. Ability to analyse and discuss scientific reports and views.
Course Type: Lecture	**P 3.3 Audition and Communication** Person responsible for course/ Instructor: Benedikt Grothe
Course content:	The lecture Audition and Communication covers the principles of auditory processing, and audio-motor interactions from the physics of acoustic stimuli to a detailed description of central auditory processing of these stimuli, and underlying theoretical concepts. The lecture is given weekly (2 SWS) and requires regular attendance and a final exam. The following topics are covered by participating lecturers: -An introduction to principles of audition and communication across animal models, the diversity of evolved systems, and their function -The physical properties of sound, the transmission properties of the outer ear structures, and middle ear impedance matching -The independent evolution and onset of hearing of airborne sound across amphibian, avian and mammalian vertebrate clades -The structure and function of the inner ear cochlea, transduction processes, and signal transmission by the auditory nerve into the CNS

	-The principal nuclei of the auditory brain stem and their function, including olivo-cochlear feedback systems -The benefits of binaural hearing for the auditory analysis of sound sources and their location, nuclei involved in binaural processing across the avian and mammalian clade -Auditory midbrain nuclei and their function for sound localisation, feature extraction, and adaptation by top-down modulation of neuronal activity -The structures of the auditory thalamus: a feedback and relay station in higher auditory processing -The representation of sound, sound sources, and sound objects in the auditory cortex. Concepts of cortical auditory processing -Psychophysical approaches on principles of peripheral and central processing across animal models (e.g. bats, gerbils, humans)
Qualification Goals:	Gain an understanding of the principles of acoustics, as well as peripheral and central auditory processing, audio-motor responses, and acoustic communication The students should be able to outline these basic principles and transfer their knowledge into an exam situation Students will obtain the fundamental knowledge required to participate in further specialized courses of the Master Program and will acquire the basic knowledge prerequisite to auditory research
Course Type: Seminar	**P 3.4 Audition and Communication Colloquium** Person responsible for course/ Instructor: Oliver Behrend
Course content:	Examples and mechanisms of acoustic communication via airborne and underwater sound. Animal models are presented and discussed across non-vertebrate and vertebrate clades. The following topics are assigned to the participants: -Neurophysiology of acoustic communication in insects, audio-motor responses, and mating behaviour -Evolution of social vocalisations in fishes, auditory coupling of sender and receiver properties -Features of amphibian communication calls, central processing, e.g. via neurones that count amplitude modulations , and ultrasonic communication -Song learning in birds, the influence of feedback and sleep on song acquirement, song contents, exotic ways of communication sound production (e.g. stridulation) -Acoustic communication in canidae, and pinnipedia: structure and function of vocalisations -Acoustic communication in whales and dolphins. Correlation of songs and sociality -Acoustic communication in primates: neural correlates of conspecific vocalisations The students independently research the topic using recommended literature and resources, and regularly consult with the instructor. The seminar entails 2 SWS, and requires an approx. 25 minute oral presentation of the topic, and the compilation of a 1 page handout.
Qualification Goals:	Gain an understanding of a variety of mechanisms underlying acoustic

	communication, and of the contextual embedding of communication behaviour Proficiency in presentation skills with different media, and routine access of library and internet resources. Ability to extract relevant information from current peer-reviewed publications and to present a scientific topic thoroughly and understandably to peers. Gain routine in communication and presentation skills in front of a group. Ability to analyse and discuss scientific reports and views.

P 4 Computational Neuroscience

Course Type: Lecture	**P 4.1 Modelling of Cellular Physiology** Person responsible for course: Prof. Herz Instructors: Prof. Borst, Prof. Herz
Course content:	The course provides an introduction to the dynamics and information processing of single neurons. This includes the biophysical processes responsible for the resting membrane potential, voltage-dependent ion channel, and the generation and propagation of action potentials. On the mathematical side, the Hodgkin-Huxley Equations are derived, and reductions to more simple description (e.g. FitzHugh-Nagumo) are discussed, together with a discussion of dynamical systems theory. The lecture is given weekly (2 SWS) and requires regular attendance and a final exam.
Qualification Goals:	General goals for the course: The students understand the biophysical basis of electrical signals in neural systems and their mathematical description. Students obtain the fundamental knowledge required to participate in further specialized courses. Students are equipped with the basic knowledge prerequisite to scientific research in this topic.
Course Type: Practical course	**P 4.2 Modelling of Cellular Physiology** Person responsible for course: Prof. Herz Instructors: Prof. Herz, Dr. Loebel
Course content:	The course complements the Lecture "Modelling of Cellular Physiology" through mathematical exercises and exercises in computational modelling. These two components enable students to understand neural dynamics at a qualitative and quantitative level. The course is given weekly (2 SWS) and requires regular attendance and a final exam.
Qualification Goals:	General goals for the course: Students are able to transfer theoretical knowledge to practical applications. Students obtain mathematical and computer programming skills for future lab work, in particular in preparation for their masters' thesis. Students can use mathematical and computer programming to approach biological questions in independent work. By working in small lab groups, social skills (teamwork, cooperation, fair play, mutual respect), communication skills (rapport with instructors and fellow students, presentations, written lab reports), as well as organizational skills (efficient planning, documentation) are refined.
Course Type: Lecture	**P 4.3 Statistical Models and Data Analysis** Person responsible for course/ Instructor: Prof. Leibold
Course content:	The course provides 1) basics of linear data analysis techniques like filtering, Fourier analysis, and correlations and 2) an introduction to probability theory and its application to neuronal data analysis and frequently used stochastic models. The course consists of a weekly lecture (2SWS) and a weekly tutorial (2SWS) and requires regular attendance and a final exam.

Qualification Goals:	General goals for the course putting it in a context for future work or academic career. What general proficiency, abilities, expertise, professional and/or social competence can be achieved in the courses? The students are able to understand fundamental data processing algorithms and statistical tests. They are able to judge the computational effort involved in these methods and can assess the validity of conclusions derived from these methods. Students obtain the fundamental knowledge required to learn to apply similar methods in research projects and their Masters thesis.
Course Type: Exercise Class	**P 4.4 Statistical Models and Data Analysis** Person responsible for course/ Instructor: Prof. Leibold
Course content:	Contents of this exercise class is the repletion and rehearsal of distributions of continuous random variables, mutual information, Poisson process, Gaussian process, random walk, diffusion, covariance matrix, matrix Eigenvalues, matrix Eigenvalue decomposition, basic transformations, principal component analysis and simple neuron models.
Qualification Goals:	Goal of this exercise class is an understanding of statistics of continuous variables, of basic principles of linear algebra and of simple non-linear dynamical systems.

P 5 Research Project 1

Course Type: Guided Scientific Work	**P 5 Research Project 1 – Systems Neurobiology** Person responsible for course/ Instructor: Members of the faculty of the Graduate School of Systemic Neurosciences
Course content:	Content of this research project is guided work on a scientific question from the field of systems neurobiology, applying elementary skills of scientific working.
Qualification Goals:	Goal of this research project to gain practice in elementary skills of scientific working.

P 6 Systemic Neurobiology II

Course Type: Lecture	**P 6.1 Fundamentals in Neuroscience II – Development and Higher Neural Functions** Person responsible for course/ Instructor: George Boyan
Course content:	The course consists of 23 two-hour lectures and provides an introduction to: - neuroanatomy and evolution of the nervous system (5 lectures); - neurogenesis, regeneration and stem cell (9 lectures); - hormones and the nervous system (3 lectures); - cognitive neuroscience (2 lectures) - clincal neuroscience (4 lectures) The lecture is given twice weekly (4 SWS) and requires a final written exam.
Qualification Goals:	Students obtain the fundamental knowledge required to participate in further specialized courses in the neurosciences. Students are equipped with the basic knowledge prerequisite to participating in theoretical and practical experiments The students are proficient in the contents of the course and are able to depict basic principles and transfer their knowledge in an exam situation. Students participating in the accompanying tutorial gain a deeper understanding of the material covered in the lectures and in addition are prepared for the final exam.
Course Type: Tutorial	**P 6.2 Fundamentals in Neuroscience II – Development and Higher Neural Functions.** Person responsible for course/ Instructor: George Boyan
Course content:	The tutorial is given by senior students of the program in MSc. Neurosciences once a week and accompanies the lecture (2 SWS). Topics of the lecture are discussed regarding to student suggestions and test exams are prepared by the senior students.
Qualification Goals:	Students participating in the accompanying tutorial gain a deeper understanding of the material covered in the lectures and in addition are prepared for the final exam.

P 7 Molecular Neurobiology

Course Type: Lecture	**P 7.1 Molecular Neurobiology** Ruediger Klein
Course content:	The lecture series gives an account of diverse roles played by various molecules in the neuronal development, differentiation, survival and regeneration. It also encompasses the involvement of different molecules in the neuronal physiology, circuit formation, behavior and pathology. The lecture is given weekly (3 SWS) and requires regular attendance and a final exam.
Qualification:	Students get well versed with the basic principles of Molecular Neurobiology as to how concerted actions of several molecules regulate the development and functioning of the nervous system and how genetic mutations in these molecules result in disruption of neuronal physiology and lead to different neurological disorders. The course, thus, provides fundamental knowledge that is necessary for students to take up research in the field of Neurobiology.
Course Type: Colloquium	**P 7.2 Molecular Neurobiology** Ruediger Klein
Course content:	The seminar series includes a number of selected research articles from peer- reviewed journals highlighting the recent findings in the field of Molecular Neurobiology. Major focus of this exercise is to learn latest methodologies, design of experiments and new concepts. The weekly seminar entails 2 SWS, and requires regular participation and approx. 35 minute oral presentation on one of the articles to the entire group.
Qualification Goals:	Using recommended literature and resources, these articles are studied and presented by the participants under the guidance of a supervisor. Students learn to carry out literature research in order to understand and explain the scientific question, the methodology used, the conclusions drawn in the specific scientific article. This course also provides a platform to critically review and discuss the findings of a scientific article as well as the merits and limitations of the experiments. This improves the analytical, communication and presentation skills and trains students towards objective thinking.
Course 3 Type: Practical course	**P 7.3 Molecular Neurobiology** Ruediger Klein
Course content:	The practical course provides an opportunity to learn several state of art techniques used in the field of molecular and cellular neurobiology research. It gives hands-on experience in primary neuron culture, axon-guidance assays, time lapse imaging, confocal imaging, genetic manipulation of the neuronal circuit and behavioural experiments, single-cell labelling in the whole-mount brain in Drosophila, etc. This course also teaches the usage of these techniques to address specific scientific questions and data acquisition followed by its analyses. The three week lab work entails 4 SWS.
Qualification Goals:	Students learn good general lab practice and carry out experiments using diverse techniques to address various scientific questions. They learn the basic principles of the techniques and how to acquire data,

	trouble-shoot the technical problems, and draw inferences from specific observations by critically reviewing the data. Along with the usefulness of the techniques, they also learn to take into consideration the limitations of such methods. In addition, they learn to work as a team and understand the benefits of the collaborative interactions. They also hone their presentation skills as they need to make at least two presentations during the course and thereby learn to communicate their findings to the fellow students and supervisors in a convincing and credible manner.

P 8 Neurophilosophy

Course Type: Lecture	**P 8.1 Lecture and Tutorial Neurophilosophy** Prof. Dr. Stephan Sellmaier
Course content:	Content of this lecture is an overview of the abovementioned area: (I) Philosophy of Mind, (II) Anthropology, (III) Philosophy of Science, (IV) Neuroscience and the History of Ideas.
Qualification:	Goal of this lecture is basic knowledge and proficiency in (I) Philosophy of Mind, (II) Anthropology, (III) Philosophy of Science, (IV) Neuroscience and the History of Ideas.
Course Type: Seminar	**P 8.2 Neurophilosophy Seminar** Prof. Dr. Stephan Sellmaier
Course content:	Content of this seminar is the focused treatment of topics in (I) Philosophy of Mind, (II) Anthropology, (III) Philosophy of Science, (IV) Neuroscience and the History of Ideas through seminar discussion, resume, protocol, oral presentation and/or essay.
Qualification Goals:	Goal of this seminar is independent working-out and presentation (oral, written) of neurophilosophical questions and possible solutions.

P 9 Research Project 2

Course Type: Guided Scientific Work	**P 9 Research Project 2 – Molecular and cellular neurobiology** Person responsible for course/ Instructor: Members of the faculty of the Graduate School of Systemic Neurosciences
Course content:	Content of this research project is guided working on a scientific question from the field of molecular or cellular neurobiology, applying general techniques of scientific working and good laboratory practice.
Qualification Goals:	Goal of this research project is to gain practice in general skills of scientific working.

P 10 Interdisciplinary Training

Course Type: All	**P 10.1 Interdisciplinary training 1** Responsible person : Members of the faculty of the Graduate School of Systemic Neurosciences
Course content:	Contents of this course are additional theoretical and practical skills in the scientific field of individual interest and interdisciplinary discussions.
Qualification Goals:	In this course the student will learn to focus his or her own scientific profile. Furthermore the students gain practice integrating insights from different fields on a common topic and enhance their ability to take part in interdisciplinary discussions.
Course Type: All	**P 10.2 Interdisciplinary training 2** Responsible person : Members of the faculty of the Graduate School of Systemic Neurosciences
Course content:	Contents of this course are additional theoretical and practical skills in the scientific field of individual interest and interdisciplinary discussions.
Qualification Goals:	In this course the student will learn to focus his or her own scientific profile. Furthermore the students gain practice integrating insights from different fields on a common topic and enhance their ability to take part in interdisciplinary discussions.
Course 3 Type: All	**P 10.2 Interdisciplinary training 2** Responsible person : Members of the faculty of the Graduate School of Systemic Neurosciences
Course content:	Contents of this course are additional theoretical and practical skills in the scientific field of individual interest and interdisciplinary discussions.
Qualification Goals:	In this course the student will learn to focus his or her own scientific profile. Furthermore the students gain practice integrating insights from different fields on a common topic and enhance their ability to take part in interdisciplinary discussions.

List of available courses for module P 10 Interdisciplinary Training:

The list of available elective courses for this module may vary from semester to semester. The following list provides some typical examples from recent semesters. For more information, please visit the LMU Online Directory:

Course Type: Practical	**P 10.2 Computer simulation of electrophysiology of the nerve cell** Person responsible for course/ Instructor: George Boyan
Course content:	The course consists of a two week, all day (6 SWS) practical in which the students expand the knowledge gained in the Fundamentals of Neuroscience I lecture course. The students are required to undertake modern electrophysiological experiments on computerized neurons and neuronal networks to gain insight into action potential generation, cable theory, synaptic interactions and in modeling neuronal interactions. The students follow a detailed accompanying tutorial and must present their results in the form of a final report which is subject to grading.
Qualification Goals:	Students are able to transfer theoretical knowledge to practical applications. Students obtain skills required for future lab work. Students can apply theoretical and practical knowledge to approach neurobiological questions by independently designing their own experiments. Students are well-trained in good general lab practice, consciencious documentation of experimental procedures, and obtain skills in specialized techniques such as voltage-clamp recording, identification and pharmacological separation of ionic currents. Students practice critical evaluation and interpretion of data as a basis for careful and relevant conclusions. In working in small lab groups, communication skills (discussion of results with instructors and fellow students, presentations, written lab reports), as well as organizational skills (efficient planning, documentation) are refined. Students learn excellent scientific method in written data presentation, including well-founded introduction to the topic, documentation, interpretation and discussion of the results.
Course Type: Practical	**P 10.2 Development of the nervous system** Person responsible for course/ Instructor: George Boyan
Course content:	The course consists of a two week, all day (6 SWS) practical in which the students expand the knowledge gained in the Fundamentals of Neuroscience II lecture course. The students are required to undertake experiments on the embryonic insect nervous system designed to reveal developmental mechanisms involved in generating complex brain structures. Students learn and apply modern experimental techniques in immunohistochemistry, intracellular dye injection and confocal fluorescence microscopy. Students analyze their data using 3D imaging software and must present

	their results in the form of an oral presentation to the group, and a final written report which is subject to grading.
Qualification Goals:	Students are able to transfer theoretical knowledge to practical applications. Students obtain skills required for future lab work. Students can apply theoretical and practical knowledge to approach developmental neurobiological questions by independently designing their own experiments. Students are well-trained in good general lab practice, consciencious documentation of experimental procedures, and obtain skills in specialized techniques such as immunolabeling and confocal microscopy. Students practice critical evaluation and interpretion of data as a basis for careful and relevant conclusions. In working in small lab groups, communication skills (discussion of results with instructors and fellow students, presentations, written lab reports), as well as organizational skills (efficient planning, documentation) are refined. Students learn excellent scientific method in written data presentation, including well-founded introduction to the topic, documentation, interpretation and discussion of the results.
Course Type: Seminar	**P 10.3 Development of the nervous system** Person responsible for course/ Instructor: George Boyan
Course content:	The course consists of a full semester (2 SWS) program in which the students are assigned topics related to one of the following areas: neurogenesis, axogenesis, synaptogenesis or regeneration in the nervous system (model systems include vertebrates & invertebrates). Each student is alloted a specific set of original, recent publications in one of the above fields to review. The students are encouraged to participate in the selection of the literature they are to review. The student is required to present a report of 45 min duration using modern presentation software to faculty and other participants in the course. Emphasis is placed on excellent scientific practice. This presentation is subject to grading.
Qualification Goals:	Students are proficient in presentation skills with different media, are introduced to library and internet resources, can assess and present a topic thoroughly and understandably to scientific peers. Students sharpen communication, presentation and posture skills gained through speaking in front of a group. Students are exposed to current literature, and gain insight into language and presentation formats required for peer-reviewed publication. Students are introduced to current events in developmental neurobiology, and can discuss this in a broad context.
Course 1 Type: Lecture	**P 10.2 Animal Communiation** Person responsible for course/ Instructor: Prof. Dr. Manfred Gahr
Course content:	Animal communication covers the role of different communication modes in reproduction and social behaviour in the animal kingdom. The lectures include the discussion of both ultimate and

	proximate mechanisms of signal production and perception. The lecture follows widely the book "Animal Communication" is given weekly (2 SWS) and requires regular attendance and a final exam. Additional material concerning the neural mechanisms of sound production and perception is handed out.
Qualification Goals:	The students are proficient in animal communication and are able to depict basic principles and transfer knowledge in an exam situation. Students obtain the fundamental knowledge required to participate in further specialized practical courses such as Mechanisms of Behaviour. Students are equipped with the basic knowledge prerequisite to scientific research in this topic.
Course Type: Practical course	**P 10.1 Mechanisms of Behaviour** Person responsible for course/ Instructor: Prof. Dr. Manfred Gahr
Course content:	In the practical course "Mechanisms of Behaviour" we investigate proximate mechanisms of hormone-sensitive behaviours such as vocal behaviours of birds. Particpants are introduced to step-by-step procedures for studying vocalization and physiological correlates quantitatively using telemetry. Further, we shall introduce neuroanatomical (light-microscopical) techniques to perform quantitative measurements of the brain and correlate these with behavioural results. Emphasis is placed on the relevance and hands-on practice with these techniques, and interpretation and presentation of data. The lab entails 3 SWS, and requires a detailed lab report according to excellent scientific practice.
Qualification Goals:	Students are able to transfer theoretical knowledge to practical applications
Course Type: Lecture with Practical course	**P 10.1 Neuroprothetik (6 ECTS)** Werner Hemmert / Michele Nicoletti
Course content:	The lecture covers neuroprostheses from already established cochlear implants to retina implants, which are still in development. As the underlying principle of all neuroprostheses is the electrical excitation of neurons, we will cover this topic in depth. Topcis: - electrical field spread - electrical excitation of neurons - biocompatibility - coding strategies In the practical computer laboratory (2h), which complements the lecture (2h), we implement a computer model of a cochlea implant and model how it will stimulate the auditory nerve. Topics: - numerical solution of linear and nonlinear differential equations - simulation of electrical field spread - simulation of electrical stimulation of neurons

	- implementation of a coding strategy for a cochlear implant Grading: - oral exam (30 Min); optional homework (practical problems to be solved with a computer) Final grade: 100 % oral exam; - correct solutions from homework contribute improve the final grade by 0.3
Qualification Goals:	After this course, the particitants will have: - knowledge how neuroprostheses work - interdisciplinary understanding of the underlying principles of electrical stimulation of neurons - ability to model electrically evoked neuronal excitation - ability to implement coding strategies for neuroprostheses
Course Type: Practical course	**P 10.2 Practical Course Bio-inspired Information Processing** Person responsible for course/ Instructor: Werner Hemmert
Course content:	Possible topics: - development of models of biological senses - models of neuronal processing of sensory information - measurement of bio-electrical signals - electrophysiological measurements (multi-electrode array) - electrical and optical stimulation of neurons Grading: - results of the project and written report (40%) - ability to solve problems: regular talks with davisor (40%) - 15-min presentation and 5-min questions (20%)
Qualification Goals:	After the practical course students are able to: - find, evaluate and present relevant literature - analyse biological systems and develop models which cover their basic principles - write research reports / scientific publications
Course Type: Seminar	**P 10.3 Advanced Seminar in Computational Neuroscience** Person responsible for course: Prof. Herz Instructors: Prof. Herz, Prof. Leibold, Dr. Wachtler
Course content:	Fundamental concepts and methods in Computational Neuroscience, illustrated by recent original publications and review articles, together with presentations of ongoing projects in the instructors' groups.
Qualification Goals:	Students are proficient in presentation skills with different media, are introduced to library and internet resources, can assess and present a topic thoroughly and understandably to scientific peers. Students sharpen communication, presentation and posture skills gained through speaking in front of a group. Students are exposed to current literature, and gain insight into language and presentation formats required for peer-reviewed publication. Students are introduced to new developments in the neurosciences, and can discuss this in a broad context.
Course Type: Seminar	**P 10.2 Intracellular and Dendritic Computation** Person responsible for course: Dr. Stemmler

	Instructors: Dr. Stemmler, Dr. Loebel
Course Content:	The course covers the dynamics of information processing within the extended geometry of neurons, including forward and backward propagation of action potentials, calcium dynamics and spikes, NMDA enhancement of synaptic input, biochemical compartmentalization, Poisson-Nernst-Planck descriptions of current flow, transient amplification and computation using intrinsic nonlinearities, and dendritic and synaptic learning rules. The lecture is given weekly (2 SWS) and requires regular attendance and a final exam.
Qualification Goals:	Students will advance their skill and knowledge concerning mathematical models of neurons, going beyond the single compartment models that are the focus in basic courses. By gaining experience in coupled systems of differential equations, these skills can then be applied to models in gene regulation, systems biology, and evolutionary biology. Students are thus introduced to current topics and gain an understanding of the state of the art in neuroscience research.
Course Type: Lecture	**P 10.2 Energy Constraints in the Nervous System** Person responsible for course: Dr. Loebel and Dr. Stemmler
Course content:	This course explores the role of energy as a constraint for the nervous system and its influence on neural coding strategies. We begin with the basic question of why computation, per-se, costs energy. Subsequently, we show how to calculate the energy cost of neural activity and discuss the non-linear trade-off between energy consumption and information gain at single neurons. Energy efficiency as a design principle for the biophysics of action potentials and the neural code is treated in depth. The lecture is given weekly (2 SWS) and requires regular attendance and a final exam.
Qualification Goals:	The students learn about the physics of the brain and develop a deeper understanding about the physical constraints of neural activity. This provides them with a novel point of view on neural processing, which complements the more traditional views that originate from studies in biology, chemistry and medicine. Students gain experience in the use of several mathematical approaches in the field of neuroscience, i.e., calculus, ordinary differential equations, Fourier analysis, information theoretic analysis, optimization methods, and independent component analysis. Students are thus introduced to current topics and gain an understanding of the state of the art in neuroscience research.
Course Type: Seminar	**P 10.3 Neurobiology of Cognition** Prof. Dr. Mark Hübener
Course content:	In this seminar, original papers covering several aspects of Cognitive Neuroscience are presented and discussed. Using suggested literature and other resources, and with consultation with the instructor, students independently research the topic. The seminar entails 2 SWS, and requires an approx. 25 minute oral presentation of the topic to the entire group. The topics are then discussed by the whole group.
Qualification Goals:	Students are trained to read and understand original scientific literature. They learn how to visualize and present complex experimental

	approaches to a mixed audience, consisting of undergraduates and PhD students. Ideally, they should learn to separate the important from the less important information. They should also learn to be critical of the data in a scientific publication.
Course Type: Lecture	**P 10.2 Clinical Neurology: Vestibular and Ocular Motor Function** Person responsible: Klaus Jahn, MD
Course content:	This course gives a general overview on fundamental principles of vestibular and ocular motor functions in humans. Students have the opportunity to learn how to test patients in a clinical environment for potential ocular motor and vestibular deficits at the bedside. Clinical testing is made together with expert neurologists at the dizziness unit of the German Center of Vertigo and Balance Disorders (IFB). Findings are discussed in the context of neuroanatomy, sensory physiology and pathophysiology. Students learn how the theoretical background and basic neuroscience relates to the typical patient's complaints. This also helps to ask relevant questions for research projects in clinical neuroscience. The course is given weekly (2 SWS) and requires regular attendance.
Qualification Goals:	Students are able to transfer theoretical knowledge about sensory physiology to practical applications. Students obtain skills for evaluating vestibular and ocular motor functions in humans. Students can apply theoretical and practical knowledge to approach biological questions in clinical neuroscience. In working in a head-to head situation with experts in the field social skills and communication skills are refined. Students learn scientific methods in clinical neuroscience.
Course Type: Practical course	**P 10.2 Diagnostic Procedures in Neurology** Olympia Kremmyda, Roman Schniepp, Michael Strupp, Marianne Dieterich
Course content:	The course consists of a practical and theoretical part. The lectures of the theoretical part give a short overview of the most important neurological diseases, such as stroke, epilepsy and dementia. The practical part takes place in the Neurological Clinic and Outpatient Department of the University Hospital Grosshadern. During the practical part, students come in contact with the electrophysiological and imaging methods used in every day clinical practice, such as Electroencephalography, Ultrasound, Evoked Potentials, Electromyography etc and watch them implemented on neurological patients. Each of the students has also to give a short presentation on a clinical method.
Qualification Goals:	Many neuroscience students are working on topics related to the pathophysiology and therapy of neurological diseases, but only few of them are given the chance to come in contact with a clinical environment where actual patients with these diseases are diagnosed and treated. This course gives the opportunity to students that don't have a medical background to become acquainted with current neurological diagnostical methods and their practical implementations. Students can thus acquire knowledge that would help them orientate their research goals on a more practical level.
Course Type: Lecture	**P 10.2 Cellular Neurophysiology** Person responsible for course/ Instructor: Felix Felmy & Lars Kunz
Course content:	The lecture covers basic and advanced principles of cellular

	neurophysiology. It comprises topics on pre- and postsynaptic mechanisms, ion channels and different types of plasticity. The lecture is given weekly (2 SWS) and requires regular attendance and a final exam.
Qualification Goals:	The students are proficient in the contents of the course and are able to depict basic principles and transfer knowledge in an exam situation. They obtain the fundamental knowledge required to understand advanced parts of the lecture and to read specialised literature on the topics covered. Students obtain the knowledge required to participate in further specialized courses (e.g. neuronal biophysics, synaptic plasticity, systemic neurosciences) as well. They are equipped with the basic knowledge prerequisite to scientific research in neuroscience or psychology.
Course Type: Lecture	**Repetition in Basic Calculus** Person responsible for course/ Instructor:Prof. Leibold
Course content:	The course provides a 1) repetition of basic topics from school math such as logarithms, trigonometry, differentials, integrals and linear systems of equations and, 2) a short introduction into dynamical systems and linear algebra The course consists of a weekly lecture (2 SWS) and will not earn credit points.
Qualification Goals:	The students are proficient in doing basic mathematical operations.
Course Type: Seminar	**P 10.3 Neurophysiology of olfaction and taste** Person responsible for course/ Instructor: Blanka Pophof
Course content:	Topics related to chemical perception, from receptor activation through signal transduction up to brain activity and behaviour, in vertebrates as well as invertebrates, are assigned to each participant. Using recommended literature and resources and with regular consultation with the instructor, students independently research the topic. The seminar entails 2 SWS, and requires in an approx. 30 minute oral presentation of the topic, according to excellent scientific practice, to the entire group.
Qualification Goals:	Students are proficient in presentation skills with different media, are introduced to library and internet resources, can assess and present a topic thoroughly and understandably to scientific peers. Students sharpen communication, presentation and posture skills gained through speaking in front of a group. Students are exposed to current literature in sensory physiology, and gain insight into language and presentation formats required for peer-reviewed publication.
Course Type: Practical course	**P 10.2 Practical Course Behavioural Profiling of Mice** Person responsible for course/ Instructor: Mathias V. Schmidt
Course content:	Animal models are a vital cornerstone for the understanding of neuroscience-related disorders and the foundation for translational research from the bench to the clinic. The choice of the best suited animal model together with the best behavioural readout is essential for the success of the research project. The aim of the course is to motivate young students at the beginning of their carrier to think about the implications of their choice of research models and behavioural tests. The students will plan, perform and analyse several behavioural tests in

	mice. The course lasts 2 weeks (3 ECTS) and requires a detailed lab report according to excellent scientific practice.
Qualification Goals:	The students will learn the theoretical background of working with animal models. They will get to know potential pitfalls and problems related to animal models and animal testing. They will then plan and perform several behavioral tests in mice. The obtained data will be statistically analyzed and presented. The students will prepare a scientific report on the performed experiments, including an introduction, a methods section, a results section and a discussion.
Course Type: Seminar	**P 10.3 Animal Models for Psychiatric Disorders** Person responsible for course/ Instructor: Mathias V. Schmidt
Course content:	The aim of the seminar is to illustrate how animal models can lead to a better understanding of the molecular basis of psychiatric disorders, using examples from the recent literature. Students will also get an overview introduction on how to find, filter, read, understand and judge scientific literature. Each student will get a specific paper illustrating good (or poor) use of animal models in psychiatric disorder research assigned, which they will present and discuss together with the group.
Qualification Goals:	The students will learn the basics on animal models for psychiatric disorders. They are then introduced to different methods of how to read and digest scientific literature. Using examples of the recent literature, they are then asked to prepare a presentation of a paper to their peers, explaining the main findings and conclusions. The implications of the paper as well as the quality of the student presentation are then discussed in the study group.
Course Type: Seminar	**P 10.3 Mental Causation** Prof. Dr. Stephan Sellmaier
Course content:	Questions about the existence and nature of mental causation are prominent in contemporary discussions of the mind and human agency. Originally, the problem of mental causation was that of understanding how an immaterial mind, a soul, could interact with the body. Most philosophers nowadays repudiate souls, but the problem of mental causation has not gone away. Instead, focus has shifted to mental properties. How could mental properties be causally relevant to bodily behavior? How could something mental qua mental cause what it does? The Seminar will examine questions of this sort.
Qualification Goals:	Students are proficient in presentation skills with different media, are introduced to library and internet resources, can assess and present a topic thoroughly and understandably to scientific peers. Students are introduced to current events in Philosophy and especially in Neurophilosophy, and can discuss this in a broad context.
Course Type: Seminar	**P 10.3 Personal Identity** Prof. Dr. Stephan Sellmaier
Course content:	The modern debate on personal identity has been hugely influenced by John Locke, whose discussion of the topic in his Essay concerning Human Understanding both originated and shaped the whole modern debate. In the seminar, we propose to do three things: We will start by discussing Locke's own text, before looking at the "classical" criticisms of Locke's position raised by Butler, Reid and Leibniz in the 18th

	century. Finally, we shall consider some influential papers by both contemporary Lockeans and their critics, which will show that the original debate has preserved its actuality up to the present. The seminar will be of interest not only to philosophers, but also to people working in other disciplines concerned with human identity and the mind, e.g. psychology or cognitive science.
Qualification Goals:	Students are proficient in presentation skills with different media, are introduced to library and internet resources, can assess and present a topic thoroughly and understandably to scientific peers. Students are introduced to current events in Philosophy and especially in Neurophilosophy, and can discuss this in a broad context.
Course Type: Seminar	**P 10.3 Seminar Neurobiology** Person responsible for course/ Instructor: Hans Straka
Course content:	In this seminar current topics of neurobiology are discussed. Topics include but are not limited to single cell physiology, molecular biology, neuroanatomy and systems neurobiology. Using recommended literature and resources, and with regular consultation with the instructor, students independently research a current topic. The seminar entails 2 SWS, and requires an approx. 30 minute oral presentation of the topic, according to excellent scientific practice, to the entire group.
Qualification Goals:	The seminar will introduce students to current events in neurobiology, which will be discussed in a broad context. Students presentation skills with different media will be assessed and commented on. Students will be exposed to current literature which will give them an insight into language and presentation formats required for peer-reviewed publication.
Course Type: Practical course	**P 10.2 Transcranial Magnetic Stimulation (TMS)** Dr. Paul Taylor
Course content:	Hands-on practical course of the use of transcranial magnetic stimulation in the study of visual cognition and action. Participants are shown one-on-one how to use non-invasive brain stimulation in normal participants including participant screening and intensity calibration using phosphene and motor thresholds. Additionally they are instructed on the use of neuronavigation using stereotactic infra-red registration to participants' structural MRI brain scans. After four sessions of training participants then run experiments on a full cohort of participants to gain 3 ECTS points.
Course Type: Seminar	**P 10.2 Genes, Hormones and the Brain: Regulation of Stress, Emotions and Behaviour** Instructor: Dr. Chadi Touma
Course content:	The seminar is focussing on the interaction of genetic, behavioural and neuroendocrine factors and their role in the aetiology and pathophysiology of affective disorders. It further gives an introduction to the methods used in preclinical psychiatric research. Using recommended literature and resources, and with regular consultation with the instructor, students independently research the topic. The seminar entails 2 SWS, and requires in an approx. 25 minute oral presentation of the topic, according to excellent scientific practice, to the entire group. Moreover, an active contribution to the scientific discussion

	after each talk is expected from all participants.
Qualification Goals:	Students are proficient in presentation skills with different media, are introduced to library and internet resources, can assess and present a topic thoroughly and understandably to scientific peers. Students sharpen communication, presentation and posture skills gained through speaking in front of a group. Students are exposed to current literature, and gain insight into language and presentation formats required for peer-reviewed publication. Students are introduced to current events in Biology, and can discuss this in a broad context.
Course Type: Lecture	**P 10.2 Models of Visual Processing** Person responsible for course/ Instructor: PD Dr. Thomas Wachtler-Kulla
Course content:	Covers the basic functional architecture of the mammalian visual system as well as computational modeling and simulation approaches used to investigate visual processing at various levels. The lecture is given weekly (2 SWS) and requires regular attendance and completion of exercises (1 SWS).
Qualification Goals:	The students are proficient in the basics of the visual system and computational principles underlying models of visual processing, and are able to transfer the knowledge in simple computer programs. Students are equipped with the basic knowledge prerequisite to do scientific research in computational neuroscience.
Course Type: Seminar	**P 10.3 Neural Mechanisms of Vision** Person responsible for course/ Instructor: PD Dr. Thomas Wachtler-Kulla
Course content:	Topics in visual neuroscience are assigned to each participant. Using recommended literature and resources, and with regular consultation with the instructor, students independently research the topic and prepare the presentation of the material. The seminar entails 2 SWS, and requires an approx. 25 minute oral presentation, with subsequent discussion, to the entire group.
Qualification Goals:	Students are proficient in presentation skills with different media, are introduced to library and internet resources, can assess and present a topic thoroughly and understandably to scientific peers. Students sharpen communication, presentation and posture skills gained through speaking in front of a group. Students are exposed to current literature, and gain insight into language and presentation formats required for peer-reviewed publication. They are able to assess and critically discuss published studies. Students are introduced to current topics in visual neuroscience and can discuss the science in a broad context.
Course Type: Lecture & Practical course	**P 10.2 Comparative Anatomy and Evolution of the Vertebrates** Mario F Wullimann (with Benedikt Grothe, Mark Hübener, Lars Kunz, Oliver Behrend)
Course content:	The two-week course includes a series of lectures in the morning followed by a practical course for the rest of the day. The lectures provide theoretical background on evolutionary issues of the vertebrate body. The practical course includes focal short talks by students on important issues related to the organ system treated on each particular

	day. Thereafter, dissections or analyses of preserved dry specimens of representative vertebrates will be performed by students with the focus on that particular organ system (digestive tract, urogenital system, heart and vascular system, sensory organs and brain, skull, rest of skeleton, musculature, swimbladder, lungs & gills). In addition there will be a museum day for the study of fossils.
Qualification Goals:	The practical exposes each student to a variety of vertebrates, including some established model systems used in biomedical and basic research, such as teleost fish, frogs and rodents, widening the systemic viewpoint for future experimentators. Lectures and student's own presentations followed by demonstrations of results of dissections will enable students to intellectually synthesize their work. In addition, much of this is done in teamwork.

P 11 Labrotation

Course Type: Supervised lab work	**P 11.1 Laboratory internship** Person responsible for course/ Instructor: Members of the faculty of the Graduate School of Systemic Neurosciences
Course content:	Content of this module is participating in the daily lab work of a participating lecturer.
Qualification Goals:	Goal of this module is getting to know every day lab work.

P 12 Research Project 3

Course Type: Guided Scientific Work	**P 12 Research Project 3 – Neurosciences** Person responsible for course/ Instructor: Members of the faculty of the Graduate School of Systemic Neurosciences
Course content:	Content of this research project is guided working on an elective scientific question. The topic is to be chosen together with the mentors.
Qualification Goals:	Goal of this research project is gaining practice in general skills of scientific working. 3In the end the student shall be able to denominate a novel question of scientific interest.

P 13 Teaching and Training

Course Type: Tutorial activity	**P 13.1 Tutoring for beginners** Person responsible for course/ Instructor: Dr. Alexander Kaiser
Course content:	Content of this course is helping younger students to rehearse contents of different lecture series and prepare them for the exam.
Qualification Goals:	Goal of this course is gaining elementary teaching practice.
Course Type: Workshop	**P 13.2 Non-scientific Skills I** Person responsible for course/ Instructor: external professionals
Course content:	Contents of this course are specialized non-scientific skills e.g. social, lingual or time management skills.
Qualification Goals:	*Goal of this course is preparing students for career demands*
Course Type: Workshop	**P 13.2 Non-scientific Skills II** Person responsible for course/ Instructor: external professionals
Course content:	Contents of this course are specialized non-scientific skills e.g. social, lingual or time management skills.
Qualification Goals:	Goal of this course is preparing students for career demands

P 14 Masters Degree Module

Course Type: Master thesis	**P 14.1 Master thesis** Person responsible for course/ Instructor: Supervisor
Course content:	Contents of the master thesis is to independently work on a given scientific question. Please note the list of conducted master theses on our homepage!
Qualification Goals:	Goal of the master thesis is a demonstration of ability to independently cope with an adequately demanding scientific question with the possibility to unfold individual ideas.
Course Type: Workshop	**P 14.2 Colloquium master thesis** Person responsible for course/ Instructor: Supervisor
Course content:	Content of this colloquium are recent publications on the wider field of topics related to the master thesis. The thesis results will be represented in this colloquium.
Qualification Goals:	Goal of this colloquium is the ability to critically judge and discuss scientific work as well as presenting own work to an expert audience.