Karlsruher Institut für Technologie

Module Handbook
Geophysics Master (M.Sc.)

SPO 2020 - valid for all students who started winter term 20/21 or later

Summer term 2025

Date: 10/03/2025

KIT DEPARTMENT OF PHYSICS

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1 General Information

1.1 Study program details

KIT-Department	KIT Department of Physics
Academic Degree	Master of Science (M.Sc.)
Examination Regulations Version	2020
Regular terms	4 terms
Maximum terms	7 terms
Credits	120
Language	English
Grade calculation	Weighted by (Weight * CP)
Additional Information	Link to study program https://www.gpi.kit.edu/english/288.php Department https://www.gpi.kit.edu/english/256.php Business unit Studium und Lehre https://www.sle.kit.edu/english/vorstudium/master-geophysics.php

1.2 Contact

lehre@gpi.kit.edu

1.3 Studies and Examination Regulations

See https://www.sle.kit.edu/english/vorstudium/master-geophysics.php

Prologue

Introduction

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. KIT therefore sees the consecutive Bachelor's and Master's degree programs offered as an overall concept with a consecutive curriculum. Students from other universities, who fulfill the requirements to study in KIT's Master's program in Geophysics, are equally admitted.

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

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

Topics studied are grouped into subjects and those are divided into modules. All modules are listed in the section ‘Modules’ within this module handbook. With this prologue we provide information that goes beyond the content of the module descriptions. All information refers to the German version of the Study and Examination Regulations (SPO), as of 06.08.2020

Both the German SPO which is legally binding and the English translation (not legally binding) can be found on the web page of our Geophysics Master's program:

https://www.gpi.kit.edu/english/288.php

Geophysics Master's program at KIT

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 in the subject “Electives”.

This profile-forming requires a solid basic education in the context of a Bachelor's degree program. Accordingly, the KIT-Department of Physics has issued admission requirements. Missing fundamentals in Geophysics can be acquired in mandatory additional studies.

Both, the German Statues for Admission which are legally binding and the English translation (not legally binding) can be found on the web page of our Geophysics Master's program:

https://www.gpi.kit.edu/english/288.php

Of central importance is the thesis, which is preceded by the subjects “Scientific Focusing Phase” and “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 credits are acquired as part of the courses offered by KIT.

2 Qualification Objectives

Students of the Geophysics Master's program know and understand the scientific basics of general and applied geophysics. The students understand the theory of seismic waves and can calculate the solution of the elastic wave equation for the general and special cases. They know the principles of inversion of seismic waves and can apply them. They understand measurement procedures used in Geophysics, can explain and compare a variety of measurement principles and know how to perform an objective and detailed error analysis of the measurement results. They can process and analyze seismic signals of different frequency ranges and assess seismic analyses. In the field of reflection seismics and array seismology, students are familiar with the working steps from data acquisition to analysis and are able to carry them out on their own. Students who have obtained their Bachelor's degree outside KIT may require to complete basic courses in the field of signal processing in the subject “Electives”, unless they have already acquired these qualifications in their previous studies.

The graduates understand geoscientific and physical context beyond the field of Geophysics, they can discuss and interpret it. Based on the acquired knowledge, they correctly classify topics and have the practical ability to solve tasks of geophysics and neighboring geoscientific disciplines.

They have the ability to deduce relationships from measured data, to formulate complex models, to derive predictions and to verify or falsify them using advanced methods like inversion of data. Graduates can apply knowledge of Geophysics to research-related questions and are able to analyze and solve technical problems using geophysical methods including software and hardware. Graduates have competences in clearly summarizing scientific results in written and spoken language and are able to present their work in a didactically appealing manner. The graduates can work independently and have extensive communication skills and organizational skills.

3 Subjects

3.1 Geophysics

The core of the Master’s program is the subject “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). Whether one or the other module is completed first depends on the beginning of the study in either winter or summer term. A start in the summer term (April) is not recommended for students from abroad or students who do not hold a Bachelor's degree in Geophysics. The module content is taught in lectures and exercises as well as individually acquired in self studies. In the subject "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 insight into current research and establish a close connection to current scientific issues in their courses. They also demonstrate and teach good scientific practice according to KIT's Statutes for Safeguarding Good Research Practice.

3.2 Electives

In order to specialize, the students can choose 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 corresponding modules must sum up to a total of at least 16 ECTS credits.

At least 8 ECTS credits must be earned through graded modules. The grade of Electives is then calculated as ECTS-weighted average of all individual graded modules. All other ungraded modules complete the Electives until the total of 16 ETCS credits has been reached. The exact nature and extent of the examinations will be announced by the corresponding lecturers at the beginning of the lecture period. Furthermore, the provisions of §8 of the Study and Examination Regulations apply to repeat examinations.

There is only a limited number of modules that are statically stored in the electronic examination system. All modules which students wish to be credited in Electives and which are not selectable in the electronic examination system must first be approved.

Therefore, the following procedure should be observed:

1. Choose one or more modules for Electives. In case your chosen modules are not selectable in the electronic examination system, continue with 2.

2. Send an email from your KIT account to the official in charge at the GPI (usually, this is the student advisor; for up-to-date details on academic counseling, please visit https://www.gpi.kit.edu/english/290.php) to apply for the approval of one or more modules as Electives. Your email must contain the following information:
    - Your full name and your matriculation number,
    - the English and, if applicable, German titles of the modules, including the module numbers, and
    - the number of credit points and information whether the module is graded or ungraded.

   Emails not sent from a clearly identifiable KIT account will be ignored. In addition to the mandatory information outlined above it would be helpful to specify whether participation of a specific course / module has already been discussed with the corresponding lecturer, see note at the end of this paragraph.

3. The official in charge at the GPI will check your application; your application will usually be approved if the corresponding courses / modules contribute to the objectives of the Geophysics Master's program. As approval, the official in charge will send an email to the Examination Office (Prüfungssekretariat) at the KIT-Department of Physics, asking to handle the corresponding case. Students get a copy of said email. Should an application be rejected, either in full or in parts, then the student will receive a corresponding message.

4. After approval by the GPI, the officer in charge of the Examination Office at the KIT-Department of Physics will dynamically include the courses / modules in the electronic examination system of the corresponding student. Entering the achievement and/or grade will finally be handled by the lecturer in charge.

   Note: In case of electives not statically included in the electronic examination system it is strongly recommended to check with the lecturer in charge (or where appropriate the corresponding student counselor) prior to sending an application for approval whether participation of a chosen course / module is possible. There could be conditions that need to be met.

3.3 Interdisciplinary Qualifications

In addition to the subject-specific qualifications, at least 4 ECTS credits must be acquired in the subject "Interdisciplinary Qualifications" (also known as professional skills or additive key competences). The corresponding modules from the fields of languages, project management, tutorials, scientific writing or public science are offered by the HoC (House of Competence), FORUM (Forum Science and Society; formerly known as ZAK), "Sprachenzentrum" or "Studienkolleg" 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, Scientific Focusing Phase and Master's Thesis

The actual work on the Master's thesis is preceded by the subjects "Scientific Focusing Phase" and "Introduction to Scientific Practice". In both subjects sound foundations and key qualifications (in integrative form) for scientific work are taught as preparation for the Master's thesis itself.

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's thesis). The students will be guided by the future supervisor of the

Master's 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's 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 and presenters.

In the subject "Scientific Focusing Phase" the students independently work on a specific task that is related to the future Master's 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's thesis essential working techniques for the processing of their Master's 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's 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.

Registration: At the beginning of the second year, once the students have found a topic to work on in their Master's thesis, they need to register for their topic of the Master's thesis. The actual work on the Master's thesis is performed during the subjects "Introduction to Scientific Practice" and "Scientific Focusing Phase" and during the module "Master's Thesis", and thus during the last year of studies.

For registration, students need to download and print an application form which is found on the web page of the Geophysics Master's program:

https://www.gpi.kit.edu/english/288.php

Afterwards, students visit the Examination Office of the KIT-Department of Physics. There, it is checked that students fulfill all requirements for starting a Master's thesis and, if applicable, the form will be signed.

This form then has to be handed over to the reviewer of the thesis by the student. The reviewer needs to fill in the required fields (start date: 12 months before intended submission) and send the form back to the Examination Office. In parallel, students have to register for all modules in the above mentioned subjects in the electronic examination system. For the thesis itself, no additional registration is necessary.

The thesis is a central component of profiling and deepening. As part of the 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 thesis are presented in a department-public colloquium.

A thesis may only be awarded by examiners according to §17 (2) of the Study and Examination Regulations. It can be carried out as project work in one of the working groups of the department or corresponding groups at the KIT. It is also possible to realize an external thesis outside the department. To do this, a supervisor from the department 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 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 department (exam copy, signed by the supervisor) and to the library of the Geophysical Institute.

For the official submission of the final thesis at the Examination Office, an additional form called “Recognition Exam Copy” needs to be presented. The form is available for download at above mentioned URL.

4 Registration for Examinations

Registration is done online via the central examination system of the KIT. Examinations and coursework 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. Coursework are not-graded reviews and are often required as a prerequisite for examinations.

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 Grade

The overall grade of the Master’s examination is calculated as an average grade weighted by credit points. The modules from the subjects “Geophysics” and “Electives” are weighted with their credit points and the module “Master’s Thesis” is weighted with twice the number of credit points.

6 Use of generative artificial intelligence

Algorithms based on "artificial intelligence" (AI) are both a working tool in physics and the subject of active research. Therefore, the aim is to familiarize students with the responsible use of this technology, particularly with regard to the considerable potential for increasing productivity, but also for the problems that can arise in the quality assurance of scientific results. The use of so-called "generative artificial intelligence" for the creation of texts and images or graphics in text documents such as theses or scientific publications is problematic with regard to the traceability of authorship and the quality of the sources used. In the case of study achievements and exams, the assessment of the author's learning objectives and personal, original contributions must not be impaired by the use of AI.

Rules on the use of artificial intelligence methods:

- The use of AI as familiarization with new subject areas, as an aid to research and for structuring content is permitted.

- The use of AI for grammatical or stylistic improvement of texts is permitted, but the tools used must be specified.
- Any further use of AI for examinations and proof of performance (theses, seminar presentations, internship protocols or homework and exercise sheets, etc.) is not permitted.
- The use of generative AI may under no circumstances replace the achievement of the learning objectives and competences defined in a module.
- Responsibility for text and images / graphics, their accuracy and the correct citation of primary sources lies with the author and cannot be transferred to an AI. The rules of good scientific practice of the KIT apply explicitly.
- The unauthorized use of AI methods or the lack of documentation of their use is considered an attempt of deception.
- Deviating rules can be established by lecturers of the departement for special specific areas of the course of study.

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 credits. An ECTS credit corresponds to a workload of 30 hours.

Module Scheme Master Geophysics, SPO 2020, as at 20.03.2023

Sem.	Geophysics		Scientific Focusing Phase, Scientific Seminars and Introduction to Scientific Practice		Compulsary Electives	SQs	Sum CP
1 (**WS**, or SS)	Physics of Seismic Instruments M: Seismometry, Signal Processing and Seismogram Analysis V2Ü1 6	Seismology M: Seismometry, Signal Processing and Seismogram Analysis V2Ü2 8			Compulsary Electives 6	SQs I 2	**1** (**WS**, or SS)
		Seismics M: Seismometry, Signal Processing and Seismogram Analysis V2Ü2 8					
Sum CP	**22**				**6**	**2**	**30**
2 (**SS**, or WS)	Theory of Seismic Waves M: Theory and Inversion of Seismic Waves V2Ü1 6	Seismic Modelling M: Theory and Inversion of Seismic Waves V1Ü1 4			Compulsary Electives 10	SQs II 2	**2** (**SS**, or WS)
		Inversion and Tomography M: Theory and Inversion of Seismic Waves V2Ü2 8					
Sum CP	**18**				**10**	**2**	**30**
3 (**WS**, or SS)			Seismic/Seismology Seminar M: Scientific Focusing Phase S2 10	Introduction to Research in a Scientific Sub-Field incl. a Seminar Paper M: Introduction to Scientific Practice 16			**3** (**WS**, or SS)
				Seminar of the Geophysical Institute or Phys. Colloquium, etc. M: Scientific Seminars S2 4			
Sum CP			**30**				**30**
4 (**SS**, or WS)	Master's Thesis and Colloquium M: Master's Thesis 30						**4** (**SS**, or WS)
Sum CP	**30**						**30**
Module	Seismometry, Signal Processing and Seismogram Analysis: 22		Introduction to Research in a Scientific Sub-Field incl. a Seminar Paper: 16		Electives: 16	SQs: 4	
	Theory and Inversion of Seismic Waves: 18		Seismic/Seismology Seminar: 10				
	Master's Thesis: 30		Seminar of the Geophysical Institute or Phys. Colloquium, etc.: 4				
Total CP	**70**		**30**		**16**	**4**	**120**

4 Field of study structure

Mandatory	
Master's Thesis	30 CR
Geophysics	40 CR
Electives	16 CR
Scientific Focusing Phase	10 CR
Introduction to Scientific Practice	20 CR
Interdisciplinary Qualifications	4 CR
Voluntary	
Additional Examinations *This field will not influence the calculated grade of its parent.*	

4.1 Master's Thesis

Credits
30

Mandatory		
M-PHYS-101730	Modul Master's Thesis	30 CR

4.2 Geophysics

Credits
40

Mandatory		
M-PHYS-101358	Seismometry, Signal Processing and Seismogram Analysis	22 CR
M-PHYS-101359	Theory and Inversion of Seismic Waves	18 CR

4.3 Electives

Credits
16

Elective Studies (Election: at least 16 credits)		
M-BGU-101030	Recent Geodynamics	4 CR
M-PHYS-101355	Modern Physics Laboratory Course	6 CR
M-PHYS-101833	Geological Hazards and Risk	8 CR
M-BGU-101996	Structural Geology and Tectonics	4 CR
M-PHYS-101870	The Black Forest Observatory at Schiltach	1 CR
M-PHYS-103142	Module Wildcard Electives	16 CR
M-PHYS-103141	Geophysical Monitoring of Tunnel Constructions	1 CR
M-PHYS-101354	Classical Physics Laboratory Course II	6 CR
M-PHYS-103856	3D reflection seismics	1 CR
M-PHYS-104186	Seismic Data Processing with Final Report (Graded)	6 CR
M-PHYS-104188	Seismic Data Processing with Final Report (Ungraded)	6 CR
M-PHYS-104189	Seismic Data Processing without Final Report (Ungraded)	2 CR
M-PHYS-104522	Full-Waveform Inversion (Ungraded)	6 CR
M-PHYS-105279	Geological Hazards and Risk (Ungraded)	8 CR
M-PHYS-105382	Eifel Seismology and Volcanology Course	2 CR
M-PHYS-105383	International Workshop on Current Geophysical Research Topics	2 CR
M-PHYS-105662	Observatory Course *First usage possible from Apr 01, 2021.*	3 CR
M-PHYS-105679	Physical Methods in Volcano Seismology *First usage possible from Apr 01, 2021.*	6 CR
M-PHYS-106196	Array Techniques in Seismology (Graded) *First usage possible from Oct 01, 2022.*	4 CR
M-PHYS-106198	Array Techniques in Seismology (Ungraded) *First usage possible from Oct 01, 2022.*	4 CR
M-PHYS-106322	In-Situ: Tectonics and Seismic Hazard in the Mediterranean Region *First usage possible from Apr 01, 2023.*	6 CR
M-PHYS-106893	Earthquake Deformation Cycle (graded)	6 CR
M-PHYS-106894	Earthquake Deformation Cycle (ungraded)	4 CR
M-PHYS-107240	InSAR processing for earthquake source analysis	5 CR

4.4 Scientific Focusing Phase

Credits
10

Mandatory		
M-PHYS-101360	Scientific Focusing Phase	10 CR

4.5 Introduction to Scientific Practice

Credits
20

Mandatory		
M-PHYS-101357	Scientific Seminars	4 CR
M-PHYS-101361	Introduction to Scientific Practice	16 CR

4.6 Interdisciplinary Qualifications

Credits
4

Mandatory		
M-PHYS-102349	Interdisciplinary Qualifications	4 CR

4.7 Additional Examinations

Additional Examinations (Election: at most 30 credits)		
M-PHYS-102020	Further Examinations	30 CR
M-FORUM-106753	Supplementary Studies on Science, Technology and Society *First usage possible from Oct 01, 2024.*	16 CR

5 Modules

M 5.1 Module: 3D reflection seismics [M-PHYS-103856]

Responsible: Prof. Dr. Thomas Bohlen
Dr. Thomas Hertweck
Organisation: KIT Department of Physics
Part of: Electives

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
1	pass/fail	Irregular	1 term	English	4	1

Mandatory			
T-PHYS-107806	3D reflection seismics	1 CR	Bohlen, Hertweck

Prerequisites
None

Competence Goal
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.

Content

- Introduction to 3D reflection seismic
- Field trip and in-situ lecture (1 day):
  a) Introduction to the survey at hand
  b) Equipment, acquisition procedures, data quality control
- Wrap-up and summary

Workload
30 hours, of which 15 hours contact time, 15 hours homework

Recommendation
Understanding of the basic reflection seismic principles.

5.2 Module: Array Techniques in Seismology (Graded) [M-PHYS-106196]

Responsible: apl. Prof. Dr. Joachim Ritter
Organisation: KIT Department of Physics
Part of: Electives (Usage from 10/1/2022)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Irregular	1 term	English	4	1

Mandatory			
T-PHYS-112590	Array Techniques in Seismology, graded	4 CR	Ritter

Competence Certificate
Grading is based on written reports on exercises. A detailed rating scheme is distributed during the first lecture together with information on the required length of the reports and rating criteria.

Competence Goal
The students understand basic principles of array techniques. This includes the increase in signal-to-noise ratio due to stacking or beamforming and the estimation of simple shear-wave velocity profiles. They know how to determine the slowness or ray parameter of an incoming wavefield as well as its backazimuth. These parameters are used to estimate the location of a seismic source. Furthermore, they know how to divide different phase arrivals using a vespagram or an f-k analysis.

The students are able to work self-organized on a specific issue of array seismology, e.g., the location of a nuclear test or the local shear-wave velocity structure underneath a local array. They are able to read and understand technical and scientific literature on array seismology. They can outline and analyze seismological cases in which array techniques can solve specific problems such as seismic phase identification or source location estimation.

Content

- Fundamentals of seismic waves
- Measurable parameters of seismic waves using arrays
- Determination of source locations
- Determination of underground properties
- Global seismic arrays and their role for monitoring nuclear tests and earthquakes
- Training on array software and application to seismological data sets

Module grade calculation
Reports on exercises need to be submitted which are individually graded. The final module grade is calculated as average of all individually graded reports. A detailed rating scheme is distributed during the first lecture.

Workload
Total workload: 120h which consist of 15h lecture at GPI, 15h reading of research papers and lecture material, 15h preparation and wrap-up of lecture, 15h guided exercise in the computing room at GPI to learn about array software (basic Linux and Python knowledge required), 30h self-organized training with array software and application to data sets, and 30h preparation of reports on exercises.

Recommendation
Participants need to know the basics of seismology.

Literature

- Schweitzer, J. et al., 2012. Seismic Arrays. In: Bormann, P. (Ed.), New Manual of Seismological Observatory Practice 2 (NMSOP-2), Potsdam, Deutsches GeoForschungsZentrum GFZ, 1-80, doi:10.2312/GFZ.NMSOP-2_ch9
- Rost, S. & Thomas, C., 2002. Array seismology: Methods and applications. Rev. Geophys., 40 (3), 1008, doi:10.1029/2000RG000100
- Kind, F. et al., 2005. Array measurements of S-wave velocities from ambient vibrations. Geophysical Journal International, 160 (1), 114–126, doi:10.1111/j.1365-246X.2005.02331.x

M 5.3 Module: Array Techniques in Seismology (Ungraded) [M-PHYS-106198]

Responsible: apl. Prof. Dr. Joachim Ritter
Organisation: KIT Department of Physics
Part of: Electives (Usage from 10/1/2022)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	pass/fail	Irregular	1 term	English	4	1

Mandatory			
T-PHYS-112593	Array Techniques in Seismology, not Graded	4 CR	Ritter

Competence Certificate
Written reports on exercises must be submitted, which are assessed and scored on an individual basis. Successful participation requires that the average score of all reports combined exceeds a certain threshold. Detailed information on the threshold and scoring is distributed in the first lecture.

Competence Goal
The students understand basic principles of array techniques. This includes the increase in signal-to-noise ratio due to stacking or beamforming and the estimation of simple shear-wave velocity profiles. They know how to determine the slowness or ray parameter of an incoming wavefield as well as its backazimuth. These parameters are used to estimate the location of a seismic source. Furthermore, they know how to divide different phase arrivals using a vespagram or an f-k analysis.

The students are able to work self-organized on a specific issue of array seismology, e.g., the location of a nuclear test or the local shear-wave velocity structure underneath a local array. They are able to read and understand technical and scientific literature on array seismology. They can outline and analyze seismological cases in which array techniques can solve specific problems such as seismic phase identification or source location estimation.

Content

- Fundamentals of seismic waves
- Measurable parameters of seismic waves using arrays
- Determination of source locations
- Determination of underground properties
- Global seismic arrays and their role for monitoring nuclear tests and earthquakes
- Training on array software and application to seismological data sets

Workload
Total workload: 120h which consist of 15h lecture at GPI, 15h reading of research papers and lecture material, 15h preparation and wrap-up of lecture, 15h guided exercise in the computing room at GPI to learn about array software (basic Linux and Python knowledge required), 30h self-organized training with array software and application to data sets, and 30h preparation of reports on exercises.

Recommendation
Participants need to know the basics of seismology.

Literature

- Schweitzer, J. et al., 2012. Seismic Arrays. In: Bormann, P. (Ed.), New Manual of Seismological Observatory Practice 2 (NMSOP-2), Potsdam, Deutsches GeoForschungsZentrum GFZ, 1-80, doi:10.2312/GFZ.NMSOP-2_ch9
- Rost, S. & Thomas, C., 2002. Array seismology: Methods and applications. Rev. Geophys., 40 (3), 1008, doi:10.1029/2000RG000100
- Kind, F. et al., 2005. Array measurements of S-wave velocities from ambient vibrations. Geophysical Journal International, 160 (1), 114–126, doi:10.1111/j.1365-246X.2005.02331.x

M 5.4 Module: Classical Physics Laboratory Course II [M-PHYS-101354]

Responsible: Studiendekan Physik
Organisation: KIT Department of Physics
Part of: Electives

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	pass/fail	Each summer term	1 term	German	4	1

Mandatory			
T-PHYS-102290	Classical Physics Laboratory Courses II	6 CR	Husemann, Simonis, Wolf

Prerequisites
none

5.5 Module: Earthquake Deformation Cycle (graded) [M-PHYS-106893]

Responsible: Prof. Dr. Henriette Sudhaus
Organisation: KIT Department of Physics
Part of: Electives

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	English	4	1

Mandatory			
T-PHYS-113816	Earthquake Deformation Cycle	4 CR	Sudhaus
T-PHYS-113817	Earthquake Deformation Cycle, Exam	2 CR	Sudhaus

Competence Certificate
Oral exam of approx. 30 minutes.

Prerequisites
The module's course work must be passed in order to enter the oral exam.

Competence Goal
Students understand and can interpret the processes involved in the earthquake deformation cycle. They know how to observe deformation processes at fault zones with different complementing geophysical and geodetic methods. Students can analyze phenomena at fault zones (seismicity, deformation, geological markers) and can interpret them towards characterizing the recent fault zone behavior and seismic hazard.

Content
This module aims to give students an overview of deformation processes at large fault zones. It introduces fault zone types, their physical characteristics and their behavior in the earthquake deformation cycle. This module provides an overview of the most important ground-based and space-borne observation methods for the different phases in the earthquake deformation cycle. In particular, the module deals with the following aspects:

- Types and general behavior of fault zones (plate boundaries and continental fault zones in extensional, convergent or lateral shearing stress regimes)
- ground-based and space-borne observation methods of distributed and localized, seismic and aseismic deformation (seismic monitoring, surface displacement observed by GNSS and InSAR)
- Analysis of deformation and seismicity to interpret deformation processes

Module grade calculation
The grade of the module is the grade of the oral exam.

Workload
Total workload 180 hours, consisting of 60 hours contact time, 60 hours homework assignments / self-study and 60 hours preparation for exam.

Learning type
Lectures, exercises, homework assignments and self-study

5.6 Module: Earthquake Deformation Cycle (ungraded) [M-PHYS-106894]

Responsible: Prof. Dr. Henriette Sudhaus
Organisation: KIT Department of Physics
Part of: Electives

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	pass/fail	Each winter term	1 term	English	4	1

Mandatory			
T-PHYS-113816	Earthquake Deformation Cycle	4 CR	Sudhaus

Competence Certificate
Passing the module requires passing the module's brick.

Competence Goal
Students understand and can interpret the processes involved in the earthquake deformation cycle. They know how to observe deformation processes at fault zones with different complementing geophysical and geodetic methods. Students can analyze phenomena at fault zones (seismicity, deformation, geological markers) and can interpret them towards characterizing the recent fault zone behavior and seismic hazard.

Content
This module aims to give students an overview of deformation processes at large fault zones. It introduces fault zone types, their physical characteristics and their behavior in the earthquake deformation cycle. This module provides an overview of the most important ground-based and space-borne observation methods for the different phases in the earthquake deformation cycle. In particular, the module deals with the following aspects:

- Types and general behavior of fault zones (plate boundaries and continental fault zones in extensional, convergent or lateral shearing stress regimes)
- ground-based and space-borne observation methods of distributed and localized, seismic and aseismic deformation (seismic monitoring, surface displacement observed by GNSS and InSAR)
- Analysis of deformation and seismicity to interpret deformation processes

Module grade calculation
The module is ungraded.

Workload
Total workload 120 hours, consisting of 60 hours contact time and 60 hours homework assignments / self-study.

Learning type
Lectures, exercises, homework assignments and self-study

M 5.7 Module: Eifel Seismology and Volcanology Course [M-PHYS-105382]

Responsible: Prof. Dr. Andreas Rietbrock
Organisation: KIT Department of Physics
Part of: Electives

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
2	Grade to a tenth	Irregular	1 term	English	4	1

Mandatory			
T-PHYS-110870	Eifel Seismology and Volcanology Course	2 CR	Rietbrock

Competence Certificate
Active attendance of lecture and practicals, discussions and data analysis, preparation of a presentation about scientific literature provided by the lecturers, preparation of a handout as a summary of the presentation.

Prerequisites

- Knowledge in seismology and physics of seismic instruments
- Programming knowledge (preferable Python and ObsPy)

Competence Goal

- Students have gained a basic knowledge and appreciation of the Eifel volcanism. They will understand the basic types of eruption styles in the Eifel region and understand the physical processes behind.
- Students have gained knowledge about the current status of seismicity in the Eifel and understand the current developments.
- Students are able to deploy seismic stations in the field, collect the data and convert the data to commonly used seismic formats. They have gained practical knowledge how to apply instrument corrections and cross-validate seismic records.
- Students are able to summarise and synthesise scientific publications and present their results in written and oral form. They will be able to communicate their view point and scientifically defend this view when challenged by fellow students or lecturers.

Content

- Field installation of different seismometers (short period, broadband, geophone, etc.)
- Data processing and instrument correction
- Introduction to the Eifel volcanism (the geological/earth sciences perspective)
- Introduction to current seismicity in the Eifel
- Careful appreciation of publications and scientific discussion

Module grade calculation
The grade of the module results from grade of the handout. A detailed grading scheme is distributed during the lecture.

Workload

- 4 h: Introductionary lectures/ practicals at GPI before field course
- 20 h: Preparation of presentation and handout, study of additional literature provided by the lecturers (before field course)
- 30 h: Field course
- 6 h: Data analysis at GPI after field course

Learning type
In situ lecture comprising introductionary lectures at GPI, 3 days field course, data analysis at GPI after field course

Literature
Literature will be provided by the lecturer.

M 5.8 Module: Full-Waveform Inversion (Ungraded) [M-PHYS-104522]

Responsible: Prof. Dr. Thomas Bohlen
Organisation: KIT Department of Physics
Part of: Electives

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	pass/fail	Irregular	1 term	English	4	2

Mandatory			
T-PHYS-109272	Full-Waveform Inversion	6 CR	Bohlen, Hertweck

Competence Certificate
Final pass based on successful participation of the exercises.

Prerequisites
None

Competence Goal
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

Module grade calculation
The coursework is not graded.

Workload
180 h hours composed of contact time (45 h), wrap-up of the lectures and solving the exercises (135 h)

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

Learning type
4060181Seismic Full Waveform Inversion (V2)
4060182 Exercises to Seismic Full Waveform Inversion (Ü1)

Literature

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

M 5.9 Module: Further Examinations [M-PHYS-102020]

Organisation: KIT Department of Physics
Part of: Additional Examinations

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
30	pass/fail	Each term	1 term	German	4	1

Additional Examinations (Election: at most 30 credits)			
T-PHYS-103898	Wildcard Additional Examinations 1 ungraded	2 CR	
T-PHYS-103937	Wildcard Additional Examinations 11 graded	2 CR	

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

Responsible: Dr. Andreas Schäfer
Organisation: KIT Department of Physics
Part of: Electives

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each winter term	1 term	English	4	5

Mandatory			
T-PHYS-103525	Geological Hazards and Risk	8 CR	Schäfer

Competence Certificate
Active and regular attendance of lecture and practicals. Project work (graded).

Prerequisites
none

Modeled Conditions
The following conditions have to be fulfilled:

1. The module M-PHYS-105279 - Geological Hazards and Risk (Ungraded) must not have been started.

Competence Goal
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. The 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

Module grade calculation
Project work will be graded.

Workload

- 60 h: active attendance during lectures and exercises
- 90 h: review, preparation and weekly assignments
- 90 h: project work

Learning type

4060121 Geological Hazards and Risk (V2)

4060122 Übungen zu Geological Hazards and Risk (Ü2)

Literature

Literature will be provided by the lecturer.

M 5.11 Module: Geological Hazards and Risk (Ungraded) [M-PHYS-105279]

Responsible: Dr. Andreas Schäfer
Organisation: KIT Department of Physics
Part of: Electives

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	pass/fail	Each winter term	1 term	English	4	1

Mandatory			
T-PHYS-110713	Geological Hazards and Risk, not graded	8 CR	Schäfer

Competence Certificate
Active and regular attendance of lecture and practicals. Project work (not graded).

Prerequisites
none

Modeled Conditions
The following conditions have to be fulfilled:

1. The module M-PHYS-101833 - Geological Hazards and Risk must not have been started.

Competence Goal
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. The 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

Workload

- 60 h: active attendance during lectures and exercises
- 90 h: review, preparation and weekly assignments
- 90 h: project work

Learning type
4060121 Geological Hazards and Risk (V2)
4060122 Übungen zu Geological Hazards and Risk (Ü2)

Literature
Literature will be provided by the lecturer.

M 5.12 Module: Geophysical Monitoring of Tunnel Constructions [M-PHYS-103141]

Responsible: Prof. Dr. Thomas Bohlen
Organisation: KIT Department of Physics
Part of: Electives

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
1	pass/fail	Irregular	1 term	German	4	1

Mandatory			
T-PHYS-106248	Geophysical Monitoring of Tunnel Constructions, Prerequisite	1 CR	Bohlen

Competence Certificate
Schriftliche Anfertigung eines Reflexionsberichts

Prerequisites
keine

Competence Goal
Die Studierenden kennen geophysikalische Messmethoden, mit denen ein Tunnelbau überwacht werden kann. Sie können die seismischen Daten, die dabei an der Erdoberflächeoder im Tunnel aufgezeichnet werden, verstehen und interpretieren. Sie kennen DIN-Normen und können diese auf die Daten anwenden. Die Studierenden kennen Beispiele, in denen ein Tunnelbau mit geophysikalischen Methoden überwacht wurde. Sie wissen auch, wo die Grenzen geophysikalischer Überwachung im Tunnelbau liegen.

Content

- Grundlagen der geophysikalischen Überwachung beim Tunnelbau
- Ziele der Überwachung mit geophysikalschen Methoden
- DIN-Normen
- Seismische Überwachung während des Tunnelvortriebs und Interpretation der Daten
- Vorauserkundung mit seismischen Methoden
- Fallbeispiele: Gotthardbasistunnel, Tunnel der U-Strab in Karlsruhe, Tunnel beim Bau von S21

Module grade calculation
Die Studienleistung ist unbenotet.

Workload
30 h teilen sich wie folgt auf:

- 10 h Vorlesung am GPI zur Vorbereitung
- 10 h In-Situ-Vorlesung bei einem Hersteller von Tunnelbohrmaschinen
- 10 h In-Situ-Vorlesung in einem Tunnelbauprojekt

Learning type
In situ Vorlesung

Literature
Wird in der Vorlesung bekanntgegeben.

5.13 Module: InSAR processing for earthquake source analysis [M-PHYS-107240]

Responsible: Prof. Dr. Henriette Sudhaus
Organisation: KIT Department of Physics
Part of: Electives

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
5	Grade to a tenth	Each summer term	1 term	English	4	1

Mandatory			
T-PHYS-114264	Earthquake source analysis: InSAR processing	2 CR	Sudhaus
T-PHYS-114265	Earthquake source analysis: optimization	1 CR	Sudhaus
T-PHYS-114266	Earthquake source analysis, Exam	2 CR	Sudhaus

Competence Certificate
Written report.

Prerequisites
Basic knowledge in seismology and InSAR as well as basic Linux knowledge required.

Competence Goal
Students understand the principles of the space-borne InSAR measurement technique. They are capable of interpreting signals in the measurements corresponding to earthquake source processes and noise sources. Students obtain experience in spatial signal processing and visualization techniques. They have practical hands-on experience in modeling a process and a scientific Bayesian optimization technique.

Content

- Step-by-step processing of raw SAR satellite data towards differential interferograms and line-of-sight surface displacement maps.
- Qualitative and quantitative interpretation of earthquake rupture processes.
- Geophysical optimization of earthquake source parameters based on surface displacement measurements.

Module grade calculation
The grade of the module is based on the grade of the written report.

Workload
150h in total split up into 60h for InSAR processing (time in class, homework assignments, follow-up, etc.), 30h for source optimization (time in class, homework assignments, follow-up, etc.) and 60h for exam (course material review, preparation of figures and report writing).

Recommendation
Prior participation of the courses "The Earthquake Deformation Cycle" and "Seismology" is recommended.

Learning type
Theoretical lectures and hands-on data processing using computers.

M 5.14 Module: In-Situ: Tectonics and Seismic Hazard in the Mediterranean Region [M-PHYS-106322]

Responsible: Prof. Dr. Andreas Rietbrock
Organisation: KIT Department of Physics
Part of: Electives (Usage from 4/1/2023)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Irregular	1 term	English	3	1

Mandatory			
T-PHYS-112830	In-Situ: Tectonics and Seismic Hazard in the Mediterranean Region	6 CR	Rietbrock

Competence Certificate
Students solve exercise sheets, prepare and give a presentation and write a final report.

Competence Goal
Students understand the geodynamic and tectonic situation in the Mediterranean and especially in seismic active regions. They gain profound knowledge about seismic hazard, can explain the concept of seismic hazard assessment, and can apply it. They can name different monitoring methods, explain them and apply them under guidance.

Content

- Geodynamics of the Mediterranean
- Tectonics in Greece, Italy and the Balkans
- Seismic hazard, with focus on the Mediterranean
- Seismic monitoring
- Field work

Module grade calculation
The final mark is computed from all submissions.

Workload
180 h in total, composed of:

1. Lecture at KIT before in-situ part: 15 h
2. Data analysis at KIT: 5 h
3. Preparation of presentation and handout: 30 h
4. In-situ lecture: 80 h
5. Wrap-up of lectures, solving exercise sheets and preparation of report: 50 h

Learning type
4060351 (In-Situ: Tectonics and Seismic Hazard in the Mediterranean Region),

4060352 (Exercises on In-Situ: Tectonics and Seismic Hazard in the Mediterranean Region).

Literature
Will be announced during the lecture.

M 5.15 Module: Interdisciplinary Qualifications [M-PHYS-102349]

Responsible: Prof. Dr. Thomas Bohlen
Organisation: KIT Department of Physics
Part of: Interdisciplinary Qualifications

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	pass/fail	Each term	2 terms	German	4	1

Elective Studies (Election: at least 1 item as well as at least 4 credits)			
T-PHYS-104675	Wildcard	2 CR	
T-PHYS-104677	Wildcard	2 CR	

Annotation
The module is ungraded. Should single courses within this module be graded, will those grades not count for the final master's average grade. The grade of those courses will however be shown in the transcript of records.

5.16 Module: International Workshop on Current Geophysical Research Topics [M-PHYS-105383]

Responsible: Prof. Dr. Andreas Rietbrock
Organisation: KIT Department of Physics
Part of: Electives

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
2	pass/fail	Irregular	1 term	English	4	2

Mandatory			
T-PHYS-110871	International Workshop on Current Geophysical Research Topics	2 CR	Rietbrock

Competence Certificate
The module is not graded. In ordert to pass the module, active participation in the workshop including an oral presentation is mandatory

Prerequisites
none

Competence Goal
Students can present their own research and critically discuss and defend their results. They know how to discuss current research topics presented by fellow students and international participants in the workshop.

Content
Overview about current geophysical research topics

Workload
2 ECTS in total, corresponding to 60 working hours, composed of active time (15 h) and preparation (45 h)

Learning type
Scientific presentation and discussion

Literature
none

M 5.17 Module: Introduction to Scientific Practice (GEOP M EWA) [M-PHYS-101361]

Responsible: Prof. Dr. Andreas Rietbrock
Organisation: KIT Department of Physics
Part of: Introduction to Scientific Practice

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
16	pass/fail	Each term	1 term	English	4	2

Mandatory			
T-PHYS-103355	Introduction to Research in a Scientific Sub-Field Including a Seminar Paper	16 CR	

Competence Goal
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

Module grade calculation
The module is not graded.

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. Total workload: 480 h.

Learning type
4061909 Einführung in die selbständige wissenschaftliche Arbeit

Literature
Task-specific, literature provided by the supervisor

M 5.18 Module: Modern Physics Laboratory Course [M-PHYS-101355]

Responsible: Studiendekan Physik
Organisation: KIT Department of Physics
Part of: Electives

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	pass/fail	Each term	1 term	German	4	1

Mandatory			
T-PHYS-102291	Modern Physics Laboratory Courses	6 CR	Naber

Prerequisites
Classical Physics Laboratory Courses I and II

Modeled Conditions
The following conditions have to be fulfilled:

1. The module M-PHYS-101353 - Classical Physics Laboratory Course I must have been passed.
2. The module M-PHYS-101354 - Classical Physics Laboratory Course II must have been passed.

Module grade calculation
The lab course is not graded.

5.19 Module: Modul Master's Thesis [M-PHYS-101730]

Responsible: Prof. Dr. Thomas Bohlen
Organisation: KIT Department of Physics
Part of: Master's Thesis

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
30	Grade to a tenth	Each term	1 term	English	4	2

Mandatory			
T-PHYS-103350	Master's Thesis	30 CR	Bohlen

Competence Certificate
Successful completion of the master's thesis and successful defense during a public colloqium.

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

Modeled Conditions
The following conditions have to be fulfilled:

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.

Competence Goal
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 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. Students know and apply the Guidelines for Safeguarding: Good Research Practice (Deutsche Forschungsgemeinschaft).

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)

Annotation

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.

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.
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.

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.

Workload

Total workload: 900 h.

Literature

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

M 5.20 Module: Module Wildcard Electives [M-PHYS-103142]

Organisation: University
Part of: Electives

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
16	Grade to a tenth	Each term	1 term	German	4	2

Wildcard (Election: at least 1 item as well as between 2 and 16 credits)			
T-PHYS-106249	Wildcard	2 CR	
T-PHYS-106253	Wildcard	2 CR	

Prerequisites
None

5.21 Module: Observatory Course [M-PHYS-105662]

Responsible: Dr. Thomas Forbriger
Organisation: KIT Department of Physics
Part of: Electives (Usage from 4/1/2021)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
3	pass/fail	Irregular	1 term	English	4	1

Mandatory			
T-PHYS-111311	Observatory Course	3 CR	Forbriger

Competence Certificate
Processing and evaluation of selected introductory problems in a supervised self-study phase and active participation in experiments with subsequent data analysis at the BFO followed by a reporting effort are mandatory.

Prerequisites
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
You have to fulfill one of 3 conditions:

1. The course T-PHYS-104727 - Physics of Seismic Instruments must have been passed.
2. The course T-PHYS-105567 - Physics of Seismic Instruments (Minor) must have been passed.
3. The course T-PHYS-102325 - Physics of Seismic Instruments, Prerequisite must have been passed.

Competence Goal
The students are able to define criteria for instrument performance in a research context. They are able to appropriately handle delicate instruments and to deploy them in an observatory environment. The students are able to assess data quality and to apply elementary measures of signal analysis to this end. The students are aware of appropriate means to mitigate disturbances. They are able to apply appropriate measures to improve data quality if needed. The students understand methods to calibrate the instruments frequency response and gain. They are able to design, carry out and analyze respective experiments. Students are able to express their results in a written report, to give appropriate feedback in a review process, and to incorporate received advice in a revision of their manuscripts.

Content

- Computational and practical application of knowledge gained in the course on 'Physics of seismic instruments.'
- Consolidation in topics that arose during the self-study phase.
- 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
- Signal processing in python

Module grade calculation
The coursework is not graded.

Annotation
Basic knowledge of python coding is essential. The course is usually arranged by appointment with participants of 'Physics of Seismic Instruments' during the winter term.

Workload
The course will be composed of an introductory guided self-study phase (2-3 weeks) followed by a practical phase held on three entire days at the Black Forest Observatory. The timely demand is roughly divided into: 45 hours self-study phase, 30 hours at BFO, 15 hours reporting

Learning type
4060914 Observatory course, Praktikum

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.
- Hutt, Charles R., Evans, John R., Followill, Fred, Nigbor, Robert L., and Wielandt, Erhard, 2010, Guidelines for standardized testing of broadband seismometers and accelerometers: U.S. Geological Survey Open-File Report, 2009-1295, 62 p. http://dx.doi.org/10.3133/ofr20091295

M 5.22 Module: Physical Methods in Volcano Seismology [M-PHYS-105679]

Responsible: Prof. Dr. Thomas Bohlen
Organisation: KIT Department of Physics
Part of: Electives (Usage from 4/1/2021)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	English	4	1

Mandatory			
T-PHYS-111334	Physical Methods in Volcano Seismology	6 CR	Bohlen

Competence Certificate
Students have to participate the lecture/exercise regularly, and present their exercises/ project work. The presentation(s) will determine the final grade.

Prerequisites
None.

Competence Goal
The students understand seismological methods that are applied and commonly used in physical volcanology: They can name seismic instruments used for recording seismic data at volcanoes as well as advantages and disadvantages of different instruments. They know how to set up a seismic experiment at a volcano and understand the importance of a careful station site selection, but can also name limitations. They know how to access the data recorded, how to analyse and interpret it. They can distinguish different types of seismic signals typically recorded at volcanoes and know models to explain those. They can summarize their analysis, are able to present it to other students and discuss their results and those of their fellow students critically.

Content

- Seismic instrumentation at volcanoes
- Station site selection
- Analysis of seismic data recorded at volcanoes
- Interpretation of different seismic signals typically recorded at volcanoes
- Presentation of data and results,
- Discussion of physical models

Module grade calculation
Exercises/ project work will be graded.

Workload
180 h hours composed of contact time (45 h), preparation and wrap-up of the lectures and exercises (45 h), and exercises/ project work (90 h).

Recommendation
No explicit requirements. However, knowledge of the topics of physical volcanology and basics of data processing as well as general computer/ programming skills are essential.

Learning type
4060381 Physical Methods in Volcano Seismology, V1

4060382 Exercises to Physical Methods in Volcano Seismology, Ü2

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

Responsible: Dr. Andreas Barth
Dr.-Ing. Michael Mayer
Dr. Malte Westerhaus

Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences

Part of: Electives

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each winter term	1 term	German/English	4	3

Mandatory			
T-BGU-101771	Recent Geodynamics	4 CR	Barth, Mayer, Seidel, Westerhaus

Competence Certificate

- T-BGU-101771 Rezente Geodynamik

For details on the assessments to be performed, see the details for the individual Teilleistungen.

Prerequisites
The modul M-BGU-101098 - Recent Geodynamics must not have stated.

Competence Goal
Students descirbe active deformation processes of the ‘rigid’ earth as a prominent source of changes in the earth system. They explain the special demands on measurement techniques and methods in Geodynamics from theory. The session is complemented by a visit at the Black Forest Observatory (BFO), where they gain an impression of the practical aspects of precise long term data recording. The students analyze the interrelation between observations, rheological characteristics, and driving forces based on current research questions. Due to the interdisciplinary approach students discussdiscipline-specific paradigms. In the exercises, the students use real data examples to model system response functions as well as source signals, and they assess the results. They are able to apply the imparted concepts to related problems and to transfer the learned knowledge to other research topics.

Content
The module provides the students with a profound insight into active deformation processes of the earth. The selected themes (geodetic and geophysical instruments and measurement techniques, earth tides, free modes of the earth’s rotational axis, plate tectonics, deformation of continental margins, mechanism of earthquakes) are specifically targeted at students of Geodesy as well as Geophysics. The central purpose of the module is to establish a link between geodetic and geophysical concepts, i.e. to relate precise geodetic measurements to the driving forces in the subsurface. The theoretical concepts are flanked by practical exercises, e.g. use of GNSS data to model earthquake ruptures and the seismic cycle. During a 1-day excursion to the Black Forest Observatory (BFO) the students obtain insight into the daily duties of a geodynamic observatory, and they have the possibility to discuss current research questions together with the scientific and technical staff members.

Module grade calculation
The grade of the module is the grade of the exam in T-BGU-101771 Rezente Geodynamik.

Annotation
Basics of Geophysics and Physical Geodesy are helpful

Workload
Total workload: 120 hours

Contact hours: 45 hours: lectures and course-related examination

Self-study: 75 hours

- Consolidation of the course by revising the lecture content
- Completion of exercises as part of the portfolio
- In-depth study of the course topics using suitable literature, internet research and reflection
- Preparation of an individual portfolio as module examination alongside the course

M 5.24 Module: Scientific Focusing Phase (GEOP M SP) [M-PHYS-101360]

Responsible: Prof. Dr. Thomas Bohlen
Organisation: KIT Department of Physics
Part of: Scientific Focusing Phase

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
10	pass/fail	Each term	1 term	English	4	3

Prerequisite Scientific Focusing Phase (Election: 1 item)			
T-PHYS-107675	Seminar on Recent Topics of Applied Geophysics	10 CR	Bohlen
T-PHYS-107676	Seminar on Recent Topics of General Geophysics	10 CR	Rietbrock
T-PHYS-110593	Seminar Seismological Analysis	10 CR	Ritter
T-PHYS-113865	Seminar on earthquakes and crustal deformation	10 CR	Sudhaus

Competence Certificate
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.

Competence Goal
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. Students know and apply the Guidelines for Safeguarding: Good Research Practice (Deutsche Forschungsgemeinschaft).

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

Module grade calculation
The module is not graded.

Workload
10 ECTS in total, corresponding to 300 working hours.

Learning type

- 4060234 Seminar on Applied Geophysics (S2)
- 4060274 Current Topics in Seismology and Hazard (S2)
- 4060244 Seminar Seismological Analysis (S2)
- 4060334 Seminar on earthquakes and crustal deformation (S2)

Literature
Task-specific, literature provided by the supervisor

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

Responsible: Dr. Thomas Forbriger
Organisation: KIT Department of Physics
Part of: Introduction to Scientific Practice

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	pass/fail	Each term	1 term	English	4	3

Mandatory			
T-PHYS-102335	Scientific Seminars	4 CR	

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

Competence Goal
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 scientfic disciplines.

Content
The students attend at least 12 seminar presentations at the Geophysical Institute, the KIT Department of Physics, and institutes of neighboring disciplines in earth sciences, at their choice (lists of current seminars are provided in the corresponding ILIAS-course). 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 report including a short (5 to 10 lines) summary of the respective presentation. Further instructions are given in the corresponding ILIAS course.

Module grade calculation
The module is not graded.

Annotation
Students taking this module shall register for the ILIAS course 'Scientific Seminars (GEOP M WS) [M-PHYS-101357]' at 'Repository >> Organisationseinheiten >> Fakultät für Physik >> Geophysikalisches Institut'. Further instructions, up-to-date information, and material is provided there. This includes form sheets for the 'Seminar Report' and the 'List of Seminars' which are available for download.

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 the student takes notes on a form sheet (seminar report) which is provided for download (ILIAS course). The notes are not necessarily complete in terms of lecture notes. They can be rather a collection of dispersed notes, keywords, and sketches.

After the presentation, the discussion with the audience, and a debriefing with fellow students, the student prepares a report on the form sheet. The report shall be written in full, proper sentences in a comprehensible and pointed way. It consists of a brief summary of the seminar and the discussion and some comments regarding the style of the presentation. This shall reflect the students judgement regarding major issues of the presentation, consistency of content, and the way he used questions to clarify open issues in the discussion of the seminar. If the presentation was not comprehensible this shall be described appropriately in the summary.

The students fill in a list of seminars. A form sheet is provided for download (ILIAS course). After having attended 12 seminar presentations, they submit the list together with the corresponding reports to the examiner. The examinar 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 examinar keeps the signed list of seminars for documentation and returns the reports to the student.

Workload
Total workload: 120 h, further details will be given individually.

Learning type
see ILIAS course

Literature
Abstracts published in the seminar programs.

M 5.26 Module: Seismic Data Processing with Final Report (Graded) [M-PHYS-104186]

Responsible: Prof. Dr. Thomas Bohlen
Dr. Thomas Hertweck

Organisation: KIT Department of Physics

Part of: Electives

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Irregular	1 term	English	4	1

Mandatory			
T-PHYS-108656	Seismic Data Processing, Final Report (Graded)	4 CR	Bohlen, Hertweck
T-PHYS-108686	Seismic Data Processing, Coursework	2 CR	Bohlen, Hertweck

Competence Certificate
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).

Prerequisites
None

Modeled Conditions
The following conditions have to be fulfilled:

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.

Competence Goal
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

Module grade calculation
The report will determine the final grade.

Annotation
A commercial data processing software is used during this course.

Workload
180 h hours composed of contact time (45 h), wrap-up of the lectures and solving the exercises (135 h)

Recommendation
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.

Learning type
4060321 Th.Bohlen, Th. Hertweck (V1)

4060322 Th.Bohlen, Th. Hertweck (Ü2)

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.

5.27 Module: Seismic Data Processing with Final Report (Ungraded) [M-PHYS-104188]

Responsible: Prof. Dr. Thomas Bohlen
Dr. Thomas Hertweck
Organisation: KIT Department of Physics
Part of: Electives

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	pass/fail	Irregular	1 term	English	4	1

Mandatory			
T-PHYS-108657	Seismic Data Processing, Final Report (ungraded)	4 CR	Bohlen, Hertweck
T-PHYS-108686	Seismic Data Processing, Coursework	2 CR	Bohlen, Hertweck

Competence Certificate
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).

Prerequisites
None

Modeled Conditions
The following conditions have to be fulfilled:

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.

Competence Goal
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

Module grade calculation
The coursework is not graded.

Annotation
A commercial data processing software is used during this course.

Workload
180 h hours composed of contact time (45 h), wrap-up of the lectures and solving the exercises (135 h)

Recommendation
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.

Learning type
4060321 Th.Bohlen, Th. Hertweck (V1)

4060322 Th.Bohlen, Th. Hertweck (Ü2)

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 5.28 Module: Seismic Data Processing without Final Report (Ungraded) [M-PHYS-104189]

Responsible: Prof. Dr. Thomas Bohlen
Dr. Thomas Hertweck

Organisation: KIT Department of Physics

Part of: Electives

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
2	pass/fail	Irregular	1 term	English	4	1

Mandatory			
T-PHYS-108686	Seismic Data Processing, Coursework	2 CR	Bohlen, Hertweck

Competence Certificate
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).

Prerequisites
None

Modeled Conditions
The following conditions have to be fulfilled:

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.

Competence Goal
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

Module grade calculation
The coursework is not graded.

Annotation
A commercial data processing software is used during this course.

Workload
60 h hours composed of contact time (45 h) and wrap-up of the lectures (15 h) - no final report

Recommendation
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.

Learning type
4060321 Th.Bohlen, Th. Hertweck (V1)

4060322 Th.Bohlen, Th. Hertweck (Ü2)

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

Responsible: Prof. Dr. Andreas Rietbrock
Organisation: KIT Department of Physics
Part of: Geophysics

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
22	Grade to a tenth	Each winter term	1 term	English	4	3

Mandatory			
T-PHYS-102325	Physics of Seismic Instruments, Prerequisite	0 CR	Forbriger
T-PHYS-109267	Seismology, Prerequisite	0 CR	Rietbrock
T-PHYS-109266	Seismics, Prerequisite	0 CR	Bohlen
T-PHYS-106217	Seismometry, Signal Processing and Seismogram Analysis, Exam	22 CR	Bohlen, Rietbrock

Competence Certificate

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 with a duration of approximately 60 minutes 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

In order to pass the course Physics of Seismic Instruments, a student must successfully participate in the corresponding exercise classes. Successful participation is based on exceeding a certain percentage of the combined total number of points awarded, as applicable, for exercise sheets, other homework (such as, for instance, reports) and written tests held as part of the exercises. The percentage threshold is communicated to students at the beginning of the course and documented in Ilias.

Seismology

In order to pass the course Seismology, a student must successfully participate in the corresponding exercise classes. Successful participation is based on exceeding a certain percentage of the combined total number of points awarded, as applicable, for exercise sheets, other homework (such as, for instance, reports) and written tests held as part of the exercises. The percentage threshold is communicated to students at the beginning of the course and documented in Ilias.

Seismics

In order to pass the course Seismics, a student must successfully participate in the corresponding exercise classes. Successful participation is based on exceeding a certain percentage of the combined total number of points awarded, as applicable, for exercise sheets, other homework (such as, for instance, reports) and written tests held as part of the exercises. The percentage threshold is communicated to students at the beginning of the course and documented in Ilias.

Competence Goal

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

Module grade calculation

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

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

- Physics of Seismic Instruments: 180 h, composed of active time (45 h), wrap-up of the lectures incl. preparation of the oral exam and solving the exercises (135 h)
- Seismology: 240 h, composed of active time (60 h), wrap-up of the lectures incl. preparation of the oral exam and solving the exercises (180 h)
- Seismics: 240 h, composed of active time (60 h), wrap-up of the lectures incl. preparation of the oral exam and solving the exercises (180 h)

Recommendation
Physics of Seismic Instruments

A sound knowledge of the theory of ordinary differential equations and integral transformations (Fourier transformation) is expected. Basic skills in pratical 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 Python/Matlab, the Linux commandline, and shell scripts is beneficial. Knowledge of fundamental signal processing theory is essential.

Learning type

- Physics of Seismic Instruments (V2 Ü1, 3 SWS, 6 ECTS, prerequisite for oral examination)
- Seismology (V2 Ü2, 4 SWS, 8 ECTS, prerequisite for oral examination)
- Seismics (V2 Ü2, 4 SWS, 8 ECTS , prerequisite for oral examination)

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 Uniersity Press.
- Thorne Lay and Terry C. Wallace, "Modern Global Seismology", Academic Press.
- Seth Stein and Michael Wysession, "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.

M 5.30 Module: Structural Geology and Tectonics [M-BGU-101996]

Responsible: apl. Prof. Dr. Agnes Kontny
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Electives

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each winter term	1 term	German	4	1

Mandatory			
T-BGU-103712	Structural Geology and Tectonics	4 CR	Kontny

Prerequisites
None

5.31 Module: Supplementary Studies on Science, Technology and Society [M-FORUM-106753]

Responsible: Dr. Christine Mielke
Christine Myglas

Organisation:

Part of: Additional Examinations (Usage from 10/1/2024)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
16	Grade to a tenth	Each term	3 terms	German	3	1

Election notes
Students have to self-record the achievements obtained in the Supplementary Studies on Science, Technology and Society in their study plan. FORUM (formerly ZAK) records the achievements as "non-assigned" under "ÜQ/SQ-Leistungen". Further instructions on self-recording of achievements can be found in the FAQ at https://campus.studium.kit.edu/ and on the FORUM homepage at https://www.forum.kit.edu/english/. The title of the examination and the amount of credits override the modules placeholders.

If you want to use FORUM achievements for both your Interdisciplinary Qualifications and for the Supplementary Studies, please record them in the Interdisciplinary Qualifications first. You can then get in contact with the FORUM study services (stg@forum.kit.edu) to also record them in your Supplementary Studies.

In the Advanced Unit you can choose examinations from three subject areas: "About Knowledge and Science", "Science in Society" and "Science in Social Debates". It is advised to complete courses from each of the three subject areas in the Advanced Unit.

To self-record achievements in the Advanced Unit, you have to select a free placeholder partial examination first. The placeholders' title do *not* affect which achievements the placeholder can be used for!

Mandatory			
T-FORUM-113578	Lecture Series Supplementary Studies on Science, Technology and Society - Self Registration	2 CR	Mielke, Myglas
T-FORUM-113579	Basic Seminar Supplementary Studies on Science, Technology and Society - Self Registration	2 CR	Mielke, Myglas
Advanced Unit Supplementary Studies on Science, Technology and Society (Election: at least 12 credits)			
T-FORUM-113580	Elective Specialization Supplementary Studies on Science, Technology and Society / About Knowledge and Science - Self-Registration	3 CR	Mielke, Myglas
T-FORUM-113581	Elective Specialization Supplementary Studies on Science, Technology and Society / Science in Society - Self-Registration	3 CR	Mielke, Myglas
T-FORUM-113582	Elective Specialization Supplementary Studies on Science, Technology and Society / Science in Public Debates - Self Registration	3 CR	Mielke, Myglas
Mandatory			
T-FORUM-113587	Registration for Certificate Issuance - Supplementary Studies on Science, Technology and Society	0 CR	Mielke, Myglas

Competence Certificate
The monitoring is explained in the respective partial achievement.

They are composed of:
- Protocols
- Reflection reports
- Presentations
- Preparation of a project work
- An individual term paper
- An oral examination
- A written exam

Upon successful completion of the supplementary studies, graduates receive a graded report and a certificate issued by the FORUM.

Prerequisites
The course is offered during the course of study and does not have to be completed within a defined period. Enrollment is required for all assessments of the modules in the supplementary studies.
Participation in the supplementary studies is regulated by § 3 of the statutes. KIT students register for the supplementary studies by selecting this module in the student portal and booking a performance themselves. Registration for courses, assessments, and exams is regulated by § 8 of the statutes and is usually possible shortly before the start of the semester.
The course catalog, module description (module manual), statutes (study regulations), and guidelines for creating the various written performance requirements can be downloaded from the FORUM homepage at https://www.forum.kit.edu/begleitstudium-wtg.php.

Registration and exam modalities

PLEASE NOTE:
Registration on the FORUM, i.e. additionally via the module selection in the student portal, enables students to receive up-to-date information about courses or study modalities. In addition, registering on the FORUM ensures that you have proof of the credits you have earned. As it is currently (as of winter semester 24-25) not yet possible to continue additional credits acquired in the Bachelor's programme electronically in the Master's programme, we strongly advise you to digitally secure the credits you have earned by archiving the Bachelor's transcript of records yourself and by registering on FORUM.
In the event that a transcript of records of the Bachelor's certificate is no longer available - we can only assign the achievements of registered students and thus take them into account when issuing the certificate.

Competence Goal
Graduates of the Supplementary Studies on Science, Technology, and Society gain a solid foundation in understanding the interplay between science, the public, business, and politics. They develop practical skills essential for careers in media, political consulting, or research management. The program prepares them to foster innovation, influence social processes, and engage in dialogue with political and societal entities. Participants are introduced to interdisciplinary perspectives, encompassing social sciences and humanities, to enhance their understanding of science, technology, and society. The teaching objectives of this supplementary degree program include equipping participants with both subject-specific knowledge and insights from epistemological, economic, social, cultural, and psychological perspectives on scientific knowledge and its application in various sectors. Students are trained to critically assess and balance the implications of their actions at the intersection of science and society. This training prepares them for roles as students, researchers, future decision-makers, and active members of society.

Through the program, participants learn to contextualize in-depth content within broader frameworks, independently analyze and evaluate selected course materials, and communicate their findings effectively in both written and oral formats. Graduates are adept at analyzing social issues and problem areas, reflecting on them critically from a socially responsible and sustainable standpoint.

Content

The Supplementary Studies on Science, Technology and Society can be started in the 1st semester of the enrolled degree programme and is not limited in time. The wide range of courses offered by FORUM makes it possible to complete the program usually within three semesters. The supplementary studies comprises 16 or more credit points (LP). It consists of **two modules: the Basic Module (4 LP) and the Advanced Module (12 LP)**.

The **basic Module** comprises the compulsory courses ‘Lecture Series Supplementary Studies on Science, Technology and Society’ and a basic seminar with a total of 4 LP.

The **Advanced Module** comprises courses totalling 12 LP in the humanities and social sciences subject areas ‘On Knowledge and Science’, ‘Science in Society’ and ‘Science in Public Debates’. The allocation of courses to the accompanying study programme can be found on the homepage https://www.forum.kit.edu/wtg-aktuelland in the printed FORUM course catalogue.

The 3 thematic subject areas:

Subject area 1: About Knowledge and Science

This is about the internal perspective of science: students explore the creation of knowledge, distinguishing between scientific and non-scientific statements (e.g., beliefs, pseudo-scientific claims, ideological statements), and examining the prerequisites, goals, and methods of knowledge generation. They investigate how researchers address their own biases, analyze the structure of scientific explanatory and forecasting models in various disciplines, and learn about the mechanisms of scientific quality assurance.

After completing courses in the "Knowledge and Science" area, students can critically reflect on the ideals and realities of contemporary science. They will be able to address questions such as: How robust is scientific knowledge? What are the capabilities and limitations of predictive models? How effective is quality assurance in science, and how can it be improved? What types of questions can science answer, and what questions remain beyond its scope?

Subject area 2: Science in Society

This focuses on the interactions between science and different areas of society, such as how scientific knowledge influences social decision-making and how social demands impact scientific research. Students learn about the specific functional logics of various societal sectors and, based on this understanding, estimate where conflicts of goals and actions might arise in transfer processes—for example, between science and business, science and politics, or science and journalism. Typical questions in this subject area include: How and under what conditions does an innovation emerge from a scientific discovery? How does scientific policy advice work? How do business and politics influence science, and when is this problematic? According to which criteria do journalists incorporate scientific findings into media reporting? Where does hostility towards science originate, and how can social trust in science be strengthened?

After completing courses in the "Sciene in Society" area, students can understand and assess the goals and constraints of actors in different societal sectors. This equips them to adopt various perspectives of communication and action partners in transfer processes and to act competently at various social interfaces with research in their professional lives.

Subject area 3: Science in Public Debates

The courses in this subject area provide insights into current debates on major social issues such as sustainability, digitalization, artificial intelligence, gender equality, social justice, and educational opportunities. Public debates on complex challenges are often polarized, leading to oversimplifications, defamation, or ideological thinking. This can hinder effective social solution-finding processes and alienate people from the political process and from science. Debates about sustainable development are particularly affected, as they involve a wide range of scientific and technological knowledge in both problem diagnosis (e.g., loss of biodiversity, climate change, resource consumption) and solution development (e.g., nature conservation, CCS, circular economy).

By attending courses in "Science in Public Debates," students are trained in an application-oriented way to engage in factual debates—exchanging arguments, addressing their own prejudices, and handling contradictory information. They learn that factual debates can often be conducted more deeply and with more nuance than is often seen in public discourse. This training enables them to handle specific factual issues in their professional lives independently of their own biases and to be open to differentiated, fact-rich arguments.

Supplementary credits:

Additional LP (supplementary work) totalling a maximum of 12 LP can also be acquired from the complementary study programme (see statutes for the WTG complementary study programme § 7). § 4 and § 5 of the statutes remain unaffected by this. These supplementary credits are not included in the overall grade of the accompanying study programme. At the request of the participant, the supplementary work will be included in the certificate of the accompanying study programme and marked as such. Supplementary coursework is listed with the grades provided for in § 9.

Module grade calculation

The overall grade of the supplementary course is calculated as a credit-weighted average of the grades that were achieved in the advanced module.

Annotation

Climate change, biodiversity crisis, antibiotic resistance, artificial intelligence, carbon capture and storage, and gene editing are just a few areas where science and technology can diagnose and address numerous social and global challenges. The extent to which scientific findings are considered in politics and society depends on various factors, such as public understanding and trust, perceived opportunities and risks, and ethical, social, or legal considerations.
To enable students to use their expertise as future decision-makers in solving social and global challenges, we aim to equip them with the skills to navigate the interfaces between science, business, and politics competently and reflectively. In the Supplementary Studies, they acquire foundational knowledge about the interactions between science, technology, and society.

They learn:
- How reliable scientific knowledge is produced,
- how social expectations and demands influence scientific research, and
- how scientific knowledge is adopted, discussed, and utilized by society.

The program integrates essential insights from psychology, philosophy, economics, social sciences, and cultural studies into these topics. After completing the supplementary studies programme, students can place the content of their specialized studies within a broader social context. This prepares them, as future decision-makers, to navigate competently and reflectively at the intersections between science and various sectors of society, such as politics, business, or journalism, and to contribute effectively to innovation processes, public debates, or political decision-making.

Workload

The workload is made up of the number of hours of the individual modules:

- Basic Module approx. 120 hours
- Advanced Module approx. 390 hours

> Total: approx. 510 hours

In the form of supplementary services, up to approximately 390 hours of work can be added.

Recommendation

It is recommended to complete the supplementary study program in three or more semesters, beginning with the lecture series on science, technology, and society in the summer semester. Alternatively, you can start with the basic seminar in the winter semester and then attend the lecture series in the summer semester.

Courses in the Advanced Module can be taken simultaneously. It is also advised to complete courses from each of the three subject areas in the advanced unit.

Learning type

- Lectures
- Seminars/Project Seminars
- Workshops

M 5.32 Module: The Black Forest Observatory at Schiltach [M-PHYS-101870]

Responsible: Dr. Thomas Forbriger
Organisation: KIT Department of Physics
Part of: Electives

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
1	pass/fail	Irregular	1 term	German/English	4	1

Mandatory			
T-PHYS-103569	The Black Forest Observatory at Schiltach, Prerequisite	1 CR	Forbriger

Competence Certificate
Report including topics of three research papers discussed in lecture.

Prerequisites
none

Competence Goal
Students can name different tasks of BFO, know which instruments are used at BFO and which questions can be addressed with the dta recorded at BFO. They know the physical principles and can explain how the instruments work. They can explain installation of instruments, and know what has to be considered when installing those instruments in the field. They have an idea about the interpretation of the data measured at BFO.

Students can name research topics where data from BFO is used and can critically discuss those. They know current and previous research projects.

They can summarize, reflect and evaluate their newly gained knowledge about BFO and its current research in a written report.

Content

- Tasks of BFO
- Instruments at BFO
- Data from BFO
- Current research with BFO data
- Current and future research projects at BFO

Module grade calculation
No grade is given.

Workload
30 h:

- Preparation/ lectures at KIT: 5 h
- In-Situ lecture at BFO: 10 h
- Wrap up, writing of report: 15 h

Learning type
In situ lecture:

Lectures at KIT for preparation, one day visit to BFO

Literature
Will be given in lecture.

M 5.33 Module: Theory and Inversion of Seismic Waves (GEOP M TIW) [M-PHYS-101359]

Responsible: Prof. Dr. Thomas Bohlen
Organisation: KIT Department of Physics
Part of: Geophysics

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
18	Grade to a tenth	Each summer term	1 term	English	4	3

Mandatory			
T-PHYS-102330	Theory of Seismic Waves, Prerequisite	0 CR	Bohlen
T-PHYS-102332	Inversion and Tomography, Prerequisite	0 CR	Ritter
T-PHYS-108636	Seismic Modelling, Prerequisite	0 CR	Bohlen
T-PHYS-106218	Theory and Inversion of Seismic Waves, Exam	18 CR	Bohlen

Competence Certificate

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 with a duration of approximately 60 minutes 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.

Competence Goal

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 waves: 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 bonds, 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

Module grade calculation

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

Workload

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

- Theory of Seismic Waves: 180 h, composed of active time (45 h), wrap-up of the lectures incl. preparation of the oral exam and solving the exercises (135 h)
- Seismic Modelling: 120 h, composed of active time (30 h), wrap-up of the lectures incl. preparation of the oral exam and solving the exercises (90 h)
- Inversion and Tomography: 240 h, composed of active time (60 h), wrap-up of the lectures incl. preparation of the oral exam and solving the exercises (180 h)

Recommendation

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.

Learning type

- Theory of Seismic Waves (V2 Ü1, 3 SWS, 6 ECTS, prerequisite for oral examination)
- Seismic Modelling (V1 Ü1, 2 SWS, 4 ECTS, prerequisite for oral examination)
- Inversion und Tomographie (V2 Ü2, 4 SWS, 8 ECTS , prerequisite for oral examination)

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.).

6 Courses

T 6.1 Course: 3D reflection seismics [T-PHYS-107806]

Responsible: Prof. Dr. Thomas Bohlen
Dr. Thomas Hertweck

Organisation: KIT Department of Physics

Part of: M-PHYS-103856 - 3D reflection seismics

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	1	pass/fail	Irregular	1

Workload
30 hours

T 6.2 Course: Array Techniques in Seismology, graded [T-PHYS-112590]

Responsible: apl. Prof. Dr. Joachim Ritter
Organisation: KIT Department of Physics
Part of: M-PHYS-106196 - Array Techniques in Seismology (Graded)

Type	Credits	Grading scale	Version
Examination of another type	4	Grade to a third	1

Competence Certificate
Grading is based on written reports on exercises. A detailed rating scheme is distributed during the first lecture together with information on the required length of the reports and rating criteria.

Recommendation
Participants need to know the basics of seismology.

Workload
120 hours

T 6.3 Course: Array Techniques in Seismology, not Graded [T-PHYS-112593]

Responsible: apl. Prof. Dr. Joachim Ritter
Organisation: KIT Department of Physics
Part of: M-PHYS-106198 - Array Techniques in Seismology (Ungraded)

Type	Credits	Grading scale	Version
Completed coursework	4	pass/fail	1

Competence Certificate
Written reports on exercises must be submitted, which are assessed and scored on an individual basis. Successful participation requires that the average score of all reports combined exceeds a certain threshold. Detailed information on the threshold, the required length of the reports and the rating criteria are distributed in the first lecture.

Recommendation
Participants need to know the basics of seismology.

Workload
120 hours

T 6.4 Course: Basic Seminar Supplementary Studies on Science, Technology and Society - Self Registration [T-FORUM-113579]

Responsible: Dr. Christine Mielke
Christine Myglas

Organisation:

Part of: M-FORUM-106753 - Supplementary Studies on Science, Technology and Society

Type	Credits	Grading scale	Recurrence	Expansion	Version
Completed coursework	2	pass/fail	Each summer term	1 terms	1

Competence Certificate
Study achievement in the form of a presentation or a term paper or project work in the selected course.

Prerequisites
None

Self service assignment of supplementary stdues
This course can be used for self service assignment of grade aquired from the following study providers:

- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- FORUM (ehem. ZAK) Begleitstudium

Recommendation
It is recommended that the basic seminar be completed during the same semester as the lecture series "Science in Society". If it is not possible to attend the lecture series and the basic seminar in the same semester, the basic seminar can also be attended in the semesters before the lecture series.
However, attending courses in the advanced unit before attending the basic seminar should be avoided.

Annotation

T 6.5 Course: Classical Physics Laboratory Courses II [T-PHYS-102290]

Responsible: Prof. Dr. Ulrich Husemann
Dr. Hans Jürgen Simonis
PD Dr. Roger Wolf

Organisation: KIT Department of Physics

Part of: M-PHYS-101354 - Classical Physics Laboratory Course II

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	6	pass/fail	Each summer term	1

Events					
ST 2025	4011213	Praktikum Klassische Physik II (Kurs 1)	6 SWS	Practical course / 🗣	Wolf, Husemann, Simonis
ST 2025	4011223	Praktikum Klassische Physik II (Kurs 2)	6 SWS	Practical course / 🗣	Wolf, Husemann, Simonis

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites

none

T 6.6 Course: Earthquake Deformation Cycle [T-PHYS-113816]

Responsible: Prof. Dr. Henriette Sudhaus
Organisation: KIT Department of Physics
Part of: M-PHYS-106893 - Earthquake Deformation Cycle (graded)
M-PHYS-106894 - Earthquake Deformation Cycle (ungraded)

Type	Credits	Grading scale	Recurrence	Expansion	Version
Completed coursework	4	pass/fail	Each winter term	1 terms	1

Competence Certificate
The assessment is based on active participation and submitting course work / homework assignments. Details are discussed in the first lecture.

Workload
120 hours

T 6.7 Course: Earthquake Deformation Cycle, Exam [T-PHYS-113817]

Responsible: Prof. Dr. Henriette Sudhaus
Organisation: KIT Department of Physics
Part of: M-PHYS-106893 - Earthquake Deformation Cycle (graded)

Type	Credits	Grading scale	Recurrence	Expansion	Version
Oral examination	2	Grade to a third	Each winter term	1 terms	1

Competence Certificate
Oral exam between 15 min and 60 min.

Prerequisites
T-PHYS-113816 must have been passed.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-PHYS-113816 - Earthquake Deformation Cycle must have been passed.

Workload
60 hours

T 6.8 Course: Earthquake source analysis, Exam [T-PHYS-114266]

Responsible: Prof. Dr. Henriette Sudhaus
Organisation: KIT Department of Physics
Part of: M-PHYS-107240 - InSAR processing for earthquake source analysis

Type	Credits	Grading scale	Recurrence	Expansion	Version
Examination of another type	2	Grade to a third	Each summer term	1 terms	1

Events					
ST 2025	4060391	InSAR processing for earthquake source analysis	1 SWS	Lecture / 🗣	Sudhaus, Mader
ST 2025	4060392	Exercises to InSAR processing for earthquake source analysis	3 SWS	Practice / 🗣	Sudhaus, Mader

Legend: 🖥 Online, ❂ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
The assessment is based on a work assignment and a written report to be handed in after the course.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-PHYS-114264 - Earthquake source analysis: InSAR processing must have been passed.
2. The course T-PHYS-114265 - Earthquake source analysis: optimization must have been passed.

Workload
60 hours

T 6.9 Course: Earthquake source analysis: InSAR processing [T-PHYS-114264]

Responsible: Prof. Dr. Henriette Sudhaus
Organisation: KIT Department of Physics
Part of: M-PHYS-107240 - InSAR processing for earthquake source analysis

Type	Credits	Grading scale	Recurrence	Expansion	Version
Completed coursework	2	pass/fail	Each summer term	1 terms	1

Events					
ST 2025	4060391	InSAR processing for earthquake source analysis	1 SWS	Lecture / 🗣	Sudhaus, Mader
ST 2025	4060392	Exercises to InSAR processing for earthquake source analysis	3 SWS	Practice / 🗣	Sudhaus, Mader

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
The assessment is based on active participation and course work. Details are discussed in the first lecture.

Recommendation
Prior participation of the courses "The Earthquake Deformation Cycle" and "Seismology" is recommended.

Workload
60 hours

T 6.10 Course: Earthquake source analysis: optimization [T-PHYS-114265]

Responsible: Prof. Dr. Henriette Sudhaus
Organisation: KIT Department of Physics
Part of: M-PHYS-107240 - InSAR processing for earthquake source analysis

Type	Credits	Grading scale	Recurrence	Expansion	Version
Completed coursework	1	pass/fail	Each summer term	1 terms	1

Events					
ST 2025	4060391	InSAR processing for earthquake source analysis	1 SWS	Lecture / 🗣	Sudhaus, Mader
ST 2025	4060392	Exercises to InSAR processing for earthquake source analysis	3 SWS	Practice / 🗣	Sudhaus, Mader

Legend: 🖥 Online, ✲ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
The assessment is based on active participation and course work. Details are discussed in the first lecture.

Recommendation
Prior participation of the courses "The Earthquake Deformation Cycle" and "Seismology" is recommended.

Workload
30 hours

T 6.11 Course: Eifel Seismology and Volcanology Course [T-PHYS-110870]

Responsible: Prof. Dr. Andreas Rietbrock
Organisation: KIT Department of Physics
Part of: M-PHYS-105382 - Eifel Seismology and Volcanology Course

Type	Credits	Grading scale	Expansion	Version
Examination of another type	2	Grade to a third	1 terms	1

T 6.12 Course: Elective Specialization Supplementary Studies on Science, Technology and Society / About Knowledge and Science - Self-Registration [T-FORUM-113580]

Responsible: Dr. Christine Mielke
Christine Myglas

Organisation:

Part of: M-FORUM-106753 - Supplementary Studies on Science, Technology and Society

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	3	Grade to a third	Each term	1

Competence Certificate
Another type of examination assessment under § 5, section 3 involves a presentation, term paper, or project work within the chosen course.

Prerequisites
None

Self service assignment of supplementary stdues
This course can be used for self service assignment of grade aquired from the following study providers:

- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- FORUM (ehem. ZAK) Begleitstudium

Recommendation
The contents of the basic module are helpful. The basic module should be completed or attended in parallel, but not after the advanced module.
The reading recommendations for primary and specialist literature are determined individually by the respective lecturers according to the subject area and course.

Annotation
This placeholder can be used for any achievement in the Advanced Unit of the Supplementary Studies.

In the Advanced Module, students can choose their own individual focus, e.g. sustainable development, data literacy, etc. The focus should be discussed with the module coordinator at the FORUM.

T 6.13 Course: Elective Specialization Supplementary Studies on Science, Technology and Society / Science in Public Debates - Self Registration [T-FORUM-113582]

Responsible: Dr. Christine Mielke
Christine Myglas

Organisation:

Part of: M-FORUM-106753 - Supplementary Studies on Science, Technology and Society

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	3	Grade to a third	Each term	1

Competence Certificate
Another type of examination assessment under § 5, section 3 involves a presentation, term paper, or project work within the chosen course.

Prerequisites
None

Self service assignment of supplementary stdues
This course can be used for self service assignment of grade aquired from the following study providers:

- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- FORUM (ehem. ZAK) Begleitstudium

Recommendation
The contents of the basic module are helpful. The basic module should be completed or attended in parallel, but not after the advanced module.
The reading recommendations for primary and specialist literature are determined individually by the respective lecturers according to the subject area and course.

Annotation
This placeholder can be used for any achievement in the Advanced Unit of the Supplementary Studies.

6.14 Course: Elective Specialization Supplementary Studies on Science, Technology and Society / Science in Society - Self-Registration [T-FORUM-113581]

Responsible: Dr. Christine Mielke
Christine Myglas

Organisation:

Part of: M-FORUM-106753 - Supplementary Studies on Science, Technology and Society

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	3	Grade to a third	Each term	1

Competence Certificate
Another type of examination assessment under § 5, section 3 involves a presentation, term paper, or project work within the chosen course.

Prerequisites
None

Self service assignment of supplementary stdues
This course can be used for self service assignment of grade aquired from the following study providers:

- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- FORUM (ehem. ZAK) Begleitstudium

Recommendation
The contents of the basic module are helpful. The basic module should be completed or attended in parallel, but not after the advanced module.
The reading recommendations for primary and specialist literature are determined individually by the respective lecturers according to the subject area and course.

Annotation
This placeholder can be used for any achievement in the Advanced Unit of the Supplementary Studies.

T 6.15 Course: Full-Waveform Inversion [T-PHYS-109272]

Responsible: Prof. Dr. Thomas Bohlen
Dr. Thomas Hertweck

Organisation: KIT Department of Physics

Part of: M-PHYS-104522 - Full-Waveform Inversion (Ungraded)

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	6	pass/fail	Each winter term	1

Workload
180 hours

6.16 Course: Geological Hazards and Risk [T-PHYS-103525]

Responsible: Dr. Andreas Schäfer
Organisation: KIT Department of Physics
Part of: M-PHYS-101833 - Geological Hazards and Risk

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	8	Grade to a third	Each winter term	2

Workload
240 hours

T 6.17 Course: Geological Hazards and Risk, not graded [T-PHYS-110713]

Responsible: Dr. Andreas Schäfer
Organisation: KIT Department of Physics
Part of: M-PHYS-105279 - Geological Hazards and Risk (Ungraded)

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	8	pass/fail	Each winter term	1

Workload
240 hours

T 6.18 Course: Geophysical Monitoring of Tunnel Constructions, Prerequisite [T-PHYS-106248]

Responsible: Prof. Dr. Thomas Bohlen
Organisation: KIT Department of Physics
Part of: M-PHYS-103141 - Geophysical Monitoring of Tunnel Constructions

Type	Credits	Grading scale	Version
Completed coursework	1	pass/fail	1

Workload
30 hours

T 6.19 Course: In-Situ: Tectonics and Seismic Hazard in the Mediterranean Region [T-PHYS-112830]

Responsible: Prof. Dr. Andreas Rietbrock
Organisation: KIT Department of Physics
Part of: M-PHYS-106322 - In-Situ: Tectonics and Seismic Hazard in the Mediterranean Region

Type	Credits	Grading scale	Recurrence	Expansion	Version
Examination of another type	6	Grade to a third	Irregular	1 terms	1

Competence Certificate
Students solve exercise sheets, prepare and give a presentation and write a final report.

Workload
180 hours

T 6.20 Course: International Workshop on Current Geophysical Research Topics [T-PHYS-110871]

Responsible: Prof. Dr. Andreas Rietbrock
Organisation: KIT Department of Physics
Part of: M-PHYS-105383 - International Workshop on Current Geophysical Research Topics

Type	Credits	Grading scale	Expansion	Version
Completed coursework	2	pass/fail	1 terms	2

T 6.21 Course: Introduction to Research in a Scientific Sub-Field Including a Seminar Paper [T-PHYS-103355]

Organisation: KIT Department of Physics
Part of: M-PHYS-101361 - Introduction to Scientific Practice

Type	Credits	Grading scale	Version
Completed coursework	16	pass/fail	1

Workload
480 hours

T 6.22 Course: Inversion and Tomography, Prerequisite [T-PHYS-102332]

Responsible: apl. Prof. Dr. Joachim Ritter
Organisation: KIT Department of Physics
Part of: M-PHYS-101359 - Theory and Inversion of Seismic Waves

Type	Credits	Grading scale	Version
Completed coursework (written)	0	pass/fail	1

Events					
ST 2025	4060231	Inversion and Tomography	2 SWS	Lecture / 🗣	Rietbrock
ST 2025	4060232	Exercises to Inversion and Tomography	2 SWS	Practice / 🗣	Gao, Rietbrock

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 6.23 Course: Lecture Series Supplementary Studies on Science, Technology and Society - Self Registration [T-FORUM-113578]

Responsible: Dr. Christine Mielke
Christine Myglas

Organisation:

Part of: M-FORUM-106753 - Supplementary Studies on Science, Technology and Society

Type	Credits	Grading scale	Recurrence	Expansion	Version
Completed coursework	2	pass/fail	Each summer term	1 terms	1

Competence Certificate
Active participation, learning protocols, if applicable.

Prerequisites
None

Self service assignment of supplementary stdues
This course can be used for self service assignment of grade aquired from the following study providers:

- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- FORUM (ehem. ZAK) Begleitstudium

Recommendation
It is recommended that you complete the lecture series "Science in Society" before attending events in the advanced module and in parallel with attending the basic seminar.
If it is not possible to attend the lecture series and the basic seminar in the same semester, the lecture series can also be attended after attending the basic seminar.
However, attending events in the advanced module before attending the lecture series should be avoided.

Annotation
The basic module consists of the lecture series "Science in Society" and the basic seminar. The lecture series is only offered during the summer semester.
The basic seminar can be attended in the summer or winter semester.

T 6.24 Course: Master's Thesis [T-PHYS-103350]

Responsible: Prof. Dr. Thomas Bohlen
Organisation: KIT Department of Physics
Part of: M-PHYS-101730 - Modul Master's Thesis

Type	Credits	Grading scale	Version
Final Thesis	30	Grade to a third	1

Final Thesis
This course represents a final thesis. The following periods have been supplied:

Submission deadline	6 months
Maximum extension period	3 months
Correction period	8 weeks

This thesis requires confirmation by the examination office.

Workload
900 hours

T 6.25 Course: Modern Physics Laboratory Courses [T-PHYS-102291]

Responsible: PD Dr. Andreas Naber
Organisation: KIT Department of Physics
Part of: M-PHYS-101355 - Modern Physics Laboratory Course

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	6	pass/fail	Each term	1

Events					
ST 2025	4011313	Praktikum Moderne Physik (Kurs 1)	4 SWS	Practical course / 🗣	Naber, Guigas, Sürgers, Wolf
ST 2025	4011323	Praktikum Moderne Physik (Kurs 2)	4 SWS	Practical course / 🗣	Naber, Guigas, Sürgers, Wolf

Legend: 🖥 Online, ❃ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
none

T 6.26 Course: Observatory Course [T-PHYS-111311]

Responsible: Dr. Thomas Forbriger
Organisation: KIT Department of Physics
Part of: M-PHYS-105662 - Observatory Course

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	3	pass/fail	Irregular	1

Workload
90 hours

T 6.27 Course: Physical Methods in Volcano Seismology [T-PHYS-111334]

Responsible: Prof. Dr. Thomas Bohlen
Organisation: KIT Department of Physics
Part of: M-PHYS-105679 - Physical Methods in Volcano Seismology

Type	Credits	Grading scale	Version
Examination of another type	6	Grade to a third	1

T 6.28 Course: Physics of Seismic Instruments, Prerequisite [T-PHYS-102325]

Responsible: Dr. Thomas Forbriger
Organisation: KIT Department of Physics
Part of: M-PHYS-101358 - Seismometry, Signal Processing and Seismogram Analysis

Type	Credits	Grading scale	Version
Completed coursework (written)	0	pass/fail	1

T 6.29 Course: Recent Geodynamics [T-BGU-101771]

Responsible: Dr. Andreas Barth
Dr.-Ing. Michael Mayer
Alison Larissa Seidel
Dr. Malte Westerhaus

Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences

Part of: M-BGU-101030 - Recent Geodynamics

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	4	Grade to a third	Each winter term	2

Competence Certificate
Other according § 4 para. 2 No. 3 SPO.

The exam consists of the creation of an individual learning portfolio, the overall impression of which is assessed. Components of the learning portfolio are

- 1 scientific presentation (duration: approx. 10 minutes) and defense
- Active participation in the exercise 'Seismic Cycle' and subsequent completion of a worksheet (approx. 5 pages); personal participation in this exercise is necessary to ensure that the practical learning objectives are achieved (e.g., scientific application of used software)
- 7 further learning portfolio contributions (written contributions: approx. 5 pages; alternative digital elements (e.g. video): approx. 5 minutes)

Details on the learning portfolio will be communicated in the course and in ILIAS.

Prerequisites
none

Recommendation
Basics of Geophysics and Physical Geodesy are helpful

Workload
120 hours

T 6.30 Course: Registration for Certificate Issuance - Supplementary Studies on Science, Technology and Society [T-FORUM-113587]

Responsible: Dr. Christine Mielke
Christine Myglas

Organisation:

Part of: M-FORUM-106753 - Supplementary Studies on Science, Technology and Society

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	0	pass/fail	Each term	1

Prerequisites

In order to register, it is mandatory that the basic module and the advanced module have been completed and that the grades for the partial performances in the advanced module are available.

Registration as a partial achievement means the issue of a certificate.

T 6.31 Course: Scientific Seminars [T-PHYS-102335]

Organisation: KIT Department of Physics
Part of: M-PHYS-101357 - Scientific Seminars

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	4	pass/fail	Each term	1

Events					
ST 2025	4060334	Institutsseminar	2 SWS	Seminar / 🧩	Bohlen, Rietbrock, Sudhaus
ST 2025	6339041	Fachgespräch Hydrogeologie und Ingenieurgeologie	1 SWS	Seminar / 🗣	Goldscheider, Fuchs

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
none

Workload
120 hours

T 6.32 Course: Seismic Data Processing, Coursework [T-PHYS-108686]

Responsible: Prof. Dr. Thomas Bohlen
Dr. Thomas Hertweck

Organisation: KIT Department of Physics

Part of: M-PHYS-104186 - Seismic Data Processing with Final Report (Graded)
M-PHYS-104188 - Seismic Data Processing with Final Report (Ungraded)
M-PHYS-104189 - Seismic Data Processing without Final Report (Ungraded)

Type	Credits	Grading scale	Version
Completed coursework	2	pass/fail	1

Workload
60 hours

T 6.33 Course: Seismic Data Processing, Final Report (Graded) [T-PHYS-108656]

Responsible: Prof. Dr. Thomas Bohlen
Dr. Thomas Hertweck

Organisation: KIT Department of Physics

Part of: M-PHYS-104186 - Seismic Data Processing with Final Report (Graded)

Type	Credits	Grading scale	Version
Examination of another type	4	Grade to a third	1

Events					
ST 2025	4060321	Seismic Data Processing	1 SWS	Lecture / 🗣	Hertweck, Bohlen
ST 2025	4060322	Exercises to Seismic Data Processing	2 SWS	Practice / 🗣	Houpt, Hertweck, Bohlen

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
Successful participation on "Seismic Data Processing, course achievement"

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-PHYS-108686 - Seismic Data Processing, Coursework must have been passed.

Workload
120 hours

T 6.34 Course: Seismic Data Processing, Final Report (ungraded) [T-PHYS-108657]

Responsible: Prof. Dr. Thomas Bohlen
Dr. Thomas Hertweck
Organisation: KIT Department of Physics
Part of: M-PHYS-104188 - Seismic Data Processing with Final Report (Ungraded)

Type	Credits	Grading scale	Version
Completed coursework	4	pass/fail	1

Events					
ST 2025	4060321	Seismic Data Processing	1 SWS	Lecture / 🗣	Hertweck, Bohlen
ST 2025	4060322	Exercises to Seismic Data Processing	2 SWS	Practice / 🗣	Houpt, Hertweck, Bohlen

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
Successful participation on "Seismic Data Processing, course achievement"

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-PHYS-108686 - Seismic Data Processing, Coursework must have been passed.

Workload
120 hours

T 6.35 Course: Seismic Modelling, Prerequisite [T-PHYS-108636]

Responsible: Prof. Dr. Thomas Bohlen
Organisation: KIT Department of Physics
Part of: M-PHYS-101359 - Theory and Inversion of Seismic Waves

Type	Credits	Grading scale	Version
Completed coursework (written)	0	pass/fail	1

Events					
ST 2025	4060261	Seismic Modelling	1 SWS	Lecture / 🗣	Bohlen
ST 2025	4060262	Exercises to Seismic Modelling	1 SWS	Practice / 🗣	Rezaei Nevisi, Bohlen, Keßler

Legend: 🖥 Online, ⚄ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 6.36 Course: Seismics, Prerequisite [T-PHYS-109266]

Responsible: Prof. Dr. Thomas Bohlen
Organisation: KIT Department of Physics
Part of: M-PHYS-101358 - Seismometry, Signal Processing and Seismogram Analysis

Type	Credits	Grading scale	Version
Completed coursework (written)	0	pass/fail	1

T 6.37 Course: Seismology, Prerequisite [T-PHYS-109267]

Responsible: Prof. Dr. Andreas Rietbrock
Organisation: KIT Department of Physics
Part of: M-PHYS-101358 - Seismometry, Signal Processing and Seismogram Analysis

Type	Credits	Grading scale	Version
Completed coursework (written)	0	pass/fail	1

T 6.38 Course: Seismometry, Signal Processing and Seismogram Analysis, Exam [T-PHYS-106217]

Responsible: Prof. Dr. Thomas Bohlen
Prof. Dr. Andreas Rietbrock

Organisation: KIT Department of Physics

Part of: M-PHYS-101358 - Seismometry, Signal Processing and Seismogram Analysis

Type	Credits	Grading scale	Recurrence	Version
Oral examination	22	Grade to a third	Each winter term	2

Modeled Conditions
The following conditions have to be fulfilled:

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.

6.39 Course: Seminar on earthquakes and crustal deformation [T-PHYS-113865]

Responsible: Prof. Dr. Henriette Sudhaus
Organisation: KIT Department of Physics
Part of: M-PHYS-101360 - Scientific Focusing Phase

Type	Credits	Grading scale	Recurrence	Expansion	Version
Completed coursework (oral)	10	pass/fail	Each term	1 terms	1

Prerequisites
none

T 6.40 Course: Seminar on Recent Topics of Applied Geophysics [T-PHYS-107675]

Responsible: Prof. Dr. Thomas Bohlen
Organisation: KIT Department of Physics
Part of: M-PHYS-101360 - Scientific Focusing Phase

Type	Credits	Grading scale	Recurrence	Version
Completed coursework (oral)	10	pass/fail	Each term	1

Events					
ST 2025	4060284	Seminar on Applied Geophysics	2 SWS	Seminar / 🧩	Bohlen, Hertweck

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 6.41 Course: Seminar on Recent Topics of General Geophysics [T-PHYS-107676]

Responsible: Prof. Dr. Andreas Rietbrock
Organisation: KIT Department of Physics
Part of: M-PHYS-101360 - Scientific Focusing Phase

Type	Credits	Grading scale	Recurrence	Version
Completed coursework (oral)	10	pass/fail	Each term	1

Events					
ST 2025	4060274	Current Topics in Seismology and Hazard	2 SWS	Seminar / 🗣	Rietbrock

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 6.42 Course: Seminar Seismological Analysis [T-PHYS-110593]

Responsible: apl. Prof. Dr. Joachim Ritter
Organisation: KIT Department of Physics
Part of: M-PHYS-101360 - Scientific Focusing Phase

Type	Credits	Grading scale	Recurrence	Version
Completed coursework (oral)	10	pass/fail	Each term	1

T 6.43 Course: Structural Geology and Tectonics [T-BGU-103712]

Responsible: apl. Prof. Dr. Agnes Kontny
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-101996 - Structural Geology and Tectonics

Type	Credits	Grading scale	Version
Written examination	4	Grade to a third	1

Prerequisites
none

T 6.44 Course: The Black Forest Observatory at Schiltach, Prerequisite [T-PHYS-103569]

Responsible: Dr. Thomas Forbriger
Organisation: KIT Department of Physics
Part of: M-PHYS-101870 - The Black Forest Observatory at Schiltach

Type	Credits	Grading scale	Version
Completed coursework	1	pass/fail	1

Events					
ST 2025	4060403	In Situ: Das geowissenschaftliche Gemeinschaftsobservatorium bei Schiltach	1 SWS	Lecture / 🗣	Forbriger, Hertweck

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Workload
30 hours

T 6.45 Course: Theory and Inversion of Seismic Waves, Exam [T-PHYS-106218]

Responsible: Prof. Dr. Thomas Bohlen
Organisation: KIT Department of Physics
Part of: M-PHYS-101359 - Theory and Inversion of Seismic Waves

Type	Credits	Grading scale	Version
Oral examination	18	Grade to a third	2

Modeled Conditions
The following conditions have to be fulfilled:

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 6.46 Course: Theory of Seismic Waves, Prerequisite [T-PHYS-102330]

Responsible: Prof. Dr. Thomas Bohlen
Organisation: KIT Department of Physics
Part of: M-PHYS-101359 - Theory and Inversion of Seismic Waves

Type	Credits	Grading scale	Version
Completed coursework (written)	0	pass/fail	1

Events					
ST 2025	4060221	Theory of Seismic Waves	2 SWS	Lecture / 🗣	Bohlen, Hertweck
ST 2025	4060222	Exercises to Theory of Seismic Waves	1 SWS	Practice / 🗣	Hertweck, Bohlen

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 6.47 Course: Wildcard [T-PHYS-104677]

Organisation: KIT Department of Physics
Part of: M-PHYS-102349 - Interdisciplinary Qualifications

Type	Credits	Grading scale	Version
Completed coursework	2	pass/fail	1

T 6.48 Course: Wildcard [T-PHYS-106253]

Organisation: University

Part of: M-PHYS-103142 - Module Wildcard Electives

Type	Credits	Grading scale	Version
Completed coursework	2	pass/fail	1

T 6.49 Course: Wildcard [T-PHYS-104675]

Organisation: KIT Department of Physics
Part of: M-PHYS-102349 - Interdisciplinary Qualifications

Type	Credits	Grading scale	Version
Examination of another type	2	Grade to a third	1

T 6.50 Course: Wildcard [T-PHYS-106249]

Organisation: University

Part of: M-PHYS-103142 - Module Wildcard Electives

Type	Credits	Grading scale	Version
Examination of another type	2	Grade to a third	1

T 6.51 Course: Wildcard Additional Examinations 1 ungraded [T-PHYS-103898]

Organisation: KIT Department of Physics

Part of: **M-PHYS-102020 - Further Examinations**

Type	Credits	Grading scale	Version
Completed coursework	2	pass/fail	1

T 6.52 Course: Wildcard Additional Examinations 11 graded [T-PHYS-103937]

Organisation: KIT Department of Physics

Part of: M-PHYS-102020 - Further Examinations

Type	Credits	Grading scale	Version
Examination of another type	2	Grade to a third	1