Overview, Recommended Study Plan and Module Descriptions

Module No.	Module	CP
1	Dynamics, Evolution and Simulation of Geophysical Systems	12.5
2	Advanced Methods for Investigating the Earth	12.5
3	Advanced Methods in Applied Geophysics	13
4	Elective Studies: Material Physics	14 – 18
5	Elective Studies: Nonlinear Physics	14 – 18
6	Elective Studies: Geosciences	14—18
7	Interdisciplinary Studies	at least 4—8
8	Professional Specialization and Project Design	30
9	Master's Project	30

Recommended Study Organization

FS	Module				
1.	**Dynamics, Evolution and Simulation of Geophysical Systems (12.5 CP)**	**Advanced Methods for Investigating the Earth (12.5 CP)**	**Advanced Methods in Applied Geophysics (13 CP)**	**Elective Studies (14-18 CP)** Nonlinear Physics *- or –* Material Physics *- or -* Geosciences	**Interdisciplinary Studies (at least 4-8 CP)**
2.					
3.	**Professional Specialization and Project Design (30 CP)**				
4.	**Master's Project (30 CP)**				

Taken together, at least 22 CP need to be achieved in the modules "Elective Studies" and "Interdisciplinary Studies".

Degree programme	**Geophysics (Master of Science)**
Module	**Dynamics, Evolution and Simulation of Geophysical Systems**
Module number	1

1	**Basic data**
Programme semester	1,2
Credits (CP)	12.5
Workload (h) in total	375
Module duration	2 Semesters
Module status (M/EM)	M

2	**Profile**
Aim of the module / Integration in the curriculum	
This module is devoted to the dynamics and evolution of geophysical systems. While many branches of classical geophysics are concerned with determining the physical properties of the Earth, the focus of this module is on dynamical processes within the Earth system. In addition to their physical description, the module also deals with numerical modelling techniques, which are taught in the context of geophysical examples. A seminar and a colloquium allow students to gain insight into current research topics.	
Teaching content	
Reiteration of the basic equations of continuum mechanics and fluid dynamics; frequently used approximations of these equations; fluid flow in rotating systems; boundary layers; stably stratified flow; gravity waves; instability and turbulence in geophysical systems; convection; dynamics of the Earth's mantle; numerical algorithms for the simulation of geophysical systems; finite difference, finite volume, finite element and spectral methods; advanced methods for solving linear and non-linear systems of equations	
Learning outcomes	
Students have mastered the basic principles of geophysical fluid dynamics. They are aware of the main dynamical characteristics of flows within the atmosphere, the oceans, the Earth's core and mantle. They are able to formulate the basic partial differential equations needed for the description of these geophysical systems and they have developed a profound understanding of various approaches for solving these equations numerically. The experience gained in writing a simple simulation code enables them to master more complex numerical models, to employ these for their purposes and to refine them as needed. They are aware of selected current research topics. Furthermore, they know how to give a compelling research talk.	

3	**Structure**						
Module components							
No.		Course category	Course form	Course	Status (M/EM)	Workload (h)	
						Attendance time (h) / SWS	Self-study (h)
1	1a	Lecture		Advanced Geophysical Fluid Dynamics	M	30 h / 2 SWS	30h

	1b	Practical		Advanced Geophysical Fluid Dynamics	M	15 h / 1 SWS	45h
2	2a	Lecture		Numerical Simulation of Geophysical Processes	M	30 h / 2 SWS	30h
	2b	Practical		Numerical Simulation of Geophysical Processes	M	30 h / 2 SWS	90h
3		Seminar		Seminar on the Dynamics and Evolution of Geophysical Systems	M	30 h / 2 SWS	30h
4		Seminar	Colloquium	Geophysical Colloquium	M	15h / 1SWS	0h
Choice within module				None			

4	**Examination structure**				
Degree-relevant examination(s)					
No.	FME/ MCE	Type	Duration/ Scope	Connection to course no. if appl.	Weight in the module grade
1	FME	Oral exam. All requirements for passing the coursework of this module have to be fulfilled before taking the oral exam.	30 -45 min		100%
Weight of the module grade for the final overall grade		The module contributes with a weight of 12.5 / 120 to the final overall grade			
Required coursework					
No.		Type	Duration/ Scope	Connection to course no. if appl.	
1		Successful participation in the practical part for Advanced Geophysical Fluid Dynamics: Exercises are worked on in self-study, checked and discussed in small exercise groups. Successful participation usually requires the correct solution of 50% of the tasks.	Weekly Exercises	1b	
2		Successful participation in the practical part for Numerical Simulation of Geophysical Processes: In pre-defined, weekly steps, students develop their own simulation code for a specific geophysical flow phenomenon. Their work is evaluated weekly and discussed within small groups. In addition, the students work on small theoretical exercises. The successful participation usually requires the complete implementation of the simulation code, complemented by the correct solution of 50% of the theoretical tasks.	Weekly Exercises, containing theoretical and practical tasks	2b	
3		Presentation of a talk in the Seminar on the Dynamics and Evolution of Geophysical Systems.	~ 20 min.	3	

5	**Requirements**
Module-related requirements for participation	Basic knowledge of geophysical continuum mechanics, geophysical fluid dynamics and on modelling approaches for geophysical systems, as for example taught in the BSc Geophysics at WWU.
Awarding credits	Academic credit is awarded upon completion of the entire module, i.e. when students have proven that they have achieved the learning outcomes in their entirety as provided by the module.
Rules on course attendance	Regular attendance of the Seminar and Colloquium is expected.

6	CP allocation	
Participation (= attendance time)	Course no. 1a	1 CP
	Course no. 1b	0.5 CP
	Course no. 2a	1 CP
	Course no. 2b	1 CP
	Course no. 3	1 CP
	Course no. 4	0.5 CP
Degree-relevant examination(s)	no. 1	2 CP
Required coursework	no. 1	1.5 CP
	no. 2	3 CP
	no. 3	1 CP
Total CP		12.5 CP

7	Module administration
Frequency	every WS
Module representative	Prof. Ulrich Hansen
Responsible faculty	Physics

8	Recognition
Usability in other degree programs	none
Module title German	Dynamik, Evolution und Simulation geophysikalischer Systeme
German translation of the module components from field 3	Course No. 1a: Fortgeschrittene geophysikalische Fluiddynamik (Vorlesung)
	Course No. 1b: Fortgeschrittene geophysikalische Fluiddynamik (Übung)
	Course No. 2a: Numerische Simulation geophysikalischer Prozesse (Vorlesung)
	Course No. 2b: Numerische Simulation geophysikalischer Prozesse (Übung)
	Course No. 3: Seminar zur Dynamik und Evolution geophysikalischer Systeme
	Course No. 4: Geophysikalisches Kolloquium

9	Miscellaneous

Degree programme	**Geophysics (Master of Science)**
Module	**Advanced Methods for Investigating the Earth**
Module number	2

1	**Basic data**
Programme semester	1,2
Credits (CP)	12.5
Workload (h) in total	375
Module duration	2 Semesters
Module status (M/EM)	M

2	**Profile**
Aim of the module / Integration in the curriculum	
Understanding and knowledge of advanced seismology and array seismic methods, reflection seismics and other geophysical methods. Ability to write a wave propagation program. Ability to analyse and interpret seismological and exploration seismic data. Overview of recent research topics.	
Teaching content	
Advanced seismic concepts to investigate Earth, for example Green's functions, ambient seismic noise, monitoring, source inversion methods, array seismic methods and array design, advanced signal processing methods and mislocation vectors. Analysis and interpretation of geophysical data. Modelling of seismic and other geophysical data with different methods. Interpretation using information from petro-physics and other fields. The practical classes enhance the understanding and ability to process and analyse real data. A wave propagation model will be written. The colloquium will allow students to learn about recent advances in geophysics research.	
Learning outcomes	
The students know methods and approaches to investigate Earth's interior, they are able to extract information from complex data sets and compare to numerically generated data sets. The students have experience in error analysis and sources of errors that may arise in the analysis of geophysics data sets. The students have the ability to transfer their knowledge to other non-geophysical data sets. The understand the relevance of the acquired geophysical content for current and recent research projects.	

3	**Structure**					
Module components						
No.	Course category	Course form	Course	Status (M/EM)	Workload (h)	
					Attendance time (h) / SWS	Self-study (h)
1	1a	Lecture	Advanced Seismology	M	30 h / 2 SWS	30 h
	1b	Practical	Advanced Seismology	M	30 h / 2 SWS	90 h
2	2a	Lecture	Analysis and Interpretation of Geophysical Data	M	30 h / 2 SWS	30 h

	2b	Practical	Analysis and Interpretation of Geophysical Data	M	30 h / 2 SWS	90 h
3		Seminar	Geophysical Colloquium	M	15 h / 1SWS	0 h
Choice within module			none			

4	Examination structure				
Degree-relevant examination(s)					
No.	FME/ MCE	Type	Duration/ Scope	Connection to course no. if appl.	Weight in the module grade
1	FME	Oral exam. All requirements for passing the coursework of this module have to be fulfilled before taking the oral exam.	30-45min		100%
Weight of the module grade for the final overall grade		The module contributes with a weight of 12.5 / 120 to the final overall grade			
Required coursework					
No.		Type	Duration/ Scope	Connection to course no. if appl.	
1		Successful participation in the practical part for advanced seismology: the practical part will deepen the knowledge gained in the Lectures. A successful participation also requires processing the tasks in the practical part as well as writing a report.	weekly tasks and a report of approx. 10 pages.	1b	
2		Successful participation in the practical part of analysis and interpretation. In the practical part techniques and analysis of data sets will be carried out to deepen the knowledge. A successful participation also requires processing the tasks in the practical part as well as writing a report.	report of approx. 30 pages.	2b	

5	Requirements
Module-related requirements for participation	Basic knowledge of Seismology and applied methods as for example taught in the BSc Geophysics at WWU are highly recommended.
Awarding credits	Academic credit is awarded upon completion of the entire module, i.e. when students have proven that they have achieved the learning outcomes in their entirety as provided by the module.
Rules on course attendance	

6	CP allocation	
Participation (= attendance time)	Course no. 1a	1 CP
	Course no. 1b	1 CP
	Course no. 2a	1 CP
	Course no. 2b	1CP
	Course no. 3	0.5 CP
Degree-relevant examination(s)	no. 1	2 CP
Required coursework	no. 1	3 CP
	no. 2	3 Cp
Total CP		12.5 CP

7	**Module administration**
Frequency	every WS
Module representative	Prof Dr. C. Thomas
Responsible faculty	Physics

8	**Recognition**
Usability in other degree programs	none
Module title German	Fortgeschrittene Methoden zur Erkundung des Erdkörpers
German translation of the module components from field 3	Course No. 1a: Fortgeschrittene Seismologie (Vorlesung)
	Course No. 1b: Fortgeschrittene Seismologie (Übung)
	Course No. 2a: Analyse und Interpretation geophysikalischer Daten (Vorlesung)
	Course No. 2b: Analyse und Interpretation geophysikalischer Daten (Übung)
	Course No. 3: Geophysikalisches Kolloquium

9	**Miscellaneous**

Degree programme	**Geophysics (Master of Science)**
Module	**Advanced Methods in Applied Geophysics**
Module number	3

1	**Basic data**
Programme semester	1,2
Credits (CP)	13
Workload (h) in total	390
Module duration	2 semesters
Module status (M/EM)	M

2	**Profile**

Aim of the module / Integration in the curriculum

Procurement of advanced concepts and skills for the collection, analysis and inversion of geophysical data under special consideration of electromagnetic deep sounding (magnetotellurics).

Teaching content

Methods for solving linear and non-linear inversion problems: deterministic and probabilistic approaches, distance methods, application of vector spaces, regularization of ill-posed problems, robust regression, gradient methods. Theory and practice of the methods of electromagnetic deep sounding and especially magnetotellurics: concepts, time series processing, analysis of transfer functions, inversion, applications in lithospheric research and exploration geophysics, interpretation. Practical application of the learned methods and procedures in an advanced field course.

Learning outcomes

The students know the methods and procedures for the inversion of geophysical data and are familiar with the concepts of electromagnetic deep sounding methods. They are able to independently collect data and to independently apply advanced procedures and methods for data processing and inversion. They are able to implement programs to solve inverse geophysical and non-geophysical problems. Students are able to assess the validity of geophysical models of the subsurface. They know the theoretical concepts, measuring principles and application areas of electromagnetic deep sounding.

3	**Structure**

Module components

No.		Course category	Course form	Course	Status (M/EM)	Workload (h)	
						Attendance time (h) / SWS	Self-study (h)
1	1a	Lecture		Modelling and inversion	M	30 h / 2 SWS	30 h
	1b	Practical		Modelling and inversion	M	15 h / 1 SWS	45 h
2	2a	Lecture		Magnetotellurics	M	30 h / 2 SWS	30 h
	2b	Practical		Magnetotellurics	M	15 h / 1 SWS	45 h

3	Practical course	excursion	Field course	M	60 h	90 h
Elective options within the module			None.			

4	**Examination structure**				
Degree-relevant examination(s)					
No.	FME/ MCE	Type	Duration/ Scope	Connection to course no. if appl.	Weight in the module grade
1	MCE	Oral examination on the contents of the lectures "Modelling and Inversion" and "Magnetotellurics". All requirements for passing the related coursework (see No. 1 and 2 below) have to be fulfilled before taking the oral exam.	30 – 45 min	1,2	50 %
2	MCE	Detailed report on the measurements carried out in the field course and on data evaluation	Report (approx. 20 p)	3	50 %
Weight of the module grade for the final overall grade		The module contributes with a weight of 13 / 120 to the final overall grade			
Required coursework					
No.		Type	Duration/ Scope	Connection to course no. if appl.	
1		Successful participation in the practical exercises on "Modelling and Inversion": Exercises are worked on in self-study, checked and discussed in small exercise groups. Successful participation usually requires the correct solution of 50% of the tasks.	Weekly Exercises	1b	
2		Successful participation in the practical exercises on "Magnetotellurics": Exercises are worked on in self-study, checked and discussed in small exercise groups. Successful participation usually requires the correct solution of 50% of the tasks.	Weekly Exercises	2b	

5	**Requirements**
Module-related requirements for participation	None
Awarding credits	Academic credit is awarded upon completion of the entire module, i.e. when students have proven that they have achieved the learning outcomes in their entirety as provided by the module.
Rules on course attendance	Attendance in the field course is required because students carry out geophysical measurements on their own.

6	**CP allocation**	
Participation (= attendance time)	Course no. 1a	1 CP
	Course no. 1b	0.5 CP
	Course no. 2a	1 CP
	Course no. 2b	0,5 CP
	Course no. 3	2 CP
Degree-relevant examination(s)	no. 1	2 CP
	no. 2	3 CP
Required coursework	no. 1	1.5 CP

	no. 1	1.5 CP
Total CP		13 CP

7	Module administration
Frequency	every WS
Module representative	Prof. Dr. M. Becken
Responsible faculty	Physics

8	Recognition
Usability in other degree programs	none
Module title German	Fortgeschrittene Methoden der angewandten Geophysik
German translation of the module components from field 3	Course No. 1a: Modellierung und Inversion (Vorlesung)
	Course No. 1b: Modellierung und Inversion (Übung)
	Course No. 2a: Magnetotellurik (Vorlesung)
	Course No. 2b: Magnetotellurik (Übung)
	Course No. 3: Feldkurs

9	Miscellaneous

Degree program	**Geophysics (Master of Science)**
Modul	**Elective Studies: Materials Physics**
Module number	4

1	**Basic data**
Program semester	1, 2
Credits (CP)	14 – 18
Workload (h) in total	420 – 540
Module duration	2 semesters
Module status (M/EM)	EM

2	**Profile**

Aim of the module / Integration in the curriculum

The evolution of our society has been and is strongly affected by materials with particular properties. Steel, as an example, consisting of a mixture of iron and carbon, has allowed one to construct buildings of several hundred meters height. High purity silicon as the basic ingredient for the fabrication of electronic devices is at the heart of the digital revolution of our society and is currently partially replaced by organic-inorganic composite materials. The macroscopic properties of a material are essentially determined by defects of different dimensionality, defined as deviations from the ideal crystal structure, which constitute the so-called microstructure of a material. In the examples given above, but also beyond and in the vast majority of all materials the specific macroscopic properties of a material, like, e.g. its hardness or electrical conductivity, are directly related to the often complex and different length scale-covering microstructure and therefore refrain from being accessible by a simple consideration.

In the module, the students are introduced to the description of single- and multi-component materials and their microstructure as well as the coupling between microstructure and property. The description of defects of the crystal lattice as well as their properties and their characterization by using modern methods of materials research are discussed to provide the students with a fundamental understanding of the properties of functional materials.

Teaching content

Lecture materials physics: structure and crystal defects, thermodynamics and constitution, diffusion, phase transitions and reaction kinetics, mechanical properties, classes of functional materials

Laboratory course of materials physics: experimental techniques and basic physical properties of materials

Advanced lectures: choice of, e.g., atomic transport, physics of soft matter and biomaterials, semiconductor physics, polymer physics, material mechanics, nanostructured materials, numerical methods of materials physics

Learning outcomes

The students have acquired advanced knowledge in the physical concepts and methods of materials physics. They are able to contribute to pertinent current research activities.

3	**Structure**					
Module components						
No.	Course-category	Course-form	Course	Status (M/EM)	Workload (h)	
					Attendance time (h)/SWS	Self studies (h)
1 1a	Lecture		Materials physics I	M	30 h / 2 SWS	30 h
1 1b	Exercise		Exercises to materials physics I	M	15 h / 1 SWS	45 h
2 2a	Lecture		Materials physics II	M	30 h / 2 SWS	30 h
2 2b	Exercise		Exercises to materials physics II	M	15 h / 1 SWS	45 h
3	Laboratory course		Laboratory course on materials physics	M	45 h / 3 SWS	105 h
4			At least one advanced lecture, possibly with exercise, or a seminar in the field of materials physics or experimental or theoretical solid-state physics or Implementation of a short research project in a materials physics research group (“mini research”) or Implementation of a project in the context of an internship in industry under scientific supervision of a university teacher of the module	M	depending on the course	depending on the course
Elective options within the module			The courses no.1 – 3 are mandatory. Courses related to no. 4 can be chosen upon agreement with a module representative.			

4	**Examination structure**				
Degree-relevant examination(s)					
No.	FME/ MCE	Type	Duration/ Scope	Connection to course No., if appl.	Weight in the module grade
1	FME	Oral final examination on the subjections of the module.	30 – 45 min		100%
Weight of the module grade for the final overall grade		The module grade contributes with the weight 17/120 to the final overall grade.			
Required coursework					

No.	Type	Duration/ Scope	Connection to course No., if appl.	
1	Successful participation in the “Exercises to materials physics I”. Exercise sheets are worked on in self-studies. They are checked, presented and discussed in small exercise groups by the students. The solutions of the exercises are graded. The successful participation usually requires the correct solution of 50 % of the exercises.	Exercise sheets on a weekly or biweekly basis	1b	
2	Successful participation in the “Exercises to materials physics I”. Exercise sheets are worked on in self-studies. They are checked, presented and discussed in small exercise groups by the students. The solutions of the exercises are graded. The successful participation usually requires the correct solution of 50 % of the exercises.	Exercise sheets on a weekly or biweekly basis	2b	
3	Successful, testified implementation and assessment of all required experiments.	10 experimental protocols	3	
4	If applicable, depending on the choice of the courses: Solution of exercises, presentation of a talk or delivery of a final report on the project.		4	

5	**Requirements**
Module-related requirements for participation	None
Awarding credits	Academic credit is awarded upon completion of the entire module, i.e. when students have proven that they have achieved the learning outcomes in their entirety as provided by the module.
Rules on course attendance	In the laboratory courses physical attendance is necessary because the competence to perform physics experiments can be acquired only by actually dealing with the provided laboratory equipment. In case of absence for a substantial reason alternative dates are offered. If under course. Nr 4 a seminar is chosen, a regular participation in the seminar is explicitly recommended because the ability to actively participate in the scientific discussion following the talks is an essential learning target.

6	**CP allocation**	
Participation (= attendance time)	Course No. 1a	1 CP
	Course No. 1b	0,5 CP
	Course No. 2a	1 CP
	Course No. 2b	0,5 CP
	Course No. 3	1,5 CP
	Course No. 4	0 – 5 CP
Degree-relevant examination(s)	No. 1	2 CP
Required coursework	No. 1	1,5 CP
	No. 2	1,5 CP
	No. 3	3,5 CP

	No. 4	0 – 5 CP
Total CP		14 – 18 CP

7	**Module administration**
Frequency	Every semester
Module representative	Prof. Dr. G. Wilde
Responsible department	Department of Physics

8	**Recognition**
Usability in other degree programs	M.Sc. Physics
Module title German	Physikalische Vertiefung: Materialphysik
German translation of the module components from field 3	Course No. 1a: Materialphysik I
	Course No. 1b: Übungen zu Materialphysik I
	Course No. 2a: Materialphysik II
	Course No. 2b: Übungen zu Materialphysik II
	Course No. 3: Praktikum der Materialphysik
	Course No. 4: Mindestens eine vertiefende Vorlesung, ggf. mit Übung, oder ein Seminar aus dem Bereich der Material- oder der experimentellen oder theoretischen Festkörperphysik, oder Durchführung eines kurzen Forschungsprojekts in einer materialphysikalischen Arbeitsgruppe (Miniforschung), oder Durchführung eines Projekts im Rahmen eines Praktikums in der Industrie unter wissenschaftlicher Begleitung durch eine Hochschullehrerin/einen Hochschullehrer des Wahlpflichtmoduls

9	**Miscellaneous**

Degree program	**Geophysics (Master of Science)**
Modul	**Elective Studies: Nonlinear Physics**
Module number	5

1	**Basic data**
Program semester	1, 2
Credits (CP)	14 – 18
Workload (h) in total	420 – 540
Module duration	2 semesters
Module status (M/EM)	EM

2	**Profile**

Aim of the module / Integration in the curriculum

Nonlinear effects show up in everyday life and in nature. Particularly fascinating examples are patterns on animal fur, turbulent weather phenomena, spatio-temporal structures in the behavior of sand or optical patterns. But also, collective phenomena in biology and social sciences like the formation of swarms, neural network structures or group dynamics can be studied by using methods of nonlinear physics. In many physical, chemical, biological or also social systems which, due to energy or information flow, are kept far from thermal equilibrium, nonlinear effects lead to the formation of spatio-temporal patterns.

The goal of the module is to introduce important phenomena and the terminology of nonlinear physics in a general form and to address in depth selected topics. For this purpose, it involves both theoretical and experimental approaches. Students get a comprehensive understanding of nonlinear physics, ranging from the classification of stationary, oscillating and chaotic behavior in systems with few degrees of freedom via the spontaneous formation of structures in spatially extended systems up to nonlinear wave phenomena and turbulence, and apply it to examples in hydrodynamics, nanophysics, biophysics and optics. The module furthermore provides the opportunity to participate in the activities of the interdisciplinary Center for Nonlinear Science. Thus, in addition to many examples in the field of physics also complex systems in biology, chemistry, medicine or social sciences are addressed.

Teaching content

The module contains theoretical and experimental topics. The focus of the studies can be more on the theoretical or the experimental side. In each combination of courses, the fundamental concepts of nonlinear physics like signatures of nonlinear and complex systems, emergence, self-organization, bifurcations, attractors or pattern formation will be addressed and specific examples of nonlinear systems will be treated. Thereby, typical nonlinear model equations and their generic properties as well as exemplary experimental systems and their applications will be discussed.

Learning outcomes

The students have developed an understanding of the fundamental concepts of nonlinear physics and are able to understand on this basis the role of nonlinearities in various physical, chemical or biological systems. They

have learned relevant methods for the theoretical and/or experimental analysis of nonlinear systems and developed skills to apply those to specific theoretical or experimental physical problems.

The students can familiarize themselves with an advanced topic in the field of nonlinear physics, prepare a talk addressed to a specific audience, present the talk and defend it in the subsequent discussion. They have the ability to contribute adequately to the scientific discussions on the subjects of the seminar talks.

3	**Structure**					
Module components						
No.	Course-category	Course-form	Course	Status (M/EM)	Workload (h)	
					Attendance time (h)/SWS	Self studies (h)
1 1a	Lecture		Two basic or advanced lectures in the field of nonlinear physics	M	60 h / 4 SWS	30 – 60 h
1b	Exercise		Exercises to a lecture from No. 1a	M	15 h / 1 SWS	45 h
2	Seminar		Seminar on nonlinear physics	M	30 h / 2 SWS	30 h
3	Laboratory course		Laboratory Course: Nonlinear Physics	M	45 h / 3 SWS	90 h
4			Additional lecture, possibly with exercises, or seminar in the field of Nonlinear Physics or Research project on a nonlinear physical problem ("mini-research") or implementation of a project within the framework of the interdisciplinary course "Nonlinear Modeling in Science" or internship in business or an external university or research institution under the scientific supervision of a university teacher of the module.	M	depending on the course	depending on the course
Elective options within the module			Taking into account the subject area and the above-mentioned structural conditions, a free choice of courses offered by the Department of Physics is possible. The individual realization of the module has to be agreed on with the module representative prior to the participation in courses.			

4	**Examination structure**				
Degree-relevant examination(s)					
No.	FME/ MCE	Type	Duration/ Scope	Connection to course no., if appl.	Weight in the module grade

1	FME	Oral final examination on the subjects of the module.	30 – 45 min		100%
Weight of the module grade for the final overall grade		The module grade contributes with the weight 17/120 to the final overall grade.			
Required coursework					
No.	Type		Duration/ Scope	Connection to course no., if appl.	
1	Successful participation in an exercise. Exercise sheets are worked on in self-studies. They are checked, presented and discussed in small exercise groups by the students. The solutions of the exercises are graded. The successful participation usually requires the correct solution of 50 % of the exercises.		Exercise sheets on a weekly or biweekly basis	1b	
2	Presentation of a talk.		30 – 45 min	2	
3	Successful, testified implementation and assessment of all required experiments.		Experimental protocols	3	
4	If applicable, depending on the choice of the courses: Solution of exercises, presentation of a talk or successful, testified implementation and assessment of experimental and/or theoretical tasks.			4	

5	**Requirements**
Module-related requirements for participation	None
Awarding credits	Academic credit is awarded upon completion of the entire module, i.e. when students have proven that they have achieved the learning outcomes in their entirety as provided by the module.
Rules on course attendance	In the laboratory courses physical attendance is necessary because the competence to perform physics experiments can be acquired only by actually dealing with the provided laboratory equipment. In case of absence for a substantial reason alternative dates are offered. A regular participation in the seminar is explicitly recommended because the ability to actively participate in the scientific discussion following the talks is an essential learning target.

6	**CP allocation**	
Participation (= attendance time)	Course No. 1a	2 CP
	Course No. 1b	0,5 CP
	Course No. 2	1 CP
	Course No. 3	1,5 CP
	Course No. 4	0 – 5,5 CP
Degree-relevant examination(s)	No. 1	2 CP
Required coursework	No. 1	1,5 CP
	No. 2	1 CP
	No. 3	3 CP

	No. 4	0 – 5,5 CP
Total CP		14 – 18 CP

7	**Module administration**
Frequency	Every semester
Module representative	Prof. Dr. C. Denz, Prof. Dr. S. Linz
Responsible department	Department of Physics

8	**Recognition**
Usability in other degree programs	M.Sc.Physics
Module title German	Physikalische Vertiefung: Nichtlineare Physik
German translation of the module components from field 3	Course No. 1a: Zwei Vorlesungen auf grundlegendem oder vertieftem Niveau aus dem Bereich der nichtlinearen Physik
	Course No. 1b: Übungen zu einer Vorlesung aus Nr. 1a
	Course No. 2: Seminar zur Nichtlinearen Physik
	Course No. 3: Praktikum zur Nichtlinearen Physik
	Course No. 4: Weitere Vorlesung, ggf. mit Übungen, oder Seminar aus dem Gebiet der Nichtlinearen Physik, oder Forschungsprojekt zu einem nichtlinear-physikalischen Problem („Mini-Forschung“), oder Durchführung eines Projekts im Rahmen des interdisziplinären Praktikums „Nichtlineare Modellierung in den Naturwissenschaften“, oder Durchführung eines Praktikums in der Wirtschaft oder einer auswärtigen Universität oder Forschungseinrichtung unter wissenschaftlicher Begleitung durch eine Hochschullehrerin/einen Hochschullehrer des Wahlpflichtmoduls.

9	**Miscellaneous**

Degree programme	**Geophysics (Master of Science)**
Module	**Elective Studies - Geociences**
Module number	6

1	**Basic data**
Programme semester	1,2
Credits (CP)	14-18
Workload (h) in total	420-540
Module duration	2 semesters
Module status (M/EM)	EM

2	**Profile**
Aim of the module / Integration in the curriculum	
The module provides in-depth knowledge from the field of geosciences. It enables students to set a focus in the field of geosciences. **This module is taught in German.**	
Teaching content	
The contents depend on the student's election of courses.	
Learning outcomes	
The learning outcomes depend on the student's election of courses.	

3	**Structure**					
Module components						
No.	Course category	Course form	Course	Status (M/EM)	Workload (h)	
					Attendance time (h) / SWS	Self-study (h)
1			Selected after consultation with the module representative	M	dependent on the student's election of courses.	dependent on the student's election of courses.
Elective options within the module			The students elect courses from the field of geosciences, which are in a meaningful context to the geophysics course program. The election of courses should be made from the modules of the Bachelor's program in geosciences as listed below,			

	and set clear thematic priorities. As a rule, all courses should be elected from the respective selected specialization modules in order to achieve a clear focus. The election of courses must be agreed upon in advance with the respective module representative responsible and be approved by her/him. The level of selected courses should match the level of the geophysics Master courses.

4	**Examination structure**				
Degree-relevant examination(s)					
No.	FME/ MCE	Type	Duration/ Scope	Connection to course no. if appl.	Weight in the module grade
		The demanded degree-relevant examination(s) depend on the student's choice of courses and are determined when the module is approved by the module supervisor. As a rule, they are based on the degree-relevant examination(s) demanded in the Bachelor's program in Earth Sciences for the selected courses. At least two degree-relevant examinations must be completed successfully.			Examination grades are included in the module grade with the weight of the credit points assigned to them and the associated course CPs.
Weight of the module grade for the final overall grade		The module contributes with a weight of 17 / 120 to the final overall grade			
Required coursework					
No.		Type	Duration/ Scope	Connection to course no. if appl.	
		The required coursework is determined when the module is approved by the module supervisor. They are based on the CPs required in the Bachelor's program in geosciences for the selected courses.	dependent on courses chosen by the student		

5	**Requirements**
Module-related requirements for participation	Knowledge from the field of geosciences, as taught in the bachelor's degree course in geophysics at the University of Münster.
Awarding credits	Academic credit is awarded upon completion of the entire module, i.e. when students have proven that they have achieved the learning outcomes in their entirety as provided by the module.
Rules on course attendance	As attendance rules, the requirements for the selected courses of the Bachelor's program in geosciences at the WWU Münster apply.

6	**CP allocation**	
Participation (= attendance time)		

Degree-relevant examination(s)		
Required coursework		
Total CP		

7	**Module administration**
Frequency	every semester
Module representative	Dr. P. Göbel
Responsible faculty	Geosciences

8	**Recognition**
Usability in other degree programmes	none.

9	**Miscellaneous**
	The examination regulations for the actual BSc Geosciences program apply to the registration and deregistration modalities as well as to the participation in and passing of the coursework and examinations of this module.

Degree programme	**Geophysics (Master of Science)**
Module	**Interdisciplinary studies**
Module number	7

1	**Basic data**
Programme semester	1,2
Credits (CP)	At least 4-8
Workload (h) in total	120h – 240h
Module duration	2 Semesters
Module status (M/EM)	M

2	**Profile**
Aim of the module / Integration in the curriculum	
This module allows students to freely choose among courses offered at WWU. This allows them to gain additional qualifications beyond those imparted by the compulsory curriculum.	
Teaching content	
The chosen courses should complement the compulsory curriculum in a sensible fashion and contribute to vocational qualification. Their level must be adequate for Master's students. To guarantee these requirements the chosen courses must be approved in advance by the module representative. In addition, students must get written permission to take part in the chosen courses and exams from the respective course organizers. Appropriate forms are provided by the examination office.	
Learning outcomes	
Depends on the courses chosen.	

3	**Structure**					
Module components						
No.	Course category	Course form	Course	Status (M/EM)	Workload (h)	
					Attendance time (h) / SWS	Self-study (h)
1	depends on the choice of courses		After consultation with the module representative.	M	depends on the choice of courses	depends on the choice of courses
Elective options within the module			This module allows students to freely choose among courses offered at WWU. The chosen courses should complement the compulsory curriculum in a sensible fashion and contribute to vocational qualification. Their level must be adequate for Master's students. To guarantee these requirements the chosen courses must be approved in advance by the module representative. In addition, students must get			

	written permission to take part in the chosen courses and exams from the respective course organizers. Together with the module "Elective studies", at least 22 CP have to be gained.

4	Examination structure				
Degree-relevant examination(s)					
No.	FME/ MCE	Type	Duration/ Scope	Connection to course no. if appl.	Weight in the module grade
		After consultation with the module representative, students have to pass at least one FME or MCE. The grade for this module is given by the grade of the FME or by the best grade obtained in MCEs.	Fixed in consultation with the module representative.		100%
Weight of the module grade for the final overall grade		The module grade contributes with a weight of 5/120 to the final grade.			
Required coursework					
No.		Type	Duration/ Scope	Connection to course no. if appl.	
		Determined in consultation with the module representative.			

5	Requirements
Module-related requirements for participation	none
Awarding credits	Academic credit is awarded upon completion of the entire module, i.e. when students have proven that they have achieved the learning outcomes in their entirety as provided by the module.
Rules on course attendance	Depends on the courses chosen.

6	CP allocation		
Participation (= attendance time)		Course no. 1	depends on the courses chosen
		[...]	
Degree-relevant examination(s)		no. 1	depends on the courses chosen
		[...]	
Required coursework		no. 1	depends on the course chosen
		[...]	
Total CP			4-8 CP

7	Module administration
Frequency	every semester
Module representative	Prof. Dr. U. Hansen / Prof. Dr. C. Thomas
Responsible faculty	Physics

8	Recognition
Usability in other degree programmes	none

9	Miscellaneous

	This module structure serves as a template for an individually arranged interdisciplinary module. The individual choice of courses must be approved beforehand by the module representative.

Degree program	**Geophysics (Master of Science)**
Modul	**Professional Specialization and Project Design**
Module number	8

1	**Basic data**
Program semester	3
Credits (CP)	30
Workload (h) in total	900
Module duration	1 semester
Module status (M/EM)	M

2	**Profile**
Aim of the module / Integration in the curriculum	
Based on research-oriented special courses and the individual familiarization with the subject, the module imparts the scientific basis for the independent work on the master's thesis. The student becomes familiar with the independent acquisition of relevant information, data and literature. Special technical and numerical or mathematic skills forming the basis for the master's thesis are acquired. The cooperation with technical staff of the workshops and the institutes is trained.	
Teaching content	
Introduction to scientific work, elaboration of the detailed contents of the chosen scientific area, familiarization with the current research literature in the field of the planned master's thesis.	
Learning outcomes	
Depending on the requirements of the chosen subject area, the student is familiar with relevant complex experimental facilities and geophysical equipment, is able to select necessary components and to procure them commercially, knows how to structure extensive calculations in such a way that the results are reliable or to implement numerical algorithms on different computer architectures. For this module the student is already integrated in a scientific research group. By means of this integration she/he has become acquainted with efficient group work and the optimal use of informal knowledge in the close environment.	

3	**Structure**					
Module components						
No.	Course category	Course form	Course	Status (M/EM)	Workload (h)	
					Attendance time (h)/SWS	Self studies (h)
1			Professional specialization and project design	M	0	900

Elective options within the module	Upon arrangement with the module representative the participation in laboratory courses, in research seminars including the presentation of a talk or in further courses may be required.

4	**Examination structure**				
Degree-relevant examination(s)					
No.	FME/ MCE	Type	Duration/ Scope	Connection to course No., if appl.	Weight in the module grade
1	FME	Final presentation in the form of a talk or a poster on the subject of the planned master's thesis with discussion in the respective research group	30 – 45 min		100%
Weight of the module grade for the final overall grade		The module grade contributes with the weight 6/120 to the final overall grade.			
Required coursework					
No.		Type	Duration/ Scope	Connection to course No., if appl.	

5	**Requirements**
Module-related requirements for participation	At least 30 CP from the master's program has to be achieved.
Awarding credits	Academic credit is awarded upon completion of the entire module, i.e. when students have proven that they have achieved the learning outcomes in their entirety as provided by the module.
Rules on course attendance	The preparation of the project usually requires participation in the activities of the research group of the supervisor. In the laboratory courses physical attendance is necessary because the competence to perform physics experiments can be acquired only by actually dealing with the provided laboratory equipment. In case of absence for a substantial reason alternative dates are offered. Depending on the research group the physical attendance in other courses may be required.

6	**CP allocation**	
Participation (= attendance time)	Course No. 1	0 CP
Degree-relevant examination(s)	No. 1	30 CP
Required coursework		
Total CP		30 CP

7	**Module administration**
Frequency	Every semester
Module representative	The supervisor of the master's thesis
Responsible department	Department of Physics

8	**Recognition**
Usability in other degree programs	
Module title German	Fachliche Spezialisierung und Projektplanung
German translation of the module components from field 3	Course No. 1: Fachliche Spezialisierung und Projektplanung

9	**Miscellaneous**

Degree program	**Geophysics (Master of Science)**
Modul	**Master's Project**
Module number	*9*

1	**Basic data**
Program semester	4
Credits (CP)	30
Workload (h) in total	900
Module duration	1 semester
Module status (M/EM)	M

2	**Profile**
Aim of the module / Integration in the curriculum	
The master's project serves for the scientific formation. In this project the student demonstrates that she/he is able to elaborate independently on a well-defined scientific problem within a research area by using scientific methods, to present the results in scientific diction in written form in the master's thesis and in oral form in the final presentation.	
Teaching content	
Upon agreement with the module representative. In the research area chosen for the master's project the student elaborates under the guidance of a scientific supervisor a topical scientific problem.	
Learning outcomes	
In addition to the scientific contents the student has become familiar with relevant key qualifications for the work as a scientist: communication skills (also in the English language), literature research, evaluation of published data and their interpretation, accuracy in experimental work, testing strategies for newly developed programs, the will and power of endurance, writing of scientific papers, if applicable presentation of the results and exchange with other scientists at conferences, if applicable communication with suppliers and workshops.	

3	**Structure**					
Module components						
No.	Course-category	Course-form	Course	Status (M/EM)	Workload (h)	
					Attendance time (h)/SWS	Self studies (h)
1			Master's project	M	0	900
Elective options within the module			None			

4	Examination structure				
Degree-relevant examination(s)					
No.	FME/ MCE	Type	Duration/ Scope	Connection to course No., if appl.	Weight inthe module grade
1	FME	Master's thesis The master's thesis is evaluated and graded by the examiners. The evaluations are handed in at the Examinations Office by the examiners after the presentation of the talk.	In general at most 80 pages	1	100%
Weight of the module grade for the final overall grade		The module grade contributes with the weight 54/120 to the final overall grade.			
Required coursework					
No.		Type	Duration/ Scope	Connection to Course No., if appl.	
1		Talk on the subject of the master's thesis with subsequent discussion under the participation of first and second examiner.	30 – 45 min	1	

5	Requirements
Module-related requirements for participation	At least 60 CP from the master's program have to be achieved. If the admission to the master's program had been granted under the condition of alignment studies, the successful completion has to be proven before starting with the master's thesis.
Awarding credits	Academic credit is awarded upon completion of the entire module, i.e. when students have proven that they have achieved the learning outcomes in their entirety as provided by the module.
Rules on course attendance	The experimental and theoretical works of the project require the active participation in the research group of the supervisor corresponding to a full-time occupation.

6	CP allocation	
Participation (= attendance time)	Course No. 1	0 CP
Degree-relevant examination(s)	No. 1	28 CP
Required coursework	No. 1	2 CP
Total CP		30 CP

7	Module administration
Frequency	Every semester
Module representative	The supervisor of the master's thesis
Responsible department	Department of Physics

8	Recognition
Usability in other degree programs	
Module title German	Masterprojekt
German translation of the module components from field 3	Course No. 1: Masterarbeit

9	Miscellaneous