

Module Handbook Geophysics Master

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Geophysical Institute



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Part I

Curriculum

Study and Examination Regulations (SPO) in the version of 2015, as of 20.09.2015

1 Introduction

The Karlsruhe Institute of Technology (KIT) has, as part of the implementation of the Bologna Process for the establishment of a European Higher Education Area, decided to provide a master's degree as the regular certificate at the end of its university studies. The KIT therefore sees the consecutive bachelor's and master's degree programs offered as an overall concept with a consecutive curriculum.

The consecutive master's program in Geophysics has - while retaining a broad range of expertise - a strongly deepening and profile-forming character. This is illustrated by the focus of the master's program in Applied Seismics, Seismology and Natural Hazards. The master's program thus has a close connection to practical issues and current research topics at the Geophysical Institute. Individual emphases can be set in the compulsory elective courses.

This profiling requires a solid basic education in the context of a bachelor's degree program. Accordingly, the Faculty of Physics has issued admission requirements. Missing fundamentals can be acquired in mandatory additional studies.

Of central importance is the master thesis, which is prepared by the "Scientific Focusing Phase" and the "Introduction to Scientific Practice". There, key qualifications are acquired in an integrative manner (goal-oriented work, measurement technology, protocol management, teamwork, study of literature, formulation of scientific questions, defense of own work results, etc.). Additive key qualifications amounting to four ECTS (European Credit Transfer System) credits are acquired as part of the course offer of the KIT.

The Study and Examination Regulations of the master's program in Geophysics (SPO MA Geophysics, 2015) define a number of 120 ECTS credits for the successful completion of a master's program. Quality assurance is provided by a compulsory master thesis, with a working time of six months, awarded with 30 ECTS points. The regular study duration is four terms (two years) including the master thesis.

After completing the master's examination, a "Master of Science (M. Sc.)" is awarded by the KIT.

The following is a course overview of the master's program Geophysics. The explicit implementation of the regulations of the degree program and the examinations can be found in the Study and Examination Regulations for the master's program Geophysics of 04.08.2015 (see Official Announcement No. 69 of the KIT dated 06.08.2015, which can be found on the website of the Faculty of Physics). The detailed descriptions of the courses and the respective rules of the examinations are announced in the module handbook.

2 Qualification Objectives

3 Courses

3.1 Geophysics

The core of the master's program is Geophysics with 40 ECTS credits. It includes the modules "Seismometry, Signal Processing and Seismogram Analysis" (winter term) and "Theory and Inversion of Seismic Waves" (summer term). From the beginning of the study in the winter or summer term, it depends on whether one or the other module is completed first. A start in the summer term (April) is not recommended for students from abroad or students who do not hold a bachelor degree in Geophysics. The module contents are taught in lectures and exercises as well as acquired in individual work. In the subject of Geophysics, a profile is formed according to the research foci of the Geophysical Institute. During the courses the students get to know the research areas of the institute. The lecturers facilitate the contact between students and scientists, regularly provide insights into current research and establish a close connection to current scientific issues in their courses.

3.2 Compulsory electives

In order to specialize the students can choose compulsory elective courses for individual profile-forming. Here, additional course offers in the field of geophysics as well as offers from the neighboring disciplines (earth sciences, physics, engineering, etc.) can be selected and combined on an advanced level. The scope of the courses must sum up to a total of at least 16 ECTS credits. All examinations, which students wish to be credited in the compulsory elective courses and which are not selectable in the electronic examination system, must first be recognized by the Examination Committee.

At least eight ECTS points must be earned through graded examinations. The module grade is then calculated as ECTS-weighted average of the individual graded courses. For this purpose, all graded examinations are used for the formation of the technical grade. All other courseworks and exams complete the list of not-graded courses until the total of 16 ECTS points have been reached. The exact nature and extent of the examinations will be announced by the corresponding lecturer at the beginning of the lecture period. Furthermore, the provisions of §8 of the Study and Examination Regulations apply to repeat examinations.

3.3 Interdisciplinary Qualifications

In addition to the subject-specific qualifications, at least four ECTS credits must be acquired in interdisciplinary qualifications (also known as professional skills or additive key competences). The corresponding modules from the fields of scientific English, patent law, project management, tutorials, scientific writing or public science are offered by the HoC, ZAK, and the SpZ at KIT. Other modules require the approval of the Examination Committee.

The certificates of the interdisciplinary qualifications are not graded. Graded offers can be selected but do not contribute to the overall grading. The exact nature and extent of the examinations will be announced by the corresponding lecturer at the beginning of the lecture period. Furthermore, the provisions of §8 of the Study and Examination Regulations apply to repeat examinations.

3.4 Introduction to Scientific Practice and Scientific Focusing Phase

The master thesis is prepared in the third master's semester through a "Scientific Focusing Phase" and "Introduction to Scientific Practice". In both subjects sound foundations and key qualifications (in integrative form) for scientific work are taught.

In the subject "Introduction to Scientific Practice" students learn basic working methods that are required for successful scientific research. The working methods themselves are independent of a scientific field, but are practiced and learned on the basis of a specific task (topic of the master thesis). The students will be guided by the future supervisor of the master thesis. As a result, the students submit a written report, which shows that they have adopted the scientific working methods and applied them to the topic of their future master thesis. In addition, students attend seminars and colloquia accompanying geophysics, geosciences, and physics. Students gain an overview of current research topics, learn to follow scientific presentations that are outside their area of specialization, and expand their knowledge through appropriate questions to the lecturers.

In the subject "Scientific Focusing Phase" the students independently work on a specific task that is related to the future master thesis. This can be, for instance, performing measurements or creating a computer program or developing a theoretical approach. In this way, the students learn – guided by the future supervisor of the master thesis – essential working techniques for the processing of their master thesis, which are specific to the corresponding scientific field. The students will attend the seminar of the research area in which they will prepare their master thesis. In this seminar, they present their work and put their work results to critical discussion. They learn to present their work to third parties and to include suggestions from the scientific discussion for the further proceeding.

3.5 Master thesis

The master thesis (30 ECTS credits, 6 months working time) is a central component of profiling and deepening. As part of the master thesis, the students demonstrate that they can independently analyze a scientific problem under guidance, develop suitable solutions, interpret the results and present the whole in a written document. These are important interdisciplinary skills for any future job. The results of the master thesis are presented in a faculty-public colloquium.

A master thesis may only be awarded by examiners according to §17 (2) of SPO MA Geophysics. It can be carried out as project work in one of the working groups of the faculty or corresponding groups at the KIT. It is also possible to realize an external master thesis outside the faculty. To do this, a supervisor from the faculty must be found who is willing to support the external work and obtain the approval of the Examination Committee.

A written document is to be prepared on the topic of the master thesis. Both the supervisor and the second reviewer each receive a printed and bound copy of the work. In addition, one copy each is to be handed to the examination office of the faculty (exam copy, signed by the supervisor) and to the library of the Geophysical Institute.

4 Registration for examinations

Registration is online via the central examination system of the KIT. Examinations and courseworks are the evaluated review of achieving the qualification objectives defined in the module. They are subject-specific, didactically coordinated

and immediate. Examinations are written, oral or of other type. Courseworks are not-graded reviews and are often required as a prerequisite for examinations.

Examinations and courseworks are usually carried out in the manner described in M-PHYS-101358. In exceptional cases deviations are possible. According to §6 of the Study and Examination Regulations, the actual type of assessment is announced for a module examination in the module handbook. The conditions under which a repetition of written and oral examinations is possible are specified in §8 of the Study and Examination Regulations.

5 Prerequisites to register for the master thesis

Registration for the master thesis can take place as soon as the module examinations in the subject “Scientific Focusing Phase” and “Introduction to Scientific Practice” have been passed.

6 Grade

The overall grade of the master’s examination is calculated as an average grade weighted by credit points. The subject Geophysics and the compulsory elective subject are weighted with their credit points and the module master thesis is weighted with twice the number of credit points.

7 Module scheme

The tabular module scheme shows the distribution of the modules and the courses they contain within the terms of the study program. The overview of the workload for the degree program is shown in ECTS points. An ECTS point corresponds to a workload of 30 hours.

Master Geophysics - Degree Program

Starting in Winter term (WS) recommended

Subject:	Geophysics	Scientific Focusing Phase	Introduction to Scientific Practice	Compulsory Elective	SQs	CPs
Term/Semester						
1 (WS)	Module: Seismometry, Signal Processing and Seismogram Analysis					
	Physics of Seismic Instruments					
SWS	V2 Ü1					
CPs	6				SQs I	2
	Seismics					
SWS	V2 Ü2					
CPs	8					
Sum CPs	22					2
2 (SS)	Module: Theory and Inversion of Seismic Waves					30
	Theory of Seismic Waves					
SWS	V2 Ü1					
CPs	6				SQs II	2
	Seismic Modelling					
SWS	V1 Ü1					
CPs	4					
Sum CPs	18					2
3 (WS)		Module: Scientific Focusing Phase	Module: Introduction to Scientific Practice			30
		Seismic/Seismology Seminar	Introduction to Research in a Scientific Sub-Field Including a Seminar paper			
SWS		S 2				
CPs		10				
			Module: Scientific Seminars			
SWS			Seminar of the Geophysical Institute/ Phys. Colloquium/etc.			
CPs			S 2			
Sum CPs		10	20			30
4 (SS)						
				Module: Master Thesis		
SWS				Master Thesis		
CPs				Master Thesis and Colloquium		
Sum CPs				30		30
Sum CPs	40	10	20			4
Sum CPs						120
Sum CPs						Sum: 120

Part II

Guidelines

8 Compulsory elective courses

8.1 Process

In order to have a course, graded or not-graded, counted for the compulsory electives, it must be individually recognized. There is no fixed list of compulsory elective courses that are statically stored in the electronic examination system. Therefore, the following procedure should be observed:

1. Choosing one or more courses for the compulsory electives.
2. An [informal list](#) of one or more courses will be checked and signed by the representative of the Examination Committee ([Dr. Ellen Gottschämmer](#)).
3. Download of a [“blue form”](#) for each individual course. The top box is to be filled out by the student.
4. This “blue form” will be handed over to the examiner of the compulsory elective course.
5. After successfully passing the exam or coursework, the “blue form” will be sent by the examiner back to the Examination Office of the Faculty of Physics, where the graded or not-graded result will be entered into the electronic examination system.

8.2 Recommendations for Compulsory elective courses

In the compulsory elective courses individual profile-forming emphases can be set. Here, both additional offers in the field of geophysics and offers from the neighboring disciplines (earth sciences, physics, engineering, etc.) can be selected and combined at an advanced level. The total number of credit points for all compulsory elective courses combined must be at least 16 out of which 8 credit points must be graded. Recommended courses are listed in chapter ??.

Courses from other universities may also be recognized, such as courses organized by the University of Strasbourg with which there is cooperation through the Eucor network. Here we recommend among others in the winter term: 'Global Dynamics of Earth and Dynamics of Geophysical Fluids'.

9 Scientific Seminars

In addition to their studies, students attend seminars and colloquia offered by geophysics, geosciences, and physics (the seminar program can be found on the homepage of the institute at [Dates](#)). The students gain an overview of current research topics in geophysics, geosciences, and physics. They learn to attend talks on special scientific topics, which do not belong to their area of specialization, and to broaden their knowledge by appropriate questions to the presenters, to clear up misunderstandings and to cultivate the critical, scientific exchange. Students are recommended to meet in small groups following the presentations and to discuss the content of the talks. The visit of at least 12 presentations must be proven as examination.

9.1 Examination

1. The student attends at least 12 presentations from one of the following seminars:
 - Geophysical Institute Seminar
 - Physics Colloquium
 - Seminars from related disciplines referenced at [Dates](#)

There is a free choice for presentations given in the individual seminars. Upon reasoned request, presentations from other seminars may also be recognized for the examination in individual cases.

2. For each presentation attended, the student completes a [seminar report](#). Reasonably, this is done during the talk. However, a short summary should be completed after the presentation. The notes taken during the presentation are not intended as a memorandum. They can be catchy and sketchy, but should also reflect ambiguities, questions, and the discussion after the talk. The summary must be written in complete sentences, legible and comprehensible in terms of content. If the talk was not comprehensible (in parts), it should also be clear from the summary.

3. As soon as 12 seminar reports are available, the student fills in a [list of seminar reports](#).
4. The list of seminars, together with all the seminar reports listed therein, will be presented to the lecturer (Dr. Thomas Forbriger), who is responsible for the course. After reviewing the seminar reports, a short meeting with the student usually takes place. The lecturer asks questions about the content of the seminar reports and the lectures attended. The student's answers must indicate that he/she has actually attended the seminar.
5. The list of seminar reports will be signed by the lecturer and filed as examination minutes. The seminar reports are handed back to the student.

10 3rd and 4th term

10.1 Preliminary remark

The module "Master Thesis" is preceded by the module "Scientific Focusing Phase" and the module "Introduction to Scientific Practice", which has a total duration of 6 months. Registration for the module "Scientific Focusing Phase" should be **no later than three months after the last course exam**. The third and fourth terms of the master's program form a closely linked unit. At the time of the changeover from the second to the third term, the students should seek a topic for a master thesis. This topic will be set at the beginning of the "Scientific Focusing Phase". The master thesis aims to show that the student is able to work on a subject independently and in a limited time according to scientific methods that correspond to the current state of research. This usually requires a thorough introduction to the scientific field of the master thesis and the learning of specific, scientific tools and methods. Since the duration of the master thesis is only six months, the modules "Scientific Focusing Phase" and "Introduction to Scientific Practice" in the third term are used by the student to familiarize himself/herself with the topic of the master thesis. Thus, at the beginning of the fourth term a "flying start" in the actual master thesis is possible. Altogether, exactly 12 months are available for work in the specific field of the master thesis.

10.2 Process

1. Before the beginning of the "Scientific Focusing Phase", the student chooses a topic for a master thesis. For this he talks to the heads of the research areas at the Geophysical Institute and/or attends the seminars of the research areas.
2. Once the topic of the master thesis has been agreed on, students will register [online](#) for exams in the modules "Scientific Focusing Phase" and "Introduction to Scientific Practice".
3. The student then visits the [Examination Office of the Faculty of Physics](#). There the prerequisites for the Master's thesis will be checked and he/she will receive a registration form for the topic of the master thesis.
4. The student passes the form to the supervisor/ reviewer of the Master's thesis. In mutual agreement they fill in the fields 'Referent' (supervisor/ reviewer), 'Korreferent' (co-supervisor/ co-reviewer), 'Vorläufiges Thema der Arbeit' (preliminary subject), and 'Beginn der Arbeit' (start date). The principal reviewer signs the form and returns it to the Examination Office where the respective entry for the Master's thesis will be created in the online system. The deadline for the thesis will then be available to the student through the online system. The supervisor contacts the webmaster (webmaster@gpi.kit.edu) to include the student in the list of [master students](#).
5. The student can only return the topic of the master thesis once and only within the first month (Study and Examination Regulations §14 [6]). If he/she makes use of it, he/she informs the supervisor and the reviewers. The principal reviewer informs the Examination Office and resigns the student from the examination of the "Scientific Focusing Phase". The student starts again at point 1.
6. Six months after the registration of the topic of the master thesis, the student performs the examination in the module "Scientific Focusing Phase" (lecture) and in the module "Introduction to Scientific Practice" (written report). The main reviewer records the grade in the electronic examination system.

10.3 Submission of master thesis

No later than twelve months after registration for the module "Scientific Focusing Phase" or the date of submission indicated on the registration form, the thesis must be submitted to the Examination Office of the Faculty of Physics. The title page must contain the English and German title.

At the latest when submitting the master thesis to the Examination Office, the student has to fill out a "green form" for the master thesis. This will then be handed over to the supervisor of the master thesis. Without the "green form" the master's grade cannot be entered in the examination system. The thesis must be printed and bound four times (including one copy per reviewer). One printout at the GPI is free. In addition, an electronic version in PDF format must be handed over to the supervisor. The student will have three copies signed by the first reviewer, who will be provided with the date of receipt by the Examination Office at the latest on the official deadline. The stamped copies are then handed over by the student to the reviewers for evaluation. This is to avoid that the reviews evaluate the thesis on the basis of different copies. The remaining copy is to be given to the library of the GPI. Upon receipt of the reports, the Examination Office will report the successful completion of the course and grading to the study service.

Upon submission of the master thesis in the Examination Office, a confirmation on a grade 4.0 or better can be issued directly.

Part III

Field structure

11 Master Thesis

Identifier	Module	ECTS Responsibility	
M-PHYS-101730	Modul Master Thesis (S. 46)	30	Thomas Bohlen

12 Geophysics

Identifier	Module	ECTS Responsibility	
M-PHYS-101358	Seismometry, Signal Processing and Seismogram Analysis (S. 60)	22	Andreas Rietbrock
M-PHYS-101359	Theory and Inversion of Seismic Waves (S. 66)	18	Thomas Bohlen

13 Electives

Identifier	Module	ECTS Responsibility	
M-PHYS-103856	3D reflection seismics (S. 15)	1	Thomas Bohlen, Thomas Hertweck
M-PHYS-103145	Black Forest Observatory Course (S. 16)	1	Thomas Forbriger
M-PHYS-101354	Classical Physics Laboratory Course II (S. 17)	6	Studiendekan Physik
M-PHYS-104522	Full-waveform inversion (S. 18)	6	Thomas Bohlen
M-PHYS-103914	Geodynamic Modelling I (S. 20)	2	Oliver Heidbach
M-PHYS-103915	Geodynamic Modelling II (S. 21)	2	Oliver Heidbach
M-PHYS-101833	Geological Hazards and Risk (S. 22)	8	Ellen Gottschämmer
M-PHYS-101952	Geophysical Deep Sounding at Volcanoes and the Example of the Vogelsberg, graded (S. 24)	4	Ellen Gottschämmer
M-PHYS-101872	Geophysical Deep Sounding at Volcanoes and the Example of the Vogelsberg, not graded (S. 25)	3	Ellen Gottschämmer
M-PHYS-101951	Geophysical Investigation of Volcanic Fields, graded (S. 26)	4	Joachim Ritter
M-PHYS-101874	Geophysical Investigation of Volcanic Fields, not graded (S. 27)	3	Joachim Ritter
M-PHYS-103141	Geophysical monitoring of tunnel constructions (S. 28)	1	Ellen Gottschämmer
M-PHYS-101873	Hazard and Risk Assessment of Mediterranean Volcanoes, graded (S. 29)	6	Ellen Gottschämmer
M-PHYS-101953	Hazard and Risk Assessment of Mediterranean Volcanoes, not graded (S. 30)	4	Ellen Gottschämmer
M-PHYS-101961	Historical Seismology for Hazard Evaluation (S. 31)	1	Ellen Gottschämmer
M-PHYS-101959	Induced Seismicity, graded (S. 32)	5	Joachim Ritter
M-PHYS-101878	Induced Seismicity, not graded (S. 33)	3	Joachim Ritter
M-PHYS-104195	In-Situ: Seismic Hazard in the Apennines (S. 34)	6	Ellen Gottschämmer
M-PHYS-104196	In-Situ: Summer School Bandung: Seismology/Geohazards (S. 35)	6	Ellen Gottschämmer, Andreas Rietbrock
M-PHYS-101866	Introduction to Volcanology, graded (S. 39)	4	Ellen Gottschämmer

17 ADDITIONAL EXAMINATIONS

M-PHYS-101944	Introduction to Volcanology, not graded (S. 41)	3	Ellen Gottschämmer
M-PHYS-101950	Measuring Methods in Physical Volcanology, graded (S. 43)	2	Ellen Gottschämmer
M-PHYS-101871	Measuring Methods in Physical Volcanology, not graded (S. 44)	1	Ellen Gottschämmer
M-PHYS-101355	Modern Physics Laboratory Course (S. 45)	6	Studiendekan Physik
M-PHYS-101946	Near Surface Geophysical Prospecting (S. 47)	1	Ellen Gottschämmer
M-PHYS-103855	Near-surface seismic and GPR (S. 48)	6	Thomas Bohlen
M-PHYS-101960	Physics of the Lithosphere, graded (S. 49)	3	Ellen Gottschämmer
M-PHYS-101875	Physics of the Lithosphere, not graded (S. 50)	2	Ellen Gottschämmer
M-BGU-101030	Recent Geodynamics (S. 51)	4	Malte Westerhaus
M-PHYS-104186	Seismic Data Processing with final report (graded) (S. 54)	6	Thomas Bohlen, Thomas Hertweck
M-PHYS-104188	Seismic Data Processing with final report (ungraded) (S. 56)	6	Thomas Bohlen, Thomas Hertweck
M-PHYS-104189	Seismic Data Processing without final report (ungraded) (S. 58)	2	Thomas Bohlen, Thomas Hertweck
M-PHYS-103803	Seminar on recent topics of risk science (S. 63)	4	Ellen Gottschämmer
M-BGU-101996	Structural Geology and Tectonics (S. 64)	4	Agnes Kontny
M-PHYS-101870	The Black Forest Observatory at Schiltach (S. 65)	1	Ellen Gottschämmer

14 Scientific Focusing Phase

Identifier	Module	ECTS Responsibility	
M-PHYS-101360	Scientific Focusing Phase (S. 52)	10	Thomas Bohlen

15 Introduction to Scientific Practice

Identifier	Module	ECTS Responsibility	
M-PHYS-101361	Introduction to Scientific Practice (S. 38)	16	Andreas Rietbrock
M-PHYS-101357	Scientific Seminars (S. 53)	4	Thomas Forbriger

16 Interdisciplinary Qualification

Identifier	Module	ECTS Responsibility	
M-PHYS-102349	Interdisciplinary Qualification (S. 37)	4	Andreas Barth

17 Additional Examinations

Identifier	Module	ECTS Responsibility	
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Part IV

Modules

M Module: 3D reflection seismics [M-PHYS-103856]

Responsibility: Thomas Bohlen, Thomas Hertweck

Organisation: KIT-Fakultät für Physik

Curricular Anchorage: Compulsory Elective

Contained in: [Electives](#)

ECTS	Recurrence	Duration	Language	Version
1	Irregular	1 term	English	1

Compulsory

Identifier	Course	ECTS Responsibility	
T-PHYS-107806	3D reflection seismics (S. 69)	1	Thomas Bohlen, Thomas Hertweck

Conditions

None

Qualification Objectives

The students refresh and elaborate their knowledge of reflection seismics. They comprehend the fundamentals of seismic data acquisition and learn about practical issues relevant in the field. They participate a field experiment and get to know hardware, procedures used in the field, and relevant people and positions in the field. In the end, students will be familiar with the basics of running field acquisition and collecting land seismic data. They deepen their knowledge of the reflection seismic principles and have a good understanding of practical issues. They are able to apply the principles to other seismic surveys and analyse important field parameters. They comprehend how theory of wave propagation and signal processing relates to practice and the influence it has on the field acquisition setup.

Content

- Introduction to 3D reflection seismic
- Land acquisition and land-specific issues
- Field trip and in-situ lecture (1 day):
 - a) Introduction to the geological background (handled by colleagues from Rhein Petroleum)
 - b) Equipment, acquisition procedures, data quality control
- Wrap-up and summary

Recommendations

Understanding of the basic reflection seismic principles.

M Module: Black Forest Observatory Course [M-PHYS-103145]

Responsibility: Thomas Forbriger
Organisation: KIT-Fakultät für Physik
Curricular Anchorage: Compulsory Elective
Contained in: [Electives](#)

ECTS	Recurrence	Duration	Language	Version
1	Each winter term	1 term	English	4

Compulsory

Identifier	Course	ECTS	Responsibility
T-PHYS-106261	Black Forest Observatory Course (S. 70)	1	Thomas Forbriger

Learning Control / Examinations

Active participation in experiments and data analysis is mandatory.

Module Grade

The coursework is not graded.

Conditions

One of the courseworks:

T-PHYS-102325 - Physics of Seismic Instruments, Prerequisite (MSc Geophysics)
T-PHYS-104727 - Physics of Seismic Instruments (MSc Physics)
T-PHYS-105567 - Physics of Seismic Instruments (NF) (MSc Physics)

Modeled Conditions

1 of 1 conditions must be met:

- The course [[T-PHYS-102325](#)] *Physics of Seismic Instruments, Prerequisite* must have been passed.

Qualification Objectives

The students are able to install and adjust a broad-band seismometer. They understand and can apply basic steps of data quality assessment. The students understand methods to calibrate the instruments frequency response and gain. They are able to carry out and analyse calibration experiments.

Content

- Practical application of knowledge gained in the course on 'Physics of seismic instruments'
- In-situ experiments with force-balance feedback broad-band seismometers
- Installation and calibration of instruments
- Quantitative data analysis, comparison with observatory recordings, and data quality assessment
- The actual program will be discussed and planned on-site together with the participants

Literature

Bormann, P., (ed.), 2012. New Manual of Seismological Observatory Practice. 2nd edition. GeoForschungsZentrum Potsdam. DOI: 10.2312/GFZ.NMSOP-2. <http://dx.doi.org/10.2312/GFZ.NMSOP-2>
Chapter 5, information sheets and exercises on seismometer calibration in particular.

Workload

The course will be held on three entire days at the Black Forest Observatory.

M Module: Classical Physics Laboratory Course II [M-PHYS-101354]

Responsibility: Studiendekan Physik
Organisation: KIT-Fakultät für Physik
Curricular Anchorage: Compulsory Elective
Contained in: [Electives](#)

ECTS	Recurrence	Duration	Language	Version
6	Each summer term	1 term	German	1

Compulsory

Identifier	Course	ECTS	Responsibility
T-PHYS-102290	Classical Physics Laboratory Courses II (S. 71)	6	Günter Quast, Hans Jürgen Simonis

Conditions
none

M Module: Full-waveform inversion [M-PHYS-104522]

Responsibility: Thomas Bohlen
Organisation: KIT-Fakultät für Physik
Curricular Anchorage: Compulsory Elective
Contained in: Electives

ECTS	Recurrence	Duration	Language	Version
6	Irregular	1 term	English	1

Compulsory

Identifier	Course	ECTS	Responsibility
T-PHYS-109272	Full-waveform inversion (S. 72)	6	Thomas Bohlen, Thomas Hertweck

Learning Control / Examinations

Final pass based on successful participation of the exercises.

Module Grade

The coursework is not graded.

Conditions

None

Qualification Objectives

The students know the fundamentals about full-waveform inversion from theory to practical implementation. They understand the basic concept of full-waveform inversion and grid-based finite-difference schemes to solve the wave equation. They understand important practical aspects such as numerical effects and critical performance issues. Students are able to implement a basic full-waveform inversion algorithm and apply it to simple data sets. They can analyze important factors influencing the success of full-waveform inversion and assess the quality of inversion results.

Content

- Introduction to full-waveform inversion (FWI)
- Solution of the wave equation with the finite-difference method
- Practical issues and numerical effects
- Adjoint-state method
- Adaption of the adjoint-state method for FWI
- FWI of shallow seismic wavefields

Recommendations

Knowledge of differential calculus is essential. Experience with Matlab and general computer skills are beneficial.

Literature

- Andreas Fichtner, "Full Seismic Waveform Modelling and Inversion", 2011, Springer.

M Module: Further Examinations [M-PHYS-102020]

Responsibility:

Organisation: KIT-Fakultät für Physik

Curricular Anchorage: Compulsory Elective

Contained in: [Additional Examinations](#)

ECTS	Recurrence	Duration	Language	Version
30	Each term	1 term	German	1

Zusatzleistungen

Non-Compulsory Block; You must choose at most 30 credits.

Identifier	Course	ECTS Responsibility

M Module: Geodynamic Modelling I [M-PHYS-103914]

Responsibility: Oliver Heidbach
Organisation: KIT-Fakultät für Physik
Curricular Anchorage: Compulsory Elective
Contained in: [Electives](#)

ECTS	Recurrence	Duration	Language	Version
2	Each winter term	1 term	English	2

Compulsory

Identifier	Course	ECTS	Responsibility
T-PHYS-107998	Geodynamic Modelling I (S. 73)	2	Oliver Heidbach

Learning Control / Examinations

Presentation at the end of the block course

Module Grade

The module is not graded.

Conditions

None

Qualification Objectives

The students have acquired basic knowledge about the stress tensor and how to estimate the individual components of the stress tensor with stress indicators, such as e.g. earthquake focal mechanisms or borehole breakouts. They are able to derive the partial differential equation of the equilibrium of forces and master the fundamental steps in the course of a geomechanical-numerical modelling. The students are able to investigate a working hypothesis by building a model to investigate it. They are able to argue why their model approach is appropriate and to critically assess others' model approaches by analysing the model assumptions, boundary and initial conditions.

Content

I. Basics theory of the 3D stress tensor

- formalism and definition of tectonic stress
- stress indicators
- World Stress Map database

II. Applications

- Earthquake cycle and tectonic processes
- Stability of underground mining and repositories
- Economic aspects in oil, natural gas reservoirs, and geothermal energy

III. Fundamentals of geomechanical modelling

- Definition of the term "modelling"
- Key steps on the course of "modelling"
- Outlook on numerical solution methods

Literature

Literature provided by the supervisor

M Module: Geodynamic Modelling II [M-PHYS-103915]

Responsibility: Oliver Heidbach
Organisation: KIT-Fakultät für Physik
Curricular Anchorage: Compulsory Elective
Contained in: [Electives](#)

ECTS	Recurrence	Duration	Language	Version
2	Each winter term	1 term	English	2

Compulsory

Identifier	Course	ECTS	Responsibility
T-PHYS-107999	Geodynamic Modelling II (S. 74)	2	Oliver Heidbach

Learning Control / Examinations

Presentation at the end of the block course

Module Grade

The module is not graded.

Conditions

M-PHYS-103914 – Geodynamic Modelling I

Modeled Conditions

The following conditions must be met:

- The module [\[M-PHYS-103914\]](#) *Geodynamic Modelling I* must have been passed.

Qualification Objectives

The students know the basic concepts that play a role in this modelling and are able to investigate a working hypothesis with a model. They understand the basic knowledge of the Finite Element Method (FEM) and are familiar with the numerical uncertainties that are made with the discretization of model space. Students are able to create simple geomechanical 3D models, discretize the volume, find a numerical solution with the FEM and visualize scalar and vectorial values of the stress tensor and displacements, and assess the results in the context of the hypothesis.

Content

I. Fundamentals of Modelling

- Process of modelling
- Rheology and temperature field
- Analytical solutions

II. Theory of the Finite Element Method (FEM)

- Discretization of the model volume
- Basic principles of the FEM
- Differences to the finite difference and the boundary element method
- Boundary and initial conditions

III. Practice

- Introduction to the commercial codes Abaqus and Hypermesh
- Simulations on the computer
- Visualization of the stress tensor and displacement results with Tecplot 360 EX

Literature

Literature provided by the supervisor

M Module: Geological Hazards and Risk [M-PHYS-101833]

Responsibility: Ellen Gottschämmer
Organisation: KIT-Fakultät für Physik
Curricular Anchorage: Compulsory Elective
Contained in: [Electives](#)

ECTS	Recurrence	Duration	Language	Version
8	Each winter term	1 term	English	2

Compulsory

Identifier	Course	ECTS	Responsibility
T-PHYS-103525	Geological Hazards and Risk (S. 75)	8	Ellen Gottschämmer

Learning Control / Examinations

Active and regular attendance of lecture and practicals.

Module Grade

Project work and weekly exercises will be graded.

Qualification Objectives

The students understand basic concepts of hazard and risk. They can explain in detail different aspects of earthquake hazard, volcanic hazard as well as other geological hazards, can compare and evaluate those hazards. They have fundamental knowledge of risk reduction and risk management. They know methods of risk modelling and are able to apply them.

Content

- Earthquake Hazards
 - Short introduction to seismology and seismometry (occurrence of tectonic earthquakes, types of seismic waves, magnitude, intensity, source physics)
 - Induced seismicity
 - Engineering seismology, Recurrence intervals, Gutenberg-Richter, PGA, PGV, spectral acceleration, hazard maps
 - Earthquake statistics
 - Liquefaction
- Tsunami Hazards
- Landslide Hazards
- Hazards from Sinkholes
- Volcanic Hazards
 - Short introduction to physical volcanology
 - Types of volcanic hazards
- The Concept of Risk, Damage and Loss
- Data Analysis and the use of GIS in Risk analysis
- Risk Modelling - Scenario Analysis
- Risk Reduction and Risk Management

-
- Analysis Feedback and Prospects in the Risk Modelling Industry

Literature

Literature will be provided by the lecturer.

M Module: Geophysical Deep Sounding at Volcanoes and the Example of the Vogelsberg, graded [M-PHYS-101952]

Responsibility: Ellen Gottschämmer
Organisation: KIT-Fakultät für Physik
Curricular Anchorage: Compulsory Elective
Contained in: [Electives](#)

ECTS	Recurrence	Duration	Language	Version
4	Irregular	1 term	German	1

Compulsory

Identifier	Course	ECTS	Responsibility
T-PHYS-103571	Geophysical Deep Sounding at Volcanoes and the Example of the Vogelsberg, Studienleistung (S. 77)	3	Ellen Gottschämmer
T-PHYS-103673	Geophysical Deep Sounding at Volcanoes and the Example of the Vogelsberg, exam (S. 76)	1	Ellen Gottschämmer

Modeled Conditions

The following conditions must be met:

- The module [\[M-PHYS-101872\]](#) *Geophysical Deep Sounding at Volcanoes and the Example of the Vogelsberg, not graded* must not have been started.

M Module: Geophysical Deep Sounding at Volcanoes and the Example of the Vogelsberg, not graded [M-PHYS-101872]

Responsibility: Ellen Gottschämmer
Organisation: KIT-Fakultät für Physik
Curricular Anchorage: Compulsory Elective
Contained in: [Electives](#)

ECTS	Recurrence	Duration	Language	Version
3	Irregular	1 term	German	1

Compulsory

Identifier	Course	ECTS	Responsibility
T-PHYS-103571	Geophysical Deep Sounding at Volcanoes and the Example of the Vogelsberg, Studienleistung (S. 77)	3	Ellen Gottschämmer

Modeled Conditions

The following conditions must be met:

- The module [[M-PHYS-101952](#)] *Geophysical Deep Sounding at Volcanoes and the Example of the Vogelsberg, graded* must not have been started.

M Module: Geophysical Investigation of Volcanic Fields, graded [M-PHYS-101951]

Responsibility: Joachim Ritter
Organisation: KIT-Fakultät für Physik
Curricular Anchorage: Compulsory Elective
Contained in: [Electives](#)

ECTS	Recurrence	Duration	Language	Version
4	Irregular	1 term	German	1

Compulsory

Identifier	Course	ECTS Responsibility	
T-PHYS-103573	Geophysical Investigation of Volcanic Fields, Studienleistung (S. 79)	3	Joachim Ritter
T-PHYS-103672	Geophysical Investigation of Volcanic Fields, exam (S. 78)	1	Joachim Ritter

Modeled Conditions

The following conditions must be met:

- The module [\[M-PHYS-101874\]](#) *Geophysical Investigation of Volcanic Fields, not graded* must not have been started.

M Module: Geophysical Investigation of Volcanic Fields, not graded [M-PHYS-101874]

Responsibility: Joachim Ritter
Organisation: KIT-Fakultät für Physik
Curricular Anchorage: Compulsory Elective
Contained in: [Electives](#)

ECTS	Recurrence	Duration	Language	Version
3	Irregular	1 term	German	1

Compulsory

Identifier	Course	ECTS Responsibility	
T-PHYS-103573	Geophysical Investigation of Volcanic Fields, Studienleistung (S. 79)	3	Joachim Ritter

Modeled Conditions

The following conditions must be met:

- The module [\[M-PHYS-101951\]](#) *Geophysical Investigation of Volcanic Fields, graded* must not have been started.

M Module: Geophysical monitoring of tunnel constructions [M-PHYS-103141]

Responsibility: Ellen Gottschämmer
Organisation: KIT-Fakultät für Physik
Curricular Anchorage: Compulsory Elective
Contained in: [Electives](#)

ECTS	Recurrence	Duration	Language	Version
1	Irregular	1 term	German	1

Compulsory

Identifier	Course	ECTS	Responsibility
T-PHYS-106248	Geophysical monitoring of tunnel constructions, Studienleistung (S. 80)	1	Ellen Gottschämmer

M Module: Hazard and Risk Assessment of Mediterranean Volcanoes, graded [M-PHYS-101873]

Responsibility: Ellen Gottschämmer
Organisation: KIT-Fakultät für Physik
Curricular Anchorage: Compulsory Elective
Contained in: [Electives](#)

ECTS	Recurrence	Duration	Language	Version
6	Irregular	1 term	German	1

Compulsory

Identifier	Course	ECTS	Responsibility
T-PHYS-103572	Hazard and Risk Assessment of Mediterranean Volcanoes, Studienleistung (S. 82)	4	Ellen Gottschämmer
T-PHYS-103674	Hazard and Risk Assessment of Mediterranean Volcanoes, exam (S. 81)	2	Ellen Gottschämmer

Modeled Conditions

The following conditions must be met:

- The module [\[M-PHYS-101953\]](#) *Hazard and Risk Assessment of Mediterranean Volcanoes, not graded* must not have been started.

M Module: Hazard and Risk Assessment of Mediterranean Volcanoes, not graded [M-PHYS-101953]

Responsibility: Ellen Gottschämmer
Organisation: KIT-Fakultät für Physik
Curricular Anchorage: Compulsory Elective
Contained in: [Electives](#)

ECTS	Recurrence	Duration	Language	Version
4	Irregular	1 term	German	1

Compulsory

Identifier	Course	ECTS	Responsibility
T-PHYS-103572	Hazard and Risk Assessment of Mediterranean Volcanoes, Studienleistung (S. 82)	4	Ellen Gottschämmer

Modeled Conditions

The following conditions must be met:

- The module [\[M-PHYS-101873\]](#) *Hazard and Risk Assessment of Mediterranean Volcanoes, graded* must not have been started.

M Module: Historical Seismology for Hazard Evaluation [M-PHYS-101961]

Responsibility: Ellen Gottschämmer
Organisation: KIT-Fakultät für Physik
Curricular Anchorage: Compulsory Elective
Contained in: [Electives](#)

ECTS	Recurrence	Duration	Language	Version
1	Irregular	1 term	German	1

Compulsory

Identifier	Course	ECTS	Responsibility
T-PHYS-103679	Historical Seismology for Hazard Evaluation, Studienleistung (S. 83)	1	Ellen Gottschämmer

M Module: Induced Seismicity, graded [M-PHYS-101959]

Responsibility: Joachim Ritter
Organisation: KIT-Fakultät für Physik
Curricular Anchorage: Compulsory Elective
Contained in: [Electives](#)

ECTS	Recurrence	Duration	Language	Version
5	Irregular	1 term	English	2

Compulsory

Identifier	Course	ECTS	Responsibility
T-PHYS-103575	Induced Seismicity, Studienleistung (S. 85)	3	Joachim Ritter
T-PHYS-103677	Induced Seismicity, exam (S. 84)	2	Joachim Ritter

Learning Control / Examinations

The grading procedure will be announced during the lectures.

Module Grade

The grading procedure will be announced during the lectures.

Modeled Conditions

The following conditions must be met:

- The module [\[M-PHYS-101878\]](#) *Induced Seismicity, not graded* must not have been started.

Qualification Objectives

The students understand physical and tectonic causes and effects of induced seismicity, and they are able to explain its occurrence. They have gained basic knowledge of legal aspects associated with induced seismicity. They are able to distinguish between different physical sources of induced seismicity and can analyse seismicity caused by the loading of dams, due to mining, and associated with geothermal energy exploitation. The students know and are able to name regions, where induced seismicity occurs and can identify structures that may indicate the possible occurrence of induced seismicity in the field.

The students are able to work self-organized on a specific issue of induced seismicity. They are able to read and understand technical literature about the topic. They can outline and analyse the problem, and they are able to critically discuss the content of technical literature with their peers and present their own point of view. They can summarise the problem, and interpret and evaluate the content of technical literature on the topic of induced seismicity.

Content

- Fundamentals of Induced Seismicity
- Cause and Effect of Induced Seismicity
- Legal Aspects
- Case Studies: Dams, Mining, Geothermal Energy
- Field Trips to a Geothermal Energy Plant, to a Mining Region in Germany and to a dam

M Module: Induced Seismicity, not graded [M-PHYS-101878]

Responsibility: Joachim Ritter
Organisation: KIT-Fakultät für Physik
Curricular Anchorage: Compulsory Elective
Contained in: [Electives](#)

ECTS	Recurrence	Duration	Language	Version
3	Irregular	1 term	English	1

Compulsory

Identifier	Course	ECTS	Responsibility
T-PHYS-103575	Induced Seismicity, Studienleistung (S. 85)	3	Joachim Ritter

Module Grade

The module is not graded.

Modeled Conditions

The following conditions must be met:

- The module [\[M-PHYS-101959\]](#) *Induced Seismicity, graded* must not have been started.

Qualification Objectives

The students understand physical and tectonic causes and effects of induced seismicity, and they are able to explain its occurrence. They have gained basic knowledge of legal aspects associated with induced seismicity. They are able to distinguish between different physical sources of induced seismicity and can analyse seismicity caused by the loading of dams, due to mining, and associated with geothermal energy exploitation. The students know and are able to name regions, where induced seismicity occurs and can identify structures that may indicate the possible occurrence of induced seismicity in the field.

The students are able to work self-organized on a specific issue of induced seismicity. They are able to read and understand technical literature about the topic. They can outline and analyse the problem, and they are able to critically discuss the content of technical literature with their peers and present their own point of view. They can summarise the problem, and interpret and evaluate the content of technical literature on the topic of induced seismicity.

Content

- Fundamentals of Induced Seismicity
- Cause and Effect of Induced Seismicity
- Legal Aspects
- Case Studies: Dams, Mining, Geothermal Energy
- Field Trips to a Geothermal Energy Plant, to a Mining Region in Germany and to a dam

Workload

The evaluation procedure will be announced during the lectures.

M Module: In-Situ: Seismic Hazard in the Apennines [M-PHYS-104195]

Responsibility: Ellen Gottschämmer
Organisation: KIT-Fakultät für Physik
Curricular Anchorage: Compulsory Elective
Contained in: [Electives](#)

ECTS	Recurrence	Duration	Language	Version
6	Irregular	1 term	German	1

Compulsory

Identifier	Course	ECTS Responsibility	
T-PHYS-108690	In-Situ: Seismic Hazard in the Apennines (S. 86)	6	Ellen Gottschämmer

M Module: In-Situ: Summer School Bandung: Seismology/Geohazards [M-PHYS-104196]

Responsibility: Ellen Gottschämmer, Andreas Rietbrock

Organisation: KIT-Fakultät für Physik

Curricular Anchorage: Compulsory Elective

Contained in: [Electives](#)

ECTS	Recurrence	Duration	Language	Version
6	Irregular	1 term	English	1

Compulsory

Identifier	Course	ECTS	Responsibility
T-PHYS-108691	In-Situ: Summer School Bandung: Seismology/Geohazards (S. 87)	6	Ellen Gottschämmer, Andreas Rietbrock

Learning Control / Examinations

The students receive a scientific paper to discuss in an international group of students regarding one of the above topics. They give a presentation about the paper (20 minutes plus 10 minutes of discussion) and write a summary (5-10 pages). The summary has to be handed in individually by every student two weeks after the end of the summer school and will be graded.

Conditions

none

Qualification Objectives

The students know about the geology and tectonics of Indonesia and surrounding regions. They understand the processes and stress distributions that led to the formation of the Indonesian archipelago and know methods to model those.

The students can explain how earthquakes sources are represented and know about the distribution and characteristics of earthquakes. They understand the concept of seismic sources and stresses and can explain basic concepts of earthquake geology. They are familiar with seismic data acquisition systems and seismic array techniques. They understand the idea behind seismic tomography methods and know applications on global as well as regional and local scale.

The students understand the concepts of physical volcanology and can name the processes that are responsible for volcanic hazard and risk. They know methods of volcano seismology, can explain several modeling techniques and know about monitoring volcanoes at observatories using different geophysical techniques.

The students know about tsunami and flooding hazard and understand basic concepts of disaster management. The students understand basic concepts of geothermal energy and its exploitation.

Content

Geology and Tectonics

- Geological Setting of Indonesia
- Visit to the Geological Museum, Bandung
- Introduction to Stress Modeling in Active Tectonic

Seismology, Seismic Hazard

- Introduction to Geohazards: Earthquake Hazard and Risk
- Distribution and Characteristic of Earthquakes
- Seismic sources and stresses
- Earthquake Geology

-
- Data acquisition and arrays
 - Seismic Travel Time Tomography: Regional and Global Scale
 - Local Earthquake Tomography
 - Passive and active seismic imaging by seismic wave propagation modeling

Volcanology, Volcanic Hazard

- Physical Volcanology
- Volcanic hazard risk and assessment
- Volcano Seismology
- Modeling of Volcanic Products
- Visit of Guntur Volcano Observatory
- Visit to Tangkuban Parahu Volcano
- Visit to Center of Volcanology and Geological Hazard Mitigation

Tsunamis and Flooding Hazard

- Tsunamis: Generation, Inundation and Propagation
- Tsunamis: Hazard, Inundation and Warning
- Flood Hazard

Introduction to Disaster Management

Geothermal Systems

- Introduction to Geothermal system & Geology of Kamojang Field
- Visit of Kamojang

M Module: Interdisciplinary Qualification [M-PHYS-102349]

Responsibility: Andreas Barth
Organisation: KIT-Fakultät für Physik
Curricular Anchorage: Compulsory
Contained in: [Interdisciplinary Qualification](#)

ECTS	Language	Version
4	German	1

Wahlbereich

Non-Compulsory Block; You must choose at least 1 courses and at least 4 credits.

Identifier	Course	ECTS Responsibility

M Module: Introduction to Scientific Practice (GEOP M EWA) [M-PHYS-101361]

Responsibility: Andreas Rietbrock
Organisation: KIT-Fakultät für Physik
Curricular Anchorage: Compulsory
Contained in: [Introduction to Scientific Practice](#)

ECTS	Recurrence	Duration	Language	Version
16	Each term	1 term	English	2

Compulsory

Identifier	Course	ECTS Responsibility
T-PHYS-103355	Introduction to Research in a Scientific Sub-Field Including a Seminar paper (S. 88)	16

Module Grade

The module is not graded.

Qualification Objectives

The students are familiarized with the topic of their master thesis. They acquired key qualifications in an integrative manner and are able to implement them. The students know basic working methods that are required for successful scientific research and are able to apply them on the basis of a specific task (topic of the master thesis).

Content

- goal-oriented work
- measurement technology
- protocol management
- teamwork
- study of literature
- formulation of scientific questions
- defense of own work results

Literature

Task-specific, literature provided by the supervisor

Workload

The students submit a written report (synopsis) on the topic of their future master thesis, which shows that they have adopted the scientific working methods and the task of their work.

M Module: Introduction to Volcanology, graded [M-PHYS-101866]

Responsibility: Ellen Gottschämmer
Organisation: KIT-Fakultät für Physik
Curricular Anchorage: Compulsory Elective
Contained in: Electives

ECTS	Recurrence	Duration	Language	Version
4	Each summer term	1 term	English	2

Compulsory

Identifier	Course	ECTS	Responsibility
T-PHYS-103553	Introduction to Volcanology, Studienleistung (S. 90)	3	Ellen Gottschämmer
T-PHYS-103644	Introduction to Volcanology, exam (S. 89)	1	Ellen Gottschämmer

Learning Control / Examinations

Prerequisite (3 ECTS): Active and regular attendance of lecture and practicals, preparation and follow-up of lectures (at home), assignments, presentation of a volcano in a short (10 – 15 minute) talk with slides. Examination (1 ECTS): Scientific essay about the given presentation, approx. 8-10 pages, submitted electronically. The grade of the module results from grade of the scientific essay.

Module Grade

The grade of the module results from grade of the scientific essay.

Modeled Conditions

The following conditions must be met:

- The module [[M-PHYS-101944](#)] *Introduction to Volcanology, not graded* must not have been started.

Qualification Objectives

The Students know and understand the basic concepts of physical volcanology. They are able to classify volcanoes by their tectonic location, can discriminate between different eruption types and describe different volcanic edifices with respect to their tectonic environment. They understand the concept of volcanic hazard and risk and are able to apply it. They can explain the physics of volcanic monitoring methods and know about their advantages and disadvantages. They gained insight into numerical modelling tools and can name several applications. The students understand the impact of volcanic eruptions on climate and know both, presently as well as historically active volcanoes and their prominent eruptions. The students have gained an overview about active volcanoes and recent eruptions and are able to summarize the main characteristics and scientific achievements about one volcano of their choice in a 10-15 minute talk. They are able to discuss and answer questions related to their subject. They can summarize their research about the volcano of their choice in a scientific essay (8-10 pages).

Content

- Introduction, Overview
- Volcanoes and Plate Tectonics
- Magma and Volcanic Deposits
- Eruption types
- Volcanic Edifices
- Volcanic Hazard and Risk
- Volcano Monitoring

-
- Volcano Seismology
 - Numerical Modelling of Volcanic Products
 - Historic Eruptions
 - Volcanoes and Climate

Literature

Literature will be provided by the lecturer.

Workload

28 h: Attendance, active participation in lectures and practicals

14 h: Preparation and follow-up of lectures (at home)

18 h: Homework, assignments

30 h: Preparation of presentation

30 h: Scientific essay about given presentation, submitted electronically

M Module: Introduction to Volcanology, not graded [M-PHYS-101944]

Responsibility: Ellen Gottschämmer
Organisation: KIT-Fakultät für Physik
Curricular Anchorage: Compulsory Elective
Contained in: [Electives](#)

ECTS	Recurrence	Duration	Language	Version
3	Each summer term	1 term	English	2

Compulsory

Identifier	Course	ECTS	Responsibility
T-PHYS-103553	Introduction to Volcanology, Studienleistung (S. 90)	3	Ellen Gottschämmer

Learning Control / Examinations

Active and regular attendance of lecture and practicals, presentation of a volcano in a short (10 – 15 minute) talk with slides.

Module Grade

The coursework is not graded.

Modeled Conditions

The following conditions must be met:

- The module [\[M-PHYS-101866\]](#) *Introduction to Volcanology, graded* must not have been started.

Qualification Objectives

The students know and understand the basic concepts of physical volcanology. They are able to classify volcanoes by their tectonic location, can discriminate between different eruption types and describe different volcanic edifices with respect to their tectonic environment. They understand the concept of volcanic hazard and risk and are able to apply it. They can explain the physics of volcanic monitoring methods and know about their advantages and disadvantages. They gained insight into numerical modelling tools and can name several applications. The students understand the impact of volcanic eruptions on climate and know both, presently as well as historically active volcanoes and their prominent eruptions. The students have gained an overview about active volcanoes and recent eruptions and are able to summarize the main characteristics and scientific achievements about one volcano of their choice in a 10-15 minute talk. They are able to discuss and answer questions related to their subject.

Content

- Introduction, Overview
- Volcanoes and Plate Tectonics
- Magma and Volcanic Deposits
- Eruption types
- Volcanic Edifices
- Volcanic Hazard and Risk
- Volcano Monitoring
- Volcano Seismology
- Numerical Modelling of Volcanic Products

-
- Historic Eruptions
 - Volcanoes and Climate

Literature

Literature will be provided by the lecturer.

M Module: Measuring Methods in Physical Volcanology, graded [M-PHYS-101950]

Responsibility: Ellen Gottschämmer
Organisation: KIT-Fakultät für Physik
Curricular Anchorage: Compulsory Elective
Contained in: [Electives](#)

ECTS	Recurrence	Duration	Language	Version
2	Irregular	1 term	German	1

Compulsory

Identifier	Course	ECTS Responsibility	
T-PHYS-103570	Measuring Methods in Physical Volcanology, Studienleistung (S. 94)	1	Ellen Gottschämmer
T-PHYS-103671	Measuring Methods in Physical Volcanology, exam (S. 93)	1	Ellen Gottschämmer

Modeled Conditions

The following conditions must be met:

- The module [\[M-PHYS-101871\]](#) *Measuring Methods in Physical Volcanology, not graded* must not have been started.

M Module: Measuring Methods in Physical Volcanology, not graded [M-PHYS-101871]

Responsibility: Ellen Gottschämmer
Organisation: KIT-Fakultät für Physik
Curricular Anchorage: Compulsory Elective
Contained in: [Electives](#)

ECTS	Recurrence	Duration	Language	Version
1	Irregular	1 term	German	1

Compulsory

Identifier	Course	ECTS	Responsibility
T-PHYS-103570	Measuring Methods in Physical Volcanology, Studienleistung (S. 94)	1	Ellen Gottschämmer

Modeled Conditions

The following conditions must be met:

- The module [\[M-PHYS-101950\]](#) *Measuring Methods in Physical Volcanology, graded* must not have been started.

M Module: Modern Physics Laboratory Course [M-PHYS-101355]

Responsibility: Studiendekan Physik
Organisation: KIT-Fakultät für Physik
Curricular Anchorage: Compulsory Elective
Contained in: [Electives](#)

ECTS	Recurrence	Duration	Language	Version
6	Each term	1 term	German	1

Compulsory

Identifier	Course	ECTS	Responsibility
T-PHYS-102291	Modern Physics Laboratory Courses (S. 95)	6	Andreas Naber

Module Grade

The lab course is not graded.

Conditions

Classical Physics Laboratory Courses I and II

M Module: Modul Master Thesis [M-PHYS-101730]

Responsibility: Thomas Bohlen
Organisation: KIT-Fakultät für Physik
Curricular Anchorage: Compulsory
Contained in: [Master Thesis](#)

ECTS	Recurrence	Duration	Language	Version
30	Each term	1 term	German/English	2

Compulsory

Identifier	Course	ECTS	Responsibility
T-PHYS-103350	Master Thesis (S. 92)	30	Thomas Bohlen

Learning Control / Examinations

Successful completion of the master's thesis and successful defense during a public colloquium.

Conditions

The modules 'Scientific Focusing Phase', 'Introduction to Scientific Practice', and 'Scientific Seminars' must be passed.

Modeled Conditions

The following conditions must be met:

1. The module [\[M-PHYS-101360\]](#) *Scientific Focusing Phase* must have been passed.
2. The module [\[M-PHYS-101361\]](#) *Introduction to Scientific Practice* must have been passed.
3. The module [\[M-PHYS-101357\]](#) *Scientific Seminars* must have been passed.

Qualification Objectives

The students are able to work independently on a scientific topic, guided by an experienced supervisor. They analyze problems, develop suitable solutions, interpret and assess results, and communicate those results and findings in writing in a clear and concise way in either German or English. Furthermore, by presenting and defending the work in a public colloquium the students constructively interact with fellow scientists as part of a scientific exchange.

Content

- Independent but supervised work on the topic of the master's thesis
- Public colloquium open to all members of the faculty (no more than six weeks after finalizing the master's thesis)

Literature

Topic-specific, literature provided by the supervisor of the master's thesis

M Module: Near Surface Geophysical Prospecting [M-PHYS-101946]

Responsibility: Ellen Gottschämmer
Organisation: KIT-Fakultät für Physik
Curricular Anchorage: Compulsory Elective
Contained in: [Electives](#)

ECTS	Recurrence	Duration	Language	Version
1	Irregular	1 term	German	1

Compulsory

Identifier	Course	ECTS Responsibility	
T-PHYS-103645	Near Surface Geophysical Prospecting, Studienleistung (S. 96)	1	Ellen Gottschämmer

M Module: Near-surface seismic and GPR [M-PHYS-103855]

Responsibility: Thomas Bohlen
Organisation: KIT-Fakultät für Physik
Curricular Anchorage: Compulsory Elective
Contained in: [Electives](#)

ECTS	Recurrence	Duration	Language	Version
6	Each winter term	1 term	English	1

Compulsory

Identifier	Course	ECTS	Responsibility
T-PHYS-107793	Near-surface seismic and GPR (S. 97)	6	Thomas Bohlen, Yudi Pan

Learning Control / Examinations

Final pass based on successful participation of the exercises.

Module Grade

The coursework is not graded.

Conditions

None

Qualification Objectives

The students know the fundamentals about wave propagation phenomena near the Earth's surface and near-surface investigations for both seismic and electromagnetic waves. They comprehend the wave composition of shallow seismic wavefields and the dispersion and multimodal characteristics of surface waves. The students understand the multichannel analysis of surface waves method and the properties of dispersion curves, how to image surface-wave dispersion curves from active-source and passive-source seismic data, and how to estimate near-surface S-wave velocity and Q-factor structures by solving inverse problems. They know and can describe the elastic-wave equations, dispersion equations, the Radon transform, least-square optimization methods, seismic interferometry, and the spatial autocorrelation method. Finally, students are able to process shallow-seismic field data and use analysis methods to solve simple near-surface geophysical and geotechnical problems.

Content

- Designing shallow-seismic acquisition systems
- Imaging, forward-calculation and inversion of surface-wave dispersion curves
- Multimodal characteristics of surface waves
- Inversion of surface-wave attenuation coefficients for quality factors
- Passive-source shallow seismic methods
- Marine surface-wave method
- Full-waveform inversion of shallow seismic data
- GPR method

Recommendations

No explicit requirements. However, basic knowledge of seismic methods, wave propagation phenomena, and signal processing is essential.

Literature

Final pass based on successful participation of the exercises.

M Module: Physics of the Lithosphere, graded [M-PHYS-101960]

Responsibility: Ellen Gottschämmer
Organisation: KIT-Fakultät für Physik
Curricular Anchorage: Compulsory Elective
Contained in: [Electives](#)

ECTS	Recurrence	Duration	Language	Version
3	Irregular	1 term	German	1

Compulsory

Identifier	Course	ECTS	Responsibility
T-PHYS-103574	Physics of the Lithosphere, Studienleistung (S. 100)	2	Ellen Gottschämmer
T-PHYS-103678	Physics of the Lithosphere, exam (S. 99)	1	Ellen Gottschämmer

Modeled Conditions

The following conditions must be met:

- The module [\[M-PHYS-101875\]](#) *Physics of the Lithosphere, not graded* must not have been started.

M Module: Physics of the Lithosphere, not graded [M-PHYS-101875]

Responsibility: Ellen Gottschämmer
Organisation: KIT-Fakultät für Physik
Curricular Anchorage: Compulsory Elective
Contained in: [Electives](#)

ECTS	Recurrence	Duration	Language	Version
2	Irregular	1 term	German	1

Compulsory

Identifier	Course	ECTS	Responsibility
T-PHYS-103574	Physics of the Lithosphere, Studienleistung (S. 100)	2	Ellen Gottschämmer

Modeled Conditions

The following conditions must be met:

- The module [\[M-PHYS-101960\]](#) *Physics of the Lithosphere, graded* must not have been started.

M Module: Recent Geodynamics (GEOD-MPGF-1) [M-BGU-101030]

Responsibility: Malte Westerhaus
Organisation: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften
Curricular Anchorage: Compulsory Elective
Contained in: [Electives](#)

ECTS	Recurrence	Duration	Language	Version
4	Each winter term	1 term	German/English	1

Compulsory

Identifier	Course	ECTS	Responsibility
T-BGU-101772	Recent Geodynamics, Prerequisite (S. 102)	1	Malte Westerhaus
T-BGU-101771	Recent Geodynamics (S. 101)	3	Malte Westerhaus

M Module: Scientific Focusing Phase (GEOP M SP) [M-PHYS-101360]

Responsibility: Thomas Bohlen
Organisation: KIT-Fakultät für Physik
Curricular Anchorage: Compulsory
Contained in: Scientific Focusing Phase

ECTS	Recurrence	Duration	Language	Version
10	Each term	1 term	English	2

Vorleistung SpezPhas

Non-Compulsory Block; You must choose one course.

Identifier	Course	ECTS Responsibility	
T-PHYS-107675	Seminar on recent topics of applied geophysics (S. 111)	10	Thomas Bohlen
T-PHYS-107676	Seminar on recent topics of general geophysics (S. 112)	10	Ellen Gottschämmer, Andreas Rietbrock

Learning Control / Examinations

Examination of other type, not graded.

The examination of other type can be repeated at any time. However, only one reexamination is permitted.

Oral presentation, scientific discussion of the task at hand and the outcome of the student's work, and critical assessment in the relevant workgroup seminar. Pass granted upon successful completion of the presentation/discussion.

Module Grade

The module is not graded.

Qualification Objectives

The students fully understand the task of their master thesis at hand and its scientific background. They know the principle approach how to address scientific questions and have gained detailed knowledge regarding their specific subject, supervised by a member of the relevant workgroup. Through active participation in scientific discussions and presenting their own results, students are able to present and to exchange scientific opinions and critically assess results. They understand the importance of feedback and know how to incorporate constructive feedback into their work and working procedures.

Content

The students work independently but supervised on a specific scientific task related to their upcoming master thesis.

- Independent but supervised work on a specific scientific task related to the upcoming master thesis
- Active participation in the relevant workgroup seminar

Literature

Task-specific, literature provided by the supervisor

Workload

10 ECTS in total, corresponding to 300 working hours.

M Module: Scientific Seminars (GEOP M WS) [M-PHYS-101357]

Responsibility: Thomas Forbriger
Organisation: KIT-Fakultät für Physik
Curricular Anchorage: Compulsory
Contained in: [Introduction to Scientific Practice](#)

ECTS	Recurrence	Duration	Language	Version
4	Each term	1 term	English	2

Compulsory

Identifier	Course	ECTS Responsibility
T-PHYS-102335	Scientific Seminars (S. 103)	4

Learning Control / Examinations

To be successful the student has to properly document the attendance at 12 seminars.

Module Grade

The module is not graded.

Qualification Objectives

The students comprehend geoscientific and physical problems, concepts and methods in a broad context beyond the core curriculum. They are able to make reasonable links to existing knowledge when listening to seminar presentations on subjects outside their field of specialization. They are able to summarize the key messages of seminar presentations. The students are able to join a critical scientific discourse. They ask well thought and precise questions in the aim to clarify misapprehensions and to deepen their understanding of neighboring scientific disciplines.

Content

The students attend at least 12 seminar presentations at the geophysical institute, the faculty of physics, and institutes of neighboring disciplines in earth sciences, at their choice. They gain an overview of major current research topics in the fields of these seminars. This way they broaden their understanding beyond their area of specialization. The students listen carefully to the presentations and make notes stating significant points of the presented subject as well as questions to be asked. They critically assess the consistency of the presentation within itself and with their existing knowledge. In the discussion of the presentation they ask appropriate questions to clarify apparent inconsistency or fill gaps of missing information. After the seminar they discuss the contents and new information with fellow students and prepare a short (5 to 10 lines) summary of the respective presentation.

Remarks

Each student attends at least 12 seminar presentations at the geophysical institute, the faculty of physics, and institutes of neighbouring disciplines in earth sciences (additional seminars may be accepted if the student applies for this in advance). At each seminar they make notes on a form sheet (seminar report) which is provided for download. The notes are not necessarily complete in terms of lecture notes. They can be rather a collection of dispersed notes, keywords, and sketches. However, they shall reflect the students judgement regarding major issues of the presentation, consistency of content, and the way they used questions to clarify open issues in the discussion of the seminar. They complement these notes by a short (5 to 10 lines) summary of the seminar which shall be written in full, proper sentences in a comprehensible and pointed way. If the presentation was not comprehensible this shall be described appropriately in the summary.

After having attended 12 seminars the students fill in a list (form is provided for download) of seminars and submit this together with the 12 corresponding report sheets to the examiner.

The examiner checks the reports and invites the student for a short interview. This interview shall give evidence, that the student in fact attended all the listed seminars. After a successful discussion of the report sheets, the examiner keeps the signed list of seminars for documentation and returns the reports to the student.

Literature

Abstracts published in the seminar programs.

M Module: Seismic Data Processing with final report (graded) [M-PHYS-104186]

Responsibility: Thomas Bohlen, Thomas Hertweck

Organisation: KIT-Fakultät für Physik

Curricular Anchorage: Compulsory Elective

Contained in: Electives

ECTS	Recurrence	Duration	Language	Version
6	Irregular	1 term	English	1

Compulsory

Identifier	Course	ECTS	Responsibility
T-PHYS-108656	Seismic Data Processing, final report (graded) (S. 105)	4	Thomas Bohlen, Thomas Hertweck
T-PHYS-108686	Seismic Data Processing, coursework (S. 104)	2	Thomas Bohlen, Thomas Hertweck

Learning Control / Examinations

Students have to participate the lecture/exercise on a regular basis and give a final presentation about their processing results (2 ECTS points). Students who would like to get the full 6 ECTS points also need to prepare and hand in a seismic data processing report. The report will determine the final grade (if applicable).

Module Grade

The report will determine the final grade.

Conditions

None

Modeled Conditions

The following conditions must be met:

1. The module [M-PHYS-104188] *Seismic Data Processing with final report (ungraded)* must not have been started.
2. The module [M-PHYS-104189] *Seismic Data Processing without final report (ungraded)* must not have been started.

Qualification Objectives

The students have hands-on experience applying typical seismic processing and imaging techniques to reflection seismic field data. In this way, they understand the reflection seismic method and have practical skills in data analysis and problem solving which are beneficial in their professional life later on, not only in exploration. Students can set up a basic processing and imaging flow, understand the individual processing steps and their purpose, and describe the influence of important parameters on processing results. They are able to identify data shortcomings and imaging challenges and develop basic solutions, analyze the success of individual processing/imaging steps, and critically assess the overall quality of their work. Finally, students are able to present their processing results in oral and written form.

Content

- Field data loading, quality control, trace edits and geometry setup
- Spectral analysis, filter application, geometrical spreading correction
- Deconvolution, zero-phasing
- Denoising using various approaches
- Multiple identification and removal (SRME, Radon)
- CMP sort, velocity analysis, NMO correction, mute and stack
- Time migration (prestack and poststack)
- Post-migration processing
- Basic interpretation (in cooperation with KIT-AGW)

-
- Optional: depth velocity model building and depth migration

Recommendations

No explicit requirements. However, basic knowledge of the reflection seismic method and general computer skills are essential. This course does not require any programming skills.

Remarks

A commercial data processing software is used during this course.

Literature

- Öz Yilmaz, "Seismic Data Analysis", 2001, Society of Exploration Geophysicists.
- Luc Ikelle and Lasse Amundsen, "Introduction to Petroleum Seismology", 2005, Society of Exploration Geophysicists.
- Robert Sheriff and Lloyd Geldart, "Exploration Seismology", 1995, Cambridge University Press.

M Module: Seismic Data Processing with final report (ungraded) [M-PHYS-104188]

Responsibility: Thomas Bohlen, Thomas Hertweck

Organisation: KIT-Fakultät für Physik

Curricular Anchorage: Compulsory Elective

Contained in: Electives

ECTS	Recurrence	Duration	Language	Version
6	Irregular	1 term	English	1

Compulsory

Identifier	Course	ECTS	Responsibility
T-PHYS-108657	Seismic Data Processing, final report (ungraded) (S. 106)	4	Thomas Bohlen, Thomas Hertweck
T-PHYS-108686	Seismic Data Processing, coursework (S. 104)	2	Thomas Bohlen, Thomas Hertweck

Learning Control / Examinations

Students have to participate the lecture/exercise on a regular basis and give a final presentation about their processing results (2 ECTS points). Students who would like to get the full 6 ECTS points also need to prepare and hand in a seismic data processing report. The report will determine the final grade (if applicable).

Module Grade

The coursework is not graded.

Conditions

None

Modeled Conditions

The following conditions must be met:

1. The module [M-PHYS-104186] *Seismic Data Processing with final report (graded)* must not have been started.
2. The module [M-PHYS-104189] *Seismic Data Processing without final report (ungraded)* must not have been started.

Qualification Objectives

The students have hands-on experience applying typical seismic processing and imaging techniques to reflection seismic field data. In this way, they understand the reflection seismic method and have practical skills in data analysis and problem solving which are beneficial in their professional life later on, not only in exploration. Students can set up a basic processing and imaging flow, understand the individual processing steps and their purpose, and describe the influence of important parameters on processing results. They are able to identify data shortcomings and imaging challenges and develop basic solutions, analyze the success of individual processing/imaging steps, and critically assess the overall quality of their work. Finally, students are able to present their processing results in oral and written form.

Content

- Field data loading, quality control, trace edits and geometry setup
- Spectral analysis, filter application, geometrical spreading correction
- Deconvolution, zero-phasing
- Denoising using various approaches
- Multiple identification and removal (SRME, Radon)
- CMP sort, velocity analysis, NMO correction, mute and stack
- Time migration (prestack and poststack)
- Post-migration processing
- Basic interpretation (in cooperation with KIT-AGW)

-
- Optional: depth velocity model building and depth migration

Recommendations

No explicit requirements. However, basic knowledge of the reflection seismic method and general computer skills are essential. This course does not require any programming skills.

Remarks

A commercial data processing software is used during this course.

Literature

- Öz Yilmaz, "Seismic Data Analysis", 2001, Society of Exploration Geophysicists.
- Luc Ikelle and Lasse Amundsen, "Introduction to Petroleum Seismology", 2005, Society of Exploration Geophysicists.
- Robert Sheriff and Lloyd Geldart, "Exploration Seismology", 1995, Cambridge University Press.

M Module: Seismic Data Processing without final report (ungraded) [M-PHYS-104189]

Responsibility: Thomas Bohlen, Thomas Hertweck

Organisation: KIT-Fakultät für Physik

Curricular Anchorage: Compulsory Elective

Contained in: Electives

ECTS	Recurrence	Duration	Language	Version
2	Irregular	1 term	English	1

Compulsory

Identifier	Course	ECTS Responsibility	
T-PHYS-108686	Seismic Data Processing, coursework (S. 104)	2	Thomas Bohlen, Thomas Hertweck

Learning Control / Examinations

Students have to participate the lecture/exercise on a regular basis and give a final presentation about their processing results (2 ECTS points). Students who would like to get the full 6 ECTS points also need to prepare and hand in a seismic data processing report. The report will determine the final grade (if applicable).

Module Grade

The coursework is not graded.

Conditions

None

Modeled Conditions

The following conditions must be met:

1. The module [M-PHYS-104186] *Seismic Data Processing with final report (graded)* must not have been started.
2. The module [M-PHYS-104188] *Seismic Data Processing with final report (ungraded)* must not have been started.

Qualification Objectives

The students have hands-on experience applying typical seismic processing and imaging techniques to reflection seismic field data. In this way, they understand the reflection seismic method and have practical skills in data analysis and problem solving which are beneficial in their professional life later on, not only in exploration. Students can set up a basic processing and imaging flow, understand the individual processing steps and their purpose, and describe the influence of important parameters on processing results. They are able to identify data shortcomings and imaging challenges and develop basic solutions, analyze the success of individual processing/imaging steps, and critically assess the overall quality of their work. Finally, students are able to present their processing results in oral and written form.

Content

- Field data loading, quality control, trace edits and geometry setup
- Spectral analysis, filter application, geometrical spreading correction
- Deconvolution, zero-phasing
- Denoising using various approaches
- Multiple identification and removal (SRME, Radon)
- CMP sort, velocity analysis, NMO correction, mute and stack
- Time migration (prestack and poststack)
- Post-migration processing
- Basic interpretation (in cooperation with KIT-AGW)
- Optional: depth velocity model building and depth migration

Recommendations

No explicit requirements. However, basic knowledge of the reflection seismic method and general computer skills are essential. This course does not require any programming skills.

Remarks

A commercial data processing software is used during this course.

Literature

- Öz Yilmaz, "Seismic Data Analysis", 2001, Society of Exploration Geophysicists.
- Luc Ikelle and Lasse Amundsen, "Introduction to Petroleum Seismology", 2005, Society of Exploration Geophysicists.
- Robert Sheriff and Lloyd Geldart, "Exploration Seismology", 1995, Cambridge University Press.

M Module: Seismometry, Signal Processing and Seismogram Analysis (GEOP M MSS) [M-PHYS-101358]

Responsibility: Andreas Rietbrock
Organisation: KIT-Fakultät für Physik
Curricular Anchorage: Compulsory
Contained in: [Geophysics](#)

ECTS	Recurrence	Duration	Language	Version
22	Each winter term	1 term	English	3

Compulsory

Identifier	Course	ECTS	Responsibility
T-PHYS-102325	Physics of Seismic Instruments, Prerequisite (S. 98)	0	Thomas Forbriger
T-PHYS-109267	Seismology, Prerequisite (S. 109)	0	Andreas Rietbrock
T-PHYS-109266	Seismics, Prerequisite (S. 108)	0	Thomas Bohlen
T-PHYS-106217	Seismometry, Signal Processing and Seismogram Analysis, exam (S. 110)	22	Thomas Bohlen

Learning Control / Examinations

General

To pass the module, the oral exam must be passed. As prerequisites the examinations of other type (of all three courses) must be passed.

The examination prerequisites are successful participation in 'Exercises of Physics of Seismic Instruments', 'Exercises of Seismology' and 'Exercises of Seismics'.

The oral exam covers the complete content of all exercises and lectures of the module comprehensively. The examinations of other type check the contents of the corresponding exercises.

In general, the examinations of other type can be repeated within 8 weeks, but at the latest within the period of one year. An oral reexamination usually takes place at the beginning of the next semester at the latest. A missed oral reexamination may be repeated once.

Physics of Seismic Instruments

Weekly exercise sheets must be solved and the solution returned to the supervisor usually within one week. Points will be attributed to the solutions, indicating the degree of success. Active participation in the discussion of solutions during group meetings with the supervisor is expected. A minimum of 60% of the total attributable points must be gained in order to pass the course successfully.

Seismology

Final pass is based on successful participation in exercise classes. Exercises deal with specific seismological topics and are based on hands-on work, usually involving the use of computers (Python, Matlab, specific software). Grading is based on written reports summarizing the exercise at hand and its solution.

Seismics

Final pass based on successful participation of the exercises. Each exercise deals with a specific topic (e.g., deconvolution, velocity analysis, or migration) and is based on hands-on work, usually involving the use of computers (Matlab and/or Seismic Unix). Grading is based on written reports summarizing the exercise at hand and its solution.

Module Grade

The grade of the module results from grade of the oral exam.

Qualification Objectives

Physics of Seismic Instruments

The students understand the causes and consequences of different physical excitation mechanisms for inertial seismometers. They can explain essential considerations for installation and shielding. The students understand the concept of frequency response and are able to express a transfer function in terms of poles and zeroes. They can apply these concepts to sensors with electrodynamic transducers. The students can explain the significance of linearity. They are able to quantitatively

infer the physical input signal from the recording of a seismic instrument. The students are able to use the concepts of bandwidth and dynamic range when expressing properties of signals and instruments. The students know means to express noise levels and to estimate instrumental self-noise. They can explain measures to increase the sensitivity and can explain the essential principles of modern force-balance feedback seismometers.

Seismology

The students understand the fundamental concepts of seismology and the earthquake rupture process. They have a knowledge of seismogram interpretation, fundamentals of seismic wave propagation and the representations of the earthquake source. Students are able to apply their knowledge to observed data to gain an insight into the Earth structure and the earthquake source.

Seismics

The students know the fundamental concepts of seismic acquisition, processing and imaging in reflection seismics. They can correctly name equipment, tools and processes and effectively communicate with specialists in the field of seismics. Students understand the various steps involved in seismic processing/imaging, their underlying theory and how they affect the data. They are able to apply the concepts and equations to simple exemplary seismic data.

Content

Physics of Seismic Instruments

- The mechanical sensor and the driven harmonic oscillator
- Various driving forces and wanted and unwanted sensitivity
- Installation and shielding
- The seismometer with electrodynamic transducer, effective gain, and damping due to passive electrodynamic feedback
- The frequency response, transfer function, poles and zeroes, non-linearity
- Seismic signals, bandwidth, dynamic range, and noise floor
- The force-balance feedback seismometer, displacement transducer, phase sensitive rectifier, controller, and the role of open-loop gain
- Effective transfer function of the velocity broad-band seismometer

Seismology

- History of seismology
- Elasticity and seismic waves
- Body waves and surface waves
- Seismogram interpretation
- Earthquake location
- Determination of Earth structure
- Seismic sources
- Seismic moment tensor
- Earthquake kinematics and dynamics
- Seismotectonics

Seismics

- Overview of seismic methods and wave propagation basics
- Essential signal processing concepts and tools
- Seismic acquisition, sources and receivers, marine and land
- Geometries and traveltimes, NMO and DMO
- Processing steps: from data loading to denoise and demultiple
- Velocity analysis, NMO correction, stacking, SNR
- Imaging: basic concepts, time and depth migration, migration methods
- Seismic resolution
- Optional: advanced acquisition, processing and imaging technologies

Recommendations

Physics of Seismic Instruments

A sound knowledge of the theory of ordinary differential equations and integral transformations (Fourier transformation) is expected. Basic skills in practical signal processing using elementary computer programming techniques are needed in the exercises. A basic understanding of seismic waves in the Earth is helpful.

Seismology

A sound knowledge of the fundamentals in Geophysics. Basic skills in programming and Python to solve exercises.

Seismics

Experience with Matlab, the Linux commandline, and shell scripts is beneficial. Knowledge of fundamental signal processing theory is essential.

Literature

Physics of Seismic Instruments

- Bormann, P., (ed.), 2012. New Manual of Seismological Observatory Practice. 2nd edition. GeoForschungsZentrum Potsdam. DOI: 10.2312/GFZ.NMSOP-2. <http://dx.doi.org/10.2312/GFZ.NMSOP-2>. Chapters 4 and 5 in particular.

Further recommendations will be given during the course.

Seismology

- Peter M. Shearer, "Introduction to Seismology", Cambridge University Press.
- Thorne Lay and Terry C. Wallace, "Modern Global Seismology", Academic Press.
- Seth Stein and Michael Wyession, "An Introduction to Seismology, Earthquakes, and Earth Structure", Blackwell Publishing.

Seismics

- Öz Yilmaz, "Seismic Data Analysis", 2001, Society of Exploration Geophysicists.
- Luc Ikelle and Lasse Amundsen, "Introduction to Petroleum Seismology", 2005, Society of Exploration Geophysicists.
- Jon Claerbout, "Fundamentals of geophysical data processing", 1976, McGraw-Hill.
- Etienne Robein, "Seismic Imaging: A Review of the Techniques, their Principles, Merits and Limitations", 2010, European Association of Geoscientists and Engineers.

Workload

22 ECTS in total, corresponding to 660 working hours. For the specific courses:

- Physics of Seismic Instruments: 180 h
- Seismology: 240 h
- Seismics: 240 h

M Module: Seminar on recent topics of risk science [M-PHYS-103803]

Responsibility: Ellen Gottschämmer
Organisation: KIT-Fakultät für Physik
Curricular Anchorage: Compulsory Elective
Contained in: [Electives](#)

ECTS	Recurrence	Duration	Language	Version
4	Each winter term	1 term	English	2

Compulsory

Identifier	Course	ECTS	Responsibility
T-PHYS-107673	Seminar on recent topics of risk science (S. 113)	4	Ellen Gottschämmer

Learning Control / Examinations

Preparation and presentation of a talk based on a scientific publication, critical discussion of the scientific results.

Module Grade

The coursework is not graded.

Conditions

None

Qualification Objectives

The students understand scientific literature regarding current topics of natural hazards and risk. They can summarize a selected topic, describe and explain the main idea to their fellow students in an oral presentation (30-40 minutes). They know how to structure and present a scientific talk. They are able to understand the topics presented by their fellow students, discuss and analyze the content critically. They are able to compare those research results and evaluate the content critically.

Content

The students will read and discuss current literature about current topics of natural hazards and risk.

M Module: Structural Geology and Tectonics [M-BGU-101996]

Responsibility: Agnes Kontny
Organisation: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften
Curricular Anchorage: Compulsory Elective
Contained in: [Electives](#)

ECTS	Recurrence	Duration	Language	Version
4	Each winter term	1 term	German	1

Compulsory

Identifier	Course	ECTS	Responsibility
T-BGU-103712	Structural Geology and Tectonics (S. 114)	4	Agnes Kontny

Conditions
None

M Module: The Black Forest Observatory at Schiltach [M-PHYS-101870]

Responsibility: Ellen Gottschämmer
Organisation: KIT-Fakultät für Physik
Curricular Anchorage: Compulsory Elective
Contained in: [Electives](#)

ECTS	Recurrence	Duration	Language	Version
1	Irregular	1 term	German	1

Compulsory

Identifier	Course	ECTS	Responsibility
T-PHYS-103569	The Black Forest Observatory at Schiltach, Studienleistung (S. 115)	1	Ellen Gottschämmer

M Module: Theory and Inversion of Seismic Waves (GEOP M TIW) [M-PHYS-101359]

Responsibility: Thomas Bohlen
Organisation: KIT-Fakultät für Physik
Curricular Anchorage: Compulsory
Contained in: [Geophysics](#)

ECTS	Recurrence	Duration	Language	Version
18	Each summer term	1 term	English	3

Compulsory

Identifier	Course	ECTS	Responsibility
T-PHYS-102330	Theory of Seismic Waves, Prerequisite (S. 117)	0	Thomas Bohlen
T-PHYS-102332	Inversion and Tomography, Prerequisite (S. 91)	0	Joachim Ritter
T-PHYS-108636	Seismic Modelling, Prerequisite (S. 107)	0	Thomas Bohlen
T-PHYS-106218	Theory and Inversion of Seismic Waves, exam (S. 116)	18	Thomas Bohlen

Learning Control / Examinations

General

To pass the module, the oral exam must be passed. As prerequisites the examinations of other type (of all three courses) must be passed.

The examination prerequisites are successful participation in 'Exercises of Theory of Seismic Wave', 'Exercises of Seismic Modelling' and 'Exercises of Inversion and Tomography'.

The oral exam covers the complete content of all exercises and lectures of the module comprehensively. The examinations of other type check the contents of the corresponding exercises.

In general, the examinations of other type can be repeated within 8 weeks, but at the latest within the period of one year. An oral reexamination usually takes place at the beginning of the next semester at the latest. A missed oral reexamination may be repeated once.

Theory of Seismic Waves

Final pass based on successful participation of the exercises. Each exercise deals with a specific topic (e.g., stress and strain tensors, Zoeppritz equations, or rays) and is based on solving a given theoretical problem by means of calculus. In some cases equations and solutions need to be visualized using Matlab (or equivalent tools).

Seismic Modelling

Final pass based on successful participation of the exercises. Each exercise deals with a specific topic (e.g., 1D finite-difference implementation) and is based on hands-on work, usually involving the use of computers.

Inversion and Tomography

Students write reports on their exercise work. These reports are rated. The necessary number of points is explained at the beginning of the individual exercises.

Module Grade

The grade of the module results from grade of the oral exam.

Qualification Objectives

Theory of Seismic Waves

The students know the fundamental laws and equations of linear elasticity and wave propagation. They understand wave propagation phenomena such as source effects, reflection and transmission or the effects of anisotropy, absorption, dispersion and scattering and can describe them in mathematical terms. They are able to apply the concepts and equations to theoretical problems and relate the theory to phenomena observed in field data.

Seismic Modelling

The students know the fundamental concepts of seismic wavefield simulations, including the mathematical descriptions and their basic numeric implementations. They understand the complexity of wave propagation and the advantages and

disadvantages of the individual methods. They are able to apply the methods using synthetic Earth models to calculate amplitudes and traveltimes of propagating elastic and/or acoustic waves.

Inversion and Tomography

The students understand how to invert data to achieve a model of physical parameters. The students realize that seismic waves can be treated in different ways: full waveform, finite-frequency approximations (banana-doughnut theory) and rays. From this they understand how seismic images can be constructed and interpreted. Students are able to evaluate inversion models based on error bounds, resolution matrices and reconstruction tests. They know the complete chain of tomography: data pre-processing, parameterization, inversion, model assessment and interpretation. The students are used to read scientific papers on inversion and tomography and to discuss questions on these papers. Finally the students are able to understand basic inverse problems and read more advanced texts. Practically, the students understand how to code simple problems with Matlab or possibly Python. The students know how to analyze inverse problems using singular value decomposition and other methods.

Content

Theory of Seismic Waves

- Theory of elasticity, stress and strain, elastic tensor, fundamental laws and equations
- Anisotropic elastic wave equation and various simplifications
- Mathematical description of sources, near-field and far-field terms
- Boundary conditions
- Reflection and transmission of plane waves at plane interfaces, Zoeppritz equations
- Surface waves, dispersion relation, phase and group velocity
- Introduction to ray theory, eikonal and transport equations and their solutions
- Absorption and dispersion
- Wave propagation in anisotropic media
- Scattering

Seismic Modelling

- Factors influencing traveltimes and amplitudes of seismic wavefields
- Analytical solutions
- Fast traveltime calculation using the eikonal equation
- Raytracing
- Reflectivity method for acoustic 1D media
- Time-domain finite-difference solutions of the acoustic/elastic wave equations
- Fourier methods
- Introduction to the finite-element method

Inversion and Tomography

- Fundamentals of tomography
- Application of seismic tomography
- Regional to global seismic tomography
- Analysis of tomography problems
- Fundamentals in seismic inversion
- Application of linear and non-linear inversion

Recommendations

Theory of Seismic Waves

Knowledge of differential and vector calculus is essential. Familiarity with Matlab (alternatively Python or Mathematica) is beneficial for certain exercises.

Seismic Modelling

Knowledge of differential and vector calculus is essential. Familiarity with Matlab (alternatively Python or Mathematica) is beneficial for certain exercises.

Inversion and Tomography

Knowledge on fundamentals of seismology and understanding of mathematics, especially matrix calculus. Fundamental skills in Linux, Matlab and computing in general.

Literature

Theory of Seismic Waves

-
- Aki and Richards, "Quantitative Seismology", 2003, University Science Books.
 - Ben-Menahem and Singh, "Seismic waves and sources", 1981, Springer.
 - Dahlen and Tromp, "Theoretical Global Seismology", 1998, Princeton University Press.
 - Frank Hadsell, "Tensors of Geophysics for Mavericks and Mongrels", 1995, Society of Exploration Geophysicists.

Seismic Modelling

- Carcione, Herman and Kroode, "Seismic modeling", 2000, Geophysics 67(4).

Inversion and Tomography

- Nolet, G., 2008. A breviary of seismic tomography. Cambridge University Press.
- Aster, R.C., Brochers, B. & Thurber, C.H., 2012. Parameter estimation and inverse problems. Elsevier (2nd ed.).
- Menke, W.A., 2012. Geophysical data analysis: discrete inverse theory. Academic Press (3rd ed.).

Workload

18 ECTS in total, corresponding to 540 working hours. For the specific courses:

- Theory of Seismic Waves: 180 h
- Seismic Modelling: 120 h
- Inversion and Tomography: 240 h

Part V

Courses

T Course: 3D reflection seismics [T-PHYS-107806]

Responsibility: Thomas Bohlen, Thomas Hertweck

Contained in: [\[M-PHYS-103856\]](#) 3D reflection seismics

ECTS	Language	Recurrence	Exam type	Version
1	English	Irregular	Studienleistung	1

Events

Term	Event-No.	Events	Type	SWS	Lecturers
WS 18/19	4060161	3D land seismics	Vorlesung (V)	1	Thomas Bohlen, Thomas Hertweck

T Course: Black Forest Observatory Course [T-PHYS-106261]**Responsibility:** Thomas Forbriger**Contained in:** [\[M-PHYS-103145\]](#) Black Forest Observatory Course

ECTS	Language	Recurrence	Exam type	Version
1	English	Each winter term	Studienleistung	1

Events

Term	Event-No.	Events	Type	SWS	Lecturers
WS 18/19	4060914	Observatory course	Praktikum (P)	2	Thomas Forbriger

T Course: Classical Physics Laboratory Courses II [T-PHYS-102290]**Responsibility:** Günter Quast, Hans Jürgen Simonis**Contained in:** [\[M-PHYS-101354\]](#) Classical Physics Laboratory Course II

ECTS	Language	Recurrence	Exam type	Version
6	German	Each summer term	Studienleistung	1

Events

Term	Event-No.	Events	Type	SWS	Lecturers
SS 2019	4011213		Praktikum (P)	6	Günter Quast, Hans Jürgen Simonis
SS 2019	4011223		Praktikum (P)	6	Günter Quast, Hans Jürgen Simonis

Conditions

none

T Course: Full-waveform inversion [T-PHYS-109272]

Responsibility: Thomas Bohlen, Thomas Hertweck

Contained in: [\[M-PHYS-104522\]](#) Full-waveform inversion

ECTS	Recurrence	Exam type	Version
6	Each winter term	Studienleistung	1

T Course: Geodynamic Modelling I [T-PHYS-107998]

Responsibility: Oliver Heidbach

Contained in: [\[M-PHYS-103914\]](#) Geodynamic Modelling I

ECTS	Recurrence	Exam type	Version
2	Each winter term	Studienleistung	1

T Course: Geodynamic Modelling II [T-PHYS-107999]

Responsibility: Oliver Heidbach

Contained in: [\[M-PHYS-103915\]](#) Geodynamic Modelling II

ECTS	Recurrence	Exam type	Version
2	Each winter term	Studienleistung	1

T Course: Geological Hazards and Risk [T-PHYS-103525]**Responsibility:** Ellen Gottschämmer**Contained in:** [\[M-PHYS-101833\]](#) Geological Hazards and Risk

ECTS	Language	Recurrence	Exam type	Version
8	English	Each winter term	Prüfungsleistung anderer Art	2

Events

Term	Event-No.	Events	Type	SWS	Lecturers
WS 18/19	4060121	Geological Hazards and Risk	Vorlesung (V)	2	James Daniell, Ellen Gottschämmer
WS 18/19	4060122		Übung (Ü)	2	James Daniell, Ellen Gottschämmer

T **Course: Geophysical Deep Sounding at Volcanoes and the Example of the Vogelsberg, exam [T-PHYS-103673]**

Responsibility: Ellen Gottschämmer

Contained in: [M-PHYS-101952] Geophysical Deep Sounding at Volcanoes and the Example of the Vogelsberg, graded

ECTS	Exam type	Version
1	Prüfungsleistung anderer Art	1

Modeled Conditions

The following conditions must be met:

- The course [T-PHYS-103571] *Geophysical Deep Sounding at Volcanoes and the Example of the Vogelsberg, Studienleistung* must have been passed.

T**Course: Geophysical Deep Sounding at Volcanoes and the Example of the Vogelsberg, Studienleistung [T-PHYS-103571]****Responsibility:** Ellen Gottschämmer**Contained in:** [\[M-PHYS-101952\]](#) Geophysical Deep Sounding at Volcanoes and the Example of the Vogelsberg, graded[\[M-PHYS-101872\]](#) Geophysical Deep Sounding at Volcanoes and the Example of the Vogelsberg, not graded

ECTS	Exam type	Version
3	Studienleistung	1

T Course: Geophysical Investigation of Volcanic Fields, exam [T-PHYS-103672]

Responsibility: Joachim Ritter

Contained in: [M-PHYS-101951] Geophysical Investigation of Volcanic Fields, graded

ECTS	Exam type	Version
1	Prüfungsleistung anderer Art	1

Modeled Conditions

The following conditions must be met:

- The course [T-PHYS-103573] *Geophysical Investigation of Volcanic Fields, Studienleistung* must have been passed.

T **Course: Geophysical Investigation of Volcanic Fields, Studienleistung**
[T-PHYS-103573]

Responsibility: Joachim Ritter

Contained in: [\[M-PHYS-101951\]](#) Geophysical Investigation of Volcanic Fields, graded
[\[M-PHYS-101874\]](#) Geophysical Investigation of Volcanic Fields, not graded

ECTS	Exam type	Version
3	Studienleistung	1

T **Course: Geophysical monitoring of tunnel constructions, Studienleistung**
[T-PHYS-106248]

Responsibility: Ellen Gottschämmer

Contained in: [\[M-PHYS-103141\]](#) Geophysical monitoring of tunnel constructions

ECTS	Exam type	Version
1	Studienleistung	1

T Course: Hazard and Risk Assessment of Mediterranean Volcanoes, exam
[T-PHYS-103674]

Responsibility: Ellen Gottschämmer

Contained in: [M-PHYS-101873] Hazard and Risk Assessment of Mediterranean Volcanoes, graded

ECTS	Exam type	Version
2	Prüfungsleistung anderer Art	1

Modeled Conditions

The following conditions must be met:

- The course [T-PHYS-103572] *Hazard and Risk Assessment of Mediterranean Volcanoes, Studienleistung* must have been passed.

T Course: Hazard and Risk Assessment of Mediterranean Volcanoes, Studienleistung
[T-PHYS-103572]

Responsibility: Ellen Gottschämmer

Contained in: [M-PHYS-101873] Hazard and Risk Assessment of Mediterranean Volcanoes, graded
[M-PHYS-101953] Hazard and Risk Assessment of Mediterranean Volcanoes, not graded

ECTS	Exam type	Version
4	Studienleistung	1

Modeled Conditions

The following conditions must be met:

- The course [T-PHYS-103553] *Introduction to Volcanology, Studienleistung* must have been passed.

T**Course: Historical Seismology for Hazard Evaluation, Studienleistung
[T-PHYS-103679]****Responsibility:** Ellen Gottschämmer**Contained in:** [\[M-PHYS-101961\]](#) Historical Seismology for Hazard Evaluation

ECTS	Recurrence	Exam type	Version
1	Irregular	Studienleistung	1

Events

Term	Event-No.	Events	Type	SWS	Lecturers
WS 18/19	4060131		Vorlesung (V)	1	Ellen Gottschämmer, Joachim Ritter

T Course: Induced Seismicity, exam [T-PHYS-103677]

Responsibility: Joachim Ritter

Contained in: [M-PHYS-101959] Induced Seismicity, graded

ECTS	Exam type	Version
2	Prüfungsleistung anderer Art	1

Modeled Conditions

The following conditions must be met:

- The course [T-PHYS-103575] *Induced Seismicity, Studienleistung* must have been passed.

T Course: Induced Seismicity, Studienleistung [T-PHYS-103575]

Responsibility: Joachim Ritter

Contained in: [\[M-PHYS-101959\]](#) Induced Seismicity, graded
[\[M-PHYS-101878\]](#) Induced Seismicity, not graded

ECTS	Recurrence	Exam type	Version
3	Irregular	Studienleistung	1

T Course: In-Situ: Seismic Hazard in the Apennines [T-PHYS-108690]

Responsibility: Ellen Gottschämmer

Contained in: [\[M-PHYS-104195\]](#) In-Situ: Seismic Hazard in the Apennines

ECTS	Exam type	Version
6	Prüfungsleistung anderer Art	1

T Course: In-Situ: Summer School Bandung: Seismology/Geohazards [T-PHYS-108691]

Responsibility: Ellen Gottschämmer, Andreas Rietbrock

Contained in: [\[M-PHYS-104196\]](#) In-Situ: Summer School Bandung: Seismology/Geohazards

ECTS	Language	Exam type	Version
6	English	Prüfungsleistung anderer Art	1

Events

Term	Event-No.	Events	Type	SWS	Lecturers
SS 2019	4060351	In-Situ: Summer School Bandung: Seismology	Veranstaltung (Veranst.)	2	Ellen Gottschämmer, Andreas Rietbrock
SS 2019	4060352	In-Situ: Summer School Bandung: Seismology	Übung (Ü)	4	Ellen Gottschämmer, Andreas Rietbrock

Conditions

none

T Course: Introduction to Research in a Scientific Sub-Field Including a Seminar paper
[T-PHYS-103355]

Responsibility:

Contained in: [\[M-PHYS-101361\]](#) Introduction to Scientific Practice

ECTS	Exam type	Version
16	Studienleistung	1

T Course: Introduction to Volcanology, exam [T-PHYS-103644]**Responsibility:** Ellen Gottschämmer**Contained in:** [M-PHYS-101866] Introduction to Volcanology, graded

ECTS	Language	Exam type	Version
1	German	Prüfungsleistung anderer Art	1

Events

Term	Event-No.	Events	Type	SWS	Lecturers
SS 2019	4060251	Introduction to Volcanology	Vorlesung (V)	1	Ellen Gottschämmer, Andreas Rietbrock
SS 2019	4060252	Exercises to Introduction to Volcanology	Übung (Ü)	1	Ellen Gottschämmer, Andreas Rietbrock

Modeled Conditions

The following conditions must be met:

- The course [T-PHYS-103553] *Introduction to Volcanology, Studienleistung* must have been passed.

T Course: Introduction to Volcanology, Studienleistung [T-PHYS-103553]**Responsibility:** Ellen Gottschämmer**Contained in:** [\[M-PHYS-101944\]](#) Introduction to Volcanology, not graded
[\[M-PHYS-101866\]](#) Introduction to Volcanology, graded

ECTS	Language	Exam type	Version
3	German	Studienleistung	1

Events

Term	Event-No.	Events	Type	SWS	Lecturers
SS 2019	4060251	Introduction to Volcanology	Vorlesung (V)	1	Ellen Gottschämmer, Andreas Rietbrock
SS 2019	4060252	Exercises to Introduction to Volcanology	Übung (Ü)	1	Ellen Gottschämmer, Andreas Rietbrock

T Course: Inversion and Tomography, Prerequisite [T-PHYS-102332]**Responsibility:** Joachim Ritter**Contained in:** [\[M-PHYS-101359\]](#) Theory and Inversion of Seismic Waves

ECTS	Language	Exam type	Version
0	English	Studienleistung schriftlich	1

Events

Term	Event-No.	Events	Type	SWS	Lecturers
SS 2019	4060231	Inversion and Tomography	Vorlesung (V)	2	Laura Gaßner, Joachim Ritter
SS 2019	4060232	Exercises to Inversion and Tomography	Übung (Ü)	2	Laura Gaßner, Joachim Ritter

T Course: Master Thesis [T-PHYS-103350]

Responsibility: Thomas Bohlen

Contained in: [\[M-PHYS-101730\]](#) Modul Master Thesis

ECTS	Language	Exam type	Version
30	German	Abschlussarbeit	1

T Course: Measuring Methods in Physical Volcanology, exam [T-PHYS-103671]

Responsibility: Ellen Gottschämmer

Contained in: [M-PHYS-101950] Measuring Methods in Physical Volcanology, graded

ECTS	Exam type	Version
1	Prüfungsleistung mündlich	1

Modeled Conditions

The following conditions must be met:

- The course [T-PHYS-103570] *Measuring Methods in Physical Volcanology, Studienleistung* must have been passed.

T Course: Measuring Methods in Physical Volcanology, Studienleistung
[T-PHYS-103570]

Responsibility: Ellen Gottschämmer

Contained in: [M-PHYS-101950] Measuring Methods in Physical Volcanology, graded
[M-PHYS-101871] Measuring Methods in Physical Volcanology, not graded

ECTS	Exam type	Version
1	Studienleistung	1

Modeled Conditions

The following conditions must be met:

- The course [T-PHYS-103553] *Introduction to Volcanology, Studienleistung* must have been passed.

T Course: Modern Physics Laboratory Courses [T-PHYS-102291]

Responsibility: Andreas Naber

Contained in: [M-PHYS-101355] Modern Physics Laboratory Course

ECTS	Language	Recurrence	Exam type	Version
6	German	Each term	Studienleistung	1

Events

Term	Event-No.	Events	Type	SWS	Lecturers
WS 18/19	4011313		Praktikum (P)	4	Gernot Guigas, Andreas Naber, Christoph Sürgers, Joachim Wolf
WS 18/19	4011323		Praktikum (P)	4	Gernot Guigas, Andreas Naber, Christoph Sürgers, Joachim Wolf
SS 2019	4011313		Praktikum (P)	4	Gernot Guigas, Andreas Naber, Christoph Sürgers, Joachim Wolf
SS 2019	4011323		Praktikum (P)	4	Gernot Guigas, Andreas Naber, Christoph Sürgers, Joachim Wolf

Conditions

none

T**Course: Near Surface Geophysical Prospecting, Studienleistung [T-PHYS-103645]****Responsibility:** Ellen Gottschämmer**Contained in:** [\[M-PHYS-101946\]](#) Near Surface Geophysical Prospecting

ECTS	Exam type	Version
1	Studienleistung	1

T Course: Near-surface seismic and GPR [T-PHYS-107793]**Responsibility:** Thomas Bohlen, Yudi Pan**Contained in:** [\[M-PHYS-103855\]](#) Near-surface seismic and GPR

ECTS	Language	Recurrence	Exam type	Version
6	English	Each winter term	Studienleistung	1

Events

Term	Event-No.	Events	Type	SWS	Lecturers
WS 18/19	4060151	Near-surface seismic and GPR	Vorlesung (V)	1	Thomas Bohlen, Yudi Pan
WS 18/19	4060152	Exercises on Near-surface seismic and GPR	Übung (Ü)	1	Nikolaos Athanassopoulos, Thomas Bohlen, Yudi Pan

T Course: Physics of Seismic Instruments, Prerequisite [T-PHYS-102325]**Responsibility:** Thomas Forbriger**Contained in:** [M-PHYS-101358] Seismometry, Signal Processing and Seismogram Analysis

ECTS	Language	Exam type	Version
0	English	Studienleistung schriftlich	1

Events

Term	Event-No.	Events	Type	SWS	Lecturers
WS 18/19	4060051	Physics of seismic instruments	Vorlesung (V)	2	Thomas Forbriger
WS 18/19	4060052		Übung (Ü)	1	Adam Ciesielski, Thomas Forbriger, Andreas Rietbrock

T Course: Physics of the Lithosphere, exam [T-PHYS-103678]

Responsibility: Ellen Gottschämmer

Contained in: [M-PHYS-101960] Physics of the Lithosphere, graded

ECTS	Exam type	Version
1	Prüfungsleistung anderer Art	1

Modeled Conditions

The following conditions must be met:

- The course [T-PHYS-103574] *Physics of the Lithosphere, Studienleistung* must have been passed.

T Course: Physics of the Lithosphere, Studienleistung [T-PHYS-103574]

Responsibility: Ellen Gottschämmer

Contained in: [\[M-PHYS-101875\]](#) Physics of the Lithosphere, not graded
[\[M-PHYS-101960\]](#) Physics of the Lithosphere, graded

ECTS	Exam type	Version
2	Studienleistung	1

T Course: Recent Geodynamics [T-BGU-101771]

Responsibility: Malte Westerhaus

Contained in: [M-BGU-101030] Recent Geodynamics

ECTS	Exam type	Version
3	Prüfungsleistung mündlich	1

Modeled Conditions

The following conditions must be met:

- The course [T-BGU-101772] *Recent Geodynamics, Prerequisite* must have been passed.

T **Course: Recent Geodynamics, Prerequisite [T-BGU-101772]**

Responsibility: Malte Westerhaus

Contained in: [[M-BGU-101030](#)] Recent Geodynamics

ECTS	Exam type	Version
1	Studienleistung	1

T Course: Scientific Seminars [T-PHYS-102335]

Responsibility:

Contained in: [M-PHYS-101357] Scientific Seminars

ECTS	Language	Recurrence	Min Term	Exam type	Version
4	German	Each term	3	Studienleistung	1

Events

Term	Event-No.	Events	Type	SWS	Lecturers
WS 18/19	4060294		Seminar (S)	2	Andreas Barth, Thomas Bohlen, Andreas Rietbrock
WS 18/19	6020730		Kolloquium (KOL)	1	Martin Breunig, Bernhard Heck, Maria Hennes, Stefan Hinz
WS 18/19	6339044		Vorlesung (V)	2	Dozenten der Geowissenschaften
SS 2019	4060334		Seminar (S)	2	Andreas Barth, Thomas Bohlen, Andreas Rietbrock
SS 2019	6339041		Seminar (S)	2	Philipp Blum, Nico Goldscheider

T Course: Seismic Data Processing, coursework [T-PHYS-108686]

Responsibility: Thomas Bohlen, Thomas Hertweck

Contained in: [\[M-PHYS-104188\]](#) Seismic Data Processing with final report (ungraded)
[\[M-PHYS-104189\]](#) Seismic Data Processing without final report (ungraded)
[\[M-PHYS-104186\]](#) Seismic Data Processing with final report (graded)

ECTS	Exam type	Version
2	Studienleistung	1

T Course: Seismic Data Processing, final report (graded) [T-PHYS-108656]

Responsibility: Thomas Bohlen, Thomas Hertweck

Contained in: [M-PHYS-104186] Seismic Data Processing with final report (graded)

ECTS	Language	Exam type	Version
4	English	Prüfungsleistung anderer Art	1

Events

Term	Event-No.	Events	Type	SWS	Lecturers
SS 2019	4060321	Seismic Data Processing	Vorlesung (V)	1	Nikolaos Athanasopoulos, Thomas Bohlen, Thomas Hertweck
SS 2019	4060322	Exercises to Seismic Data Processing	Übung (Ü)	2	Nikolaos Athanasopoulos, Thomas Bohlen, Thomas Hertweck

Conditions

Successful participation on "Seismic Data Processing, course achievement"

Modeled Conditions

The following conditions must be met:

- The course [T-PHYS-108686] *Seismic Data Processing, coursework* must have been passed.

T Course: Seismic Data Processing, final report (ungraded) [T-PHYS-108657]

Responsibility: Thomas Bohlen, Thomas Hertweck

Contained in: [M-PHYS-104188] Seismic Data Processing with final report (ungraded)

ECTS	Exam type	Version
4	Prüfungsleistung anderer Art	1

Conditions

Successfull participoation on "Seismic Data Processing, course achievement"

Modeled Conditions

The following conditions must be met:

- The course [T-PHYS-108686] *Seismic Data Processing, coursework* must have been passed.

T Course: Seismic Modelling, Prerequisite [T-PHYS-108636]**Responsibility:** Thomas Bohlen**Contained in:** [\[M-PHYS-101359\]](#) Theory and Inversion of Seismic Waves

ECTS	Language	Exam type	Version
0	English	Studienleistung schriftlich	1

Events

Term	Event-No.	Events	Type	SWS	Lecturers
SS 2019	4060261	Seismic Modelling	Vorlesung (V)	1	Thomas Bohlen, Yudi Pan
SS 2019	4060262	Exercises to Seismic Modelling	Übung (Ü)	1	Thomas Bohlen, Yudi Pan

T Course: Seismics, Prerequisite [T-PHYS-109266]**Responsibility:** Thomas Bohlen**Contained in:** [M-PHYS-101358] Seismometry, Signal Processing and Seismogram Analysis

ECTS	Language	Exam type	Version
0	English	Studienleistung schriftlich	1

Events

Term	Event-No.	Events	Type	SWS	Lecturers
WS 18/19	4060111	Seismics	Vorlesung (V)	2	Thomas Bohlen, Thomas Hertweck
WS 18/19	4060112	Exercises on Seismics	Übung (Ü)	2	Thomas Bohlen, Thomas Hertweck, Tilman Steinweg

T Course: Seismology, Prerequisite [T-PHYS-109267]**Responsibility:** Andreas Rietbrock**Contained in:** [M-PHYS-101358] Seismometry, Signal Processing and Seismogram Analysis

ECTS	Language	Exam type	Version
0	English	Studienleistung schriftlich	1

Events

Term	Event-No.	Events	Type	SWS	Lecturers
WS 18/19	4060171	Seismology	Vorlesung (V)	2	Ellen Gottschämmer, Andreas Rietbrock
WS 18/19	4060172	Exercises on Seismology	Übung (Ü)	2	Ellen Gottschämmer, Andreas Rietbrock

T Course: Seismometry, Signal Processing and Seismogram Analysis, exam [T-PHYS-106217]

Responsibility: Thomas Bohlen

Contained in: [M-PHYS-101358] Seismometry, Signal Processing and Seismogram Analysis

ECTS	Recurrence	Exam type	Version
22	Each winter term	Prüfungsleistung mündlich	2

Modeled Conditions

The following conditions must be met:

1. The course [T-PHYS-102325] *Physics of Seismic Instruments, Prerequisite* must have been passed.
2. The course [T-PHYS-109266] *Seismics, Prerequisite* must have been passed.
3. The course [T-PHYS-109267] *Seismology, Prerequisite* must have been passed.

T Course: Seminar on recent topics of applied geophysics [T-PHYS-107675]**Responsibility:** Thomas Bohlen**Contained in:** [\[M-PHYS-101360\]](#) Scientific Focusing Phase

ECTS	Language	Recurrence	Exam type	Version
10	English	Each term	Studienleistung mündlich	1

Events

Term	Event-No.	Events	Type	SWS	Lecturers
WS 18/19	4060234	Seminar on Applied Geophysics	Seminar (S)	2	Thomas Bohlen, Thomas Hertweck
SS 2019	4060284	Seminar on Applied Geophysics	Seminar (S)	2	Thomas Bohlen, Thomas Hertweck

T Course: Seminar on recent topics of general geophysics [T-PHYS-107676]**Responsibility:** Ellen Gottschämmer, Andreas Rietbrock**Contained in:** [\[M-PHYS-101360\]](#) Scientific Focusing Phase

ECTS	Language	Recurrence	Exam type	Version
10	English	Each term	Studienleistung mündlich	1

Events

Term	Event-No.	Events	Type	SWS	Lecturers
WS 18/19	4060274	Current Topics in Seismology and Hazard	Seminar (S)	2	Ellen Gottschämmer, Andreas Rietbrock
SS 2019	4060274	Current Topics in Seismology and Hazard	Seminar (S)	2	Andreas Rietbrock

T Course: Seminar on recent topics of risk science [T-PHYS-107673]**Responsibility:** Ellen Gottschämmer**Contained in:** [\[M-PHYS-103803\]](#) Seminar on recent topics of risk science

ECTS	Language	Recurrence	Exam type	Version
4	German	Each winter term	Studienleistung	1

Events

Term	Event-No.	Events	Type	SWS	Lecturers
WS 18/19	4060284		Seminar (S)	2	Ellen Gottschämmer

T Course: Structural Geology and Tectonics [T-BGU-103712]**Responsibility:** Agnes Kontny**Contained in:** [\[M-BGU-101996\]](#) Structural Geology and Tectonics

ECTS	Exam type	Version
4	Prüfungsleistung schriftlich	1

Events

Term	Event-No.	Events	Type	SWS	Lecturers
WS 18/19	6339009		Vorlesung / Übung 3 (VÜ)		Agnes Kontny

Conditions
none

**T Course: The Black Forest Observatory at Schiltach, Studienleistung
[T-PHYS-103569]**

Responsibility: Ellen Gottschämmer

Contained in: [\[M-PHYS-101870\]](#) The Black Forest Observatory at Schiltach

ECTS	Language	Exam type	Version
1	German	Studienleistung	1

Events

Term	Event-No.	Events	Type	SWS	Lecturers
SS 2019	4060403		Vorlesung (V)	1	Thomas Forbriger, Ellen Gottschämmer

T Course: Theory and Inversion of Seismic Waves, exam [T-PHYS-106218]

Responsibility: Thomas Bohlen

Contained in: [M-PHYS-101359] Theory and Inversion of Seismic Waves

ECTS	Exam type	Version
18	Prüfungsleistung mündlich	2

Modeled Conditions

The following conditions must be met:

1. The course [T-PHYS-102330] *Theory of Seismic Waves, Prerequisite* must have been passed.
2. The course [T-PHYS-102332] *Inversion and Tomography, Prerequisite* must have been passed.
3. The course [T-PHYS-108636] *Seismic Modelling, Prerequisite* must have been passed.

T Course: Theory of Seismic Waves, Prerequisite [T-PHYS-102330]**Responsibility:** Thomas Bohlen**Contained in:** [\[M-PHYS-101359\]](#) Theory and Inversion of Seismic Waves

ECTS	Language	Exam type	Version
0	English	Studienleistung schriftlich	1

Events

Term	Event-No.	Events	Type	SWS	Lecturers
SS 2019	4060221	Theory of Seismic Waves	Vorlesung (V)	2	Thomas Bohlen, Thomas Hertweck
SS 2019	4060222	Exercises to Theory of Seismic Waves	Übung (Ü)	1	Thomas Bohlen, Thomas Hertweck

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