Karlsruher Institut für Technologie

Module Handbook
Remote Sensing and Geoinformatics Master 2018 (Master of Science (M.Sc.))

SPO 2018

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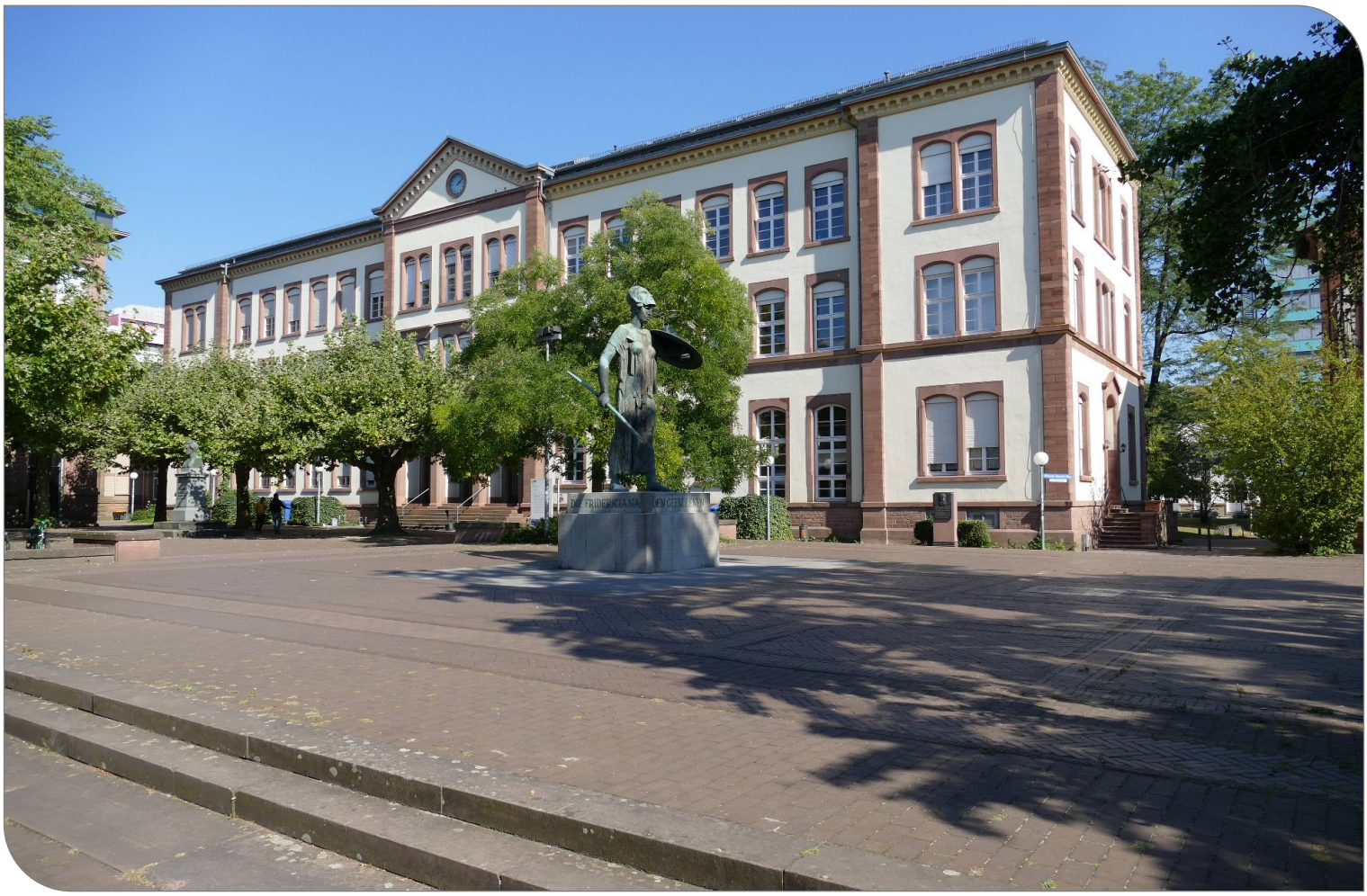
KIT DEPARTMENT OF CIVIL ENGINEERING, GEO AND ENVIRONMENTAL SCIENCES



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Chapter 1

The Handbook of Modules: Purpose and Organization

This module handbook is the relevant document providing information on the structure and the contents of the master's degree program "Remote Sensing and Geoinformatics". It contains helpful information and offers individual guidance for selecting courses and planning the studies. The organization of the degree program and its modules are described in detail. This document is meant to provide all necessary information for tailoring an interdisciplinary course of studies compliant with each student's personal interests and needs.

Chapter 2 of this document describes the contents and structure of the master program as a whole and an exemplary study plan. In Chapter 3 the qualification targets are summarized. Chapter 4 give an overview over the courses of the modules and the applicable modes of examination. The detailed descriptions of each module are reported in Chapters 5-7. Chapter 8 provides contacts of the study program.

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Chapter 2

Contents and Structure of the Master Program

2.1 The Master Program

The purpose of the master's degree program "Remote Sening and Geoinformatics" offered by the Karslruhe Institute of Technology (KIT) is to deepen and complement the scientific qualification the student has acquired in one of the related bachelor programs. The program is composed of a balanced combination of lectures, exercises, and seminars. In the compulsory modules of the topic "Remote Sensing" the students who may have bachelor's degrees in different fields, will acquire a common basis of knowledge upon which the more specialized courses can build. The selection of one out of six profiles allows for a specialization according to the student's interests as well as for some flexibility to react to the developments of the employment market. First experience in scientific work is gained in "Lab Rotations". The final step is the master thesis on a topic in the field of remote sensing and/or geoinformatics; the master thesis shall be finished within 6 months. Successful students are awarded with the degree "Master of Science (M. Sc.)" in "Remote Sensing and Geoinformatics"

The language of the program is English. Some elective courses may also be offered in German. These are, however, not required to finish the program.

The current studies and examination regulations can be found at https://www.sle.kit.edu under 'Statutes and regulations'. Please take into account, that there are six statute amendings to the study and examination regulations of the year 2018.

2.2 The Modular Structure of the Master Program

This master's degree program is organized in various topics (Remote Sensing, Mathematics and Beyond, etc.), and each topic is in itself organized in multiple modules. Each module consists of one or multiple successive courses. Usually, a module is finished by passing the related examination. In many cases, for the admission to examinations requirements have to be fulfilled. The amount of work related to a module is reflected by the respective credit points (CP) which are booked after the successful finalization of the module. In this master program, some of the modules are compulsory, but there is a large number of compulsory elective or fully elective modules. This allows to tailor this interdisciplinary study program to the needs (both with respect to the time available and the contents) according to personal interests and job perspectives. This module handbook describes the modules of the degree program with respect to

- the composition of the modules,
- the number of credit points associated with the module,
- the dependencies of the modules among each other,
- the learning objectives of the module,
- the mode of control of success,
- the calculation of grades.

While the module handbook provides some necessary orientation and is meant to be a useful guide for planning the studies, the university calendar remains indispensable for obtaining accurate details about course schedules, including dates, times, and locations.

2.2.1 Finalization of a Module

Usually the final examination associated with a module covers the entire content of all courses of the module on one examination date. The module is successfully completed after passing the related examination with grade 4.0 or better; in the grading system at German universities, the grade 1.0 corresponds to the optimum grade. The weight of this grade in the calculation of the final grade is defined by the credit points of the module. Failed examinations must be repeated (see also below).

Online registration for module examinations is made via the SLE system, where the following actions are supported

- registration for examination or cancellation of registration
- inquiry about results of the examination
- compilation of a summary of grades achieved so far.

Further information on the "Studierendenportal" is available at

`https://studium.kit.edu/`

2.2.2 Regular Participation as a special form of Academic Achievement

In lectures that require active participation of students and in which students practice scientific methods (in particular practical lectures), and in lectures with a discursive character (in particular seminars) regular participation in lectures can be requested as a basis for competency acquisition.

- Regular participation is assumed if the student has attended at least 80% of the lecture hours.
- If attendance is less than 80%, it is assumed that the student has not attended regularly. This assumption can be refuted in individual cases (e.g., illness). In such cases, the lecturer shall, at the student's request, determine which further contributions are to be made by the student in addition to attendance in order to achieve the qualification objective(s).
- If attendance is less than 60%, it is assumed that successful participation is excluded.

The following modules require active participation:

- Basics of Estimation Theory and its Application in Geoscience Remote Sensing
- Fundamentals in Remote Sensing, Image Processing and Computer Vision
- Geoinformatics
- Hyperspectral Remote Sensing
- Mobile GIS / Location Based Services
- Remote Sensing of the Atmosphere
- SAR and InSAR Remote Sensing
- Tomographic Laser- and Radar Sensing

2.2.3 Repetition of Examinations

Possibilities of repetition of examinations are described in §8 of the "Studien- und Prüfungsordnung des Karlsruher Instituts für Technologie (KIT) für den Masterstudiengang Remote Sensing and Geoinformatics".

2.2.4 Choices of Modules

Within topics there are compulsory modules and compulsory elective modules. The compulsory modules are associated with fewer credit points than required for the completion of the topic. The missing credit points can be obtained by compulsory elective modules of this topic of the student's choice.

Each student selects one out of six profiles. As described above for topics in a general sense, each profile contains compulsory and elective modules. The total number of ECTS points from this profile shall be at least 20 in two semesters, whereof 10 have to be gained in the compulsory modules and 10 in the compulsory elective modules.

Knowledge of a second European language besides English is of great use to improve job market perspectives. Within the topic "Key Competences Modules" participation in a language course is highly recommended; for students with no or limited knowledge of German, a German-language course would be advisable. Further, participation in at least one seminar course is compulsory, regardless of which topic the seminar is assigned to. Beyond this, modules from any other profile or modules offered by other degree programs can be selected as part of the topic "Supplementary Modules". This shall foster interdisciplinarity, but in order to avoid too extravagant choices, approval by the Examination Committee is required.

2.2.5 Voluntary Modules / Additional Examinations

The purpose of voluntary modules is to develop a better interdisciplinary view and to develop competences overarching over specific fields. The grades of voluntary modules are not relevant for the final grade. When the student registers for the examination of a voluntary module, this has

to be indicated as such. Retroactive rebooking of credit points and grades achieved for voluntary modules to compulsory modules, compulsory elective modules or elective modules is not possible. No more than 30 credit points can be acquired for voluntary modules.

2.2.6 Preliminary Examinations

The possibility of preliminary examinations ("Mastervorzugsleistungen") is regulated by the "Studien- und Prüfungsordnung des Karlsruher Instituts für Technologie (KIT) für den Masterstudiengang Remote Sensing and Geoinformatics". Since winter term 2022/23, students of KIT's bachelor degree program "Geodäsie und Geoinformatik" are allowed to take all prequalifications/exams of KIT's master degree program "Remote Sensing and Geoinformatics".

2.2.7 More Details

Information on all legal and official details of this master program are provided by the study regulations ("Studienordnung") and the examination regulations ("Prüfungsordnung").

2.3 Overview over the Structure of the Program and the Courses

The total sum of credit points (CP) is 120. They are distributed over the courses as follows:

- **Remote Sensing 21 CP**
- **Mathematics and Beyond 17 CP**
- **Profile Courses 20 CP**
  - Choice of 1 out of 6 profile courses, 20 CP.
  - Each profile contains compulsory (10 CP) and optional (10 CP) modules.
- **Supplementary Modules 8 CP**
- **Lab Rotation 20 CP**
- **Key Competences 4 CP**
- **Master Thesis 30 CP**

Commencement of studies in the winter semester is recommended. However, there is no mandatory sequence for most modules, thus commencement in the summer semester is also possible. An exemplary study plan of the study program MSc 'Remote Sensing and Geoinformatics (begin winter semester) can be found for the exemplary profile choice 'Profile 5: Geoinformatics and Environmental Geodesy' in Section 2.7.

2.4 Overview over the modules and examination modes

In each profile, the required number of CPs is 10 for compulsory modules and 10 for compulsory elective modules.

Topic: **Remote Sensing**			
Module		CP	Examination mode
RSGI-MRRIC	Fundamentals in Remote Sensing, Image Processing and Computer Vision	6	oral, graded
GEOD-MAGI-2	Geoinformatics	5	oral, graded
RSGI-MRRA	Remote Sensing of the Atmosphere	5	oral, graded
RSGI-MRFE	Fundamentals of Environmental Geodesy	5	oral, graded

Topic: **Mathematics and Beyond**			
Module		CP	Examination mode
GEOD-MANM-2	Numerical Mathematics	6	written, graded
RSGI-MMCM-3	Estimation and Signal Theory for Geosciences	8	oral, graded
In addition, within the compulsory module 'Scientific Programming' a total of 3 or more CPs have to be acquired.			
RSGI-MMCE-1	Scientific Programming	3	not graded

Topic: **Profiles** (Choice of 1 out of 6)			
Module		CP	Examination mode
1: Computer Vision and Geoinformatics	2 compulsory modules plus ~ 3 compulsory elective modules	20	see module description
2: Computer Vision and Remote Sensing of the Atmosphere	2 compulsory modules plus ~ 3 compulsory elective modules	20	see module description
3: Computer Vision and Environmental Geodesy	2 compulsory modules plus ~ 4 compulsory elective modules	20	see module description
4: Geoinformatics and Remote Sensing of the Atmosphere	2 compulsory modules plus ~ 3 compulsory elective modules	20	see module description
5: Geoinformatics and Environmental Geodesy	2 compulsory modules plus ~ 3 compulsory elective modules	20	see module description
6: Remote Sensing of the Atmosphere and Environmental Geodesy	2 compulsory modules plus ~ 3 compulsory elective modules	20	see module description

Topic: **Supplementary Modules**			
Module		CP	Examination mode
Choice of modules summing up to 8 CP	$\sim 2-4$ elective modules	8	see module description

Topic: **Key Competences**			
Module		CP	Examination mode
Choice of modules summing up to 4 CP	~ 2 elective modules	4	see module description

Topic: **Lab Rotation**			
Module		CP	Examination mode
Choice of 2 Lab Rotations	2×10 CP	20	other according to SPO RSGI §4/2

Topic: **Master Thesis**			
Module		CP	Examination mode
Master Thesis	6 months	30	Thesis

The courses offered in the degree program are continuously adapted - e.g. with a special focus on the demands of the working world. As a rule, frequent changes to the modules are not to be expected. However, the courses with the associated assessments or the type of module examination may change. Where possible, such changes will be announced in the module handbook with sufficient advance notice and marked accordingly (yellow color) in sect. 4, at the latest at the beginning of the semester in which they are applied for the first time. As a basic rule, students

who have started a module can complete it in the form in which they started it (protection of confidence). The corresponding performance assessments will continue to be offered for a certain period of time - usually at least one semester after the date of the change. In the event that a performance assessment is no longer offered or is offered in a modified form, consultation with the examiner is highly recommended.

2.5 Accreditation of external accomplishments

2.5.1 Accreditation of qualifications obtained outside of the Higher Education System

Accomplishments obtained outside of the higher education system, for example vocational training, can be accredited if the acquired competences contribute to the qualification goals of the MSc program. At maximum, 50% of the university credits can be replaced. A request for accreditation can be submitted to the exams committee (Prüfungsausschuss). The request must be submitted within the first academic semester. The exams committee verifies to which extent the acquired competences can be accredited, and which parts of the program they can replace. A form is available for this purpose on the web page of the MSc programme (link) that can be used for the accreditation of externally obtained competences as equivalent to one or several of the modules in the programme, and for competences complementary to the program, but contributing to the general qualification goals. Further details can be found in §18 of the current studies and examination regulations (see https://www.sle.kit.edu, 'Statutes and regulations').

2.5.2 Accreditation of qualifications obtained inside of the Higher Education System

Accomplishments obtained at other universities, for example credits from another MSc program or Eucor (The European Campus is a trinational alliance of five universities in the Upper Rhine), can be accredited if the acquired competences contribute to the qualification goals of the MSc program. A request for accreditation can be submitted to the exams committee (Prüfungsausschuss). The request must be submitted within the first academic semester. The exams committee verifies to which extent the acquired competences can be accredited, and which parts of the program they can replace. A form is available for this purpose on the web page of the MSc programme (link) that can be used for the accreditation of externally obtained competences as equivalent to one or several of the modules in the programme, and for competences complementary to the program, but contributing to the general qualification goals. Further details can be found in §18 of the current studies and examination regulations (see https://www.sle.kit.edu, 'Statutes and regulations').

2.5.3 Study abroad during the programme

The lab rotations (semester 3) can be completed abroad, and other qualifications obtained in other countries can be accredited as well. Before going abroad, a student will set up a learning agreement together with the student counseller of the programme (Michael Mayer), which the exams committee (Prüfungsausschuss) will then agree to, and modify where necessary. The form for accreditation of external accomplishments is available on the programme web page. For specific questions, any lecturer can be contacted. For general enquiries, please check the respective web site of the department (Erasmus+Studies) or talk to the student counseller of the programme. Please note that there are deadlines for applying for funded exchange programs.

2.6 Students with a Disability or Chronic Disease (§13, SPO)

(1) When organizing degree programs and examinations, the needs of students with a disability or chronic disease are to be considered. In particular, students with a disability or chronic disease are to be granted preferred access to courses with a limited number of participants and the order for passing certain courses shall be adapted to their needs. According to the Federal Equality Act (Bundesgleichstellungsgesetz, BGG) and Vol. 9 of the Social Code (SGB IX), students are disabled, if their bodily function, mental capacity, or emotional health most probably deviates from the state typical of the age for a period longer than six months and, hence, their participation in social life is impaired. At the request of the student, the examination committee shall decide on the existence of conditions outlined in clauses 2 and 3. The student shall submit the required evidence for this purpose. (2) If a student provides evidence of a disability or chronic disease, as a result of which she/he is not able to pass examinations completely or partly within the planned time or in the form envisaged, the examination committee may permit examinations within other time periods or in another form. In particular, disabled students shall be permitted to use the required aids. (3) In case students provide evidence of a disability or chronic disease, a a result of which they are not able to attend courses regularly or to pass the required coursework or examinations as outlined in Article 19, the examination committee may permit at the student's request passing of certain coursework and examinations after the expiry of the deadlines given in the present Regulations for Study and Examination.

Chapter 3

Qualification Goals of the Program

General Issues

Goals of qualification generally describe

- the subject-specific and overarching competences which students can acquire in this program
- which learning outcomes can/should be achieved during the studies in this program. These learning outcomes are specified on three levels. First on the level of the master program, and then on the levels of modules and courses. They describe competences and verifiable learning outcomes.

Subject-specific competences are related to fundamental as well as specific knowledge and understanding with respect to methods, tenets, concepts and working approaches in the field of remote sensing and geoinformatics. Overarching competences are basic as well as specific competences which are applicable in multiple fields and disciplines and which do not depend on a specific subject. Typical examples are soft skills like the ability of teamwork and of networked thinking, communication skills and so forth.
Learning outcomes describe the success of the learning/studying which is testable by examinations and allow to determine the level up to which the competence has been formed and developed during the studies.

3.1 Qualification Goals

In this master's degree program the scientific qualification acquired in related bachelor programs are deepened and complemented. The goal of this program is to convey the ability to independently apply scientific knowledge and methods and to evaluate their implications and relevance to the solution of complex scientific problems.

The degree holders of the master program Remote Sensing and Geoinformatics have profound knowledge in current and future-oriented technologies and methods related to the processing and analysis of spatially and temporally resolved geoscientific and remotely sensed data. They have detailed technical and methodical knowledge in remote sensing and geoinformatics and have in-depth insight into selected professional fields for remote sensing scientists and geo-information scientists. Based on broad basic knowledge, they have the ability to identify, characterize and elaborate future scientific and technical key questions with innovation potential in the given subject area. They have actively developed the ability to methodically explore knowledge sources,

and are thus capable of acquainting themselves with advanced research problems.

They have the comprehensive ability to autonomously analyze and evaluate tasks in the field of remote sensing and geoinformatics and to implement related practical solutions. They can, under consideration of a particular situation, select the adequate methods, apply them in a targeted and problem-solving fashion, and to evaluate them critically. They have the ability to put the knowledge gained to work both in their own field as well as in an interdisciplinary context. The degree holders have proven to be able to collect and pre-select all relevant information, particularly in complex situations, to analyze and evaluate this information, to process, characterize, document, visualize relevant data and to present results in a compelling manner. They can familiarize themselves independently with current research topics and complex problems and thoroughly analyze, interpret and evaluate them. They have the ability to autonomously develop and implement concepts to tackle problems they have identified and analyzed. They classify subject-specific and interdisciplinary tasks and identify, or, if need be, develop, adequate methods of measurement, data analysis and processing as well as data characterization.

They are able to extensively document, compile, illustrate and interpret results in a goal-oriented manner. They have the ability to work both independently or in a team and can take leadership in interdisciplinary projects. They can thoroughly explore technical literature in English, bring forward their argument and defend their stance in topical discussions both with specialists and laypersons in an adequate language. In the application of their topic-related knowledge they consider societal, scientific, and ethical issues.

The qualification targets of the master program Remote Sensing and Geoinformatics are summarized in the following table in a structured manner. Then follow the qualification targets and learning outcomes on module and course levels.

The following abbreviations are used:
DQR: Deutscher Qualifikationsrahmen
QZ-Nr: Qualifikationszielnummer

DQR	QZ-Nr.	Qualification targets on program level	Module
Subject-specific competences "Knowledge and Understanding"			
Subject-specific competence: broadening of knowledge	1	The degree holder has profound knowledge in current and future-oriented techniques and methods for processing, characterization and analysis of spatially and temporally resolved geoscientific and remotely sensed data	all
	2	The student has detailed technical and methodical knowledge in remote sensing and geoinformatics and has in-depth insight into selected professional fields for remote sensing scientists and geoinformation	all

		scientists.	
Subject-specific competence: deepening of knowledge	3	Based on broad basic knowledge the degree holder can identify, describe and tackle advanced scientific questions with innovation potential in the given subject area.	all, particularly modules of the profiles
	4	The student has actively developed the ability to methodically explore knowledge sources, is thus capable to acquaint themselves with advanced research problems.	all seminars lab rotations master thesis
Instrumental competence	5	The student has the comprehensive ability to analyze and evaluate tasks in the field of remote sensing and geoinformatics and to implement related practical solutions.	lab rotations master thesis
	6	The student can, under consideration of a particular situation, select the adequate methods, apply them in a targeted and problem-solving fashion, and evaluate them critically.	seminars lab rotations master thesis
	7	The student has the ability to put the knowledge gained to work both in their own field as well as in an interdisciplinary context.	all
System Competence	8	The degree holder has proven to be able to collect and pre-select all relevant information, particularly in complex situations, to analyze and evaluate this information, to process, characterize, document, visualize relevant data and to present results in a compelling manner.	all, particularly seminars
	9	The student can familiarize themselves independently with current research topics and complex problems and thoroughly analyze, interpret and evaluate them.	seminars lab rotations master thesis
	10	The student has the ability to develop and implement concepts to tackle problems.	seminars lab rotations master thesis
	11	The student classifies subject-specific and interdisciplinary tasks and identifies adequate methods of measurement, data analysis and data processing as well as data characterization.	lab rotations master thesis
	12	The student is able to extensively document, complile, illustrate and interpret results in a targeted manner.	seminars lab rotations scientific writing master thesis

	13	In the application of the topical knowledge the student considers societal, scientific and ethical aspects.	all
Communication skills	14	The student has the ability to work both independently or in teams and can take leadership in interdisciplinary projects.	projects lab rotations master thesis
	15	The student can thoroughly explore technical literature in the English language.	all
	16	The student has the ability to bring forward their argument and defend their stance in topical discussions both with specialists and laypersons in adequate language.	seminars

Chapter 4

Overview Over the Courses of the Modules and Modes of Examination

4.1 Remote Sensing

All modules are compulsory							
Module	Course No	Course	Sem.	Contact hours	CP	Condition for admission to examination	Examination type and duration
Fundamentals of Remote Sensing, Image Processing and Computer Vsision RSGI-MRRIC	6048101/ 6048102	Methods of Remote Sensing	WS	1+1	3	Yes: Successful participation in exercise	oral ∼30 min.
	6042101/ 6042102	Image Processing and Computer Vision	WS	2+1	3	No	
Geo-informatics GEOD-MAGI-2	6022105/ 6022106	Geoinformatics Part A	WS	1+1	5	Yes: Successful participation in both exercises	oral ∼30 min.
	6022205/ 6022206	Geoinformatics Part B	SS	1+1			
Remote Sensing of the Atmosphere RSGI-MRRA	6043106/ 6043107	Satellite Climatology: Remote Sensing of a Changing Climate	SS	2+1	3	Yes: Successful participation in both exercises	oral ∼20 min.
	6020247	Atmospheric Remote Sensing Infrastructures	SS	1	2		
Fundamentals of Environmental Geodesy RSGI-MRFE	6021201/ 6021202	Fundamentals of Environmental Geodesy Part A	WS	1+1	5	Yes: Successful participation in both exercises	oral ∼30 min.
	6020151	Fundamentals of Environmental Geodesy Part B	SS	1+1			

From summer semester 2024 on, the course 'Sensors and Signals in Computer Vision and Remote Sensing' is further developed and moved from the module 'Fundamentals of Remote Sensing, Image Processing and Computer Vision' (formerly named 'Remote Sensing and Computer

Vision') to the module 'Estimation and Signal Theory for Geosciences' (formerly named 'Basics of Estimation Theory and its Application in Geoscience Remote Sensing', see chapter 4.2). The module composition described in chapters 4.1 and 4.2 is valid for all students starting the MSc program 'Remote Sensing and Geoinformatics' from the summer term 2024 on.

4.2 Mathematics and Beyond

All modules are compulsory; particular courses within 'Scientific Programming' are elective							
Module	Course No	Course	Sem.	contact hours	CP	Condition for Admission to Examination	Examination Type and Duration
Numerical Mathematics GEOD-MANM-2	6062101/ 6062102	Numerical Mathematics	WS	3+1	6	Yes: Successful participation in exercises	written 60 min.
Estimation and Signal Theory for Geosciences RSGI-MMCM-3	6043210/ 6043211	Data Analysis in Geoscience Remote Sensing Projects	WS	1+2	3	Yes: Successful participation in exercises	not graded
	6022208	Basics of Estimation Theory	SS	1+1	3	Yes: Successful participation in exercises	oral ∼30 min.
	6042201	Sensors and Signals in Computer Vision and Remote Sensing	SS	2+0	2	No	
Scientific Programming RSGI-MMCE-1	6224907	Introduction to Matlab	WS / SS	2	3	course achievement	not graded

Students who have little programming experience regarding matlab/python are strongly encouraged to attend a course where they can deepen these skills (e.g., Introduction to Matlab, listed in table above). It is strongly recommended to take a programming-related course in the first semester, therefore in summer as well as in winter terms a Matlab lecture is provided.
Instead of focusing on Matlab, students are allowed to take the winter term lecture Introduction to Python (module number 106199).
Students who have more advanced programming skills and therefore wish to attend another course are advised to consult with the student advisor of the study program. From summer semester 2024 on, the course 'Sensors and Signals in Computer Vision and Remote Sensing' is further developed and moved from the module 'Fundamentals of Remote Sensing, Image Processing and Computer Vision' (formerly named 'Remote Sensing and Computer Vision', see chapter 4.1) to the module 'Estimation and Signal Theory for Geosciences' (formerly named 'Basics of Estimation Theory and its Application in Geoscience Remote Sensing'). The module composition described in chapters 4.1 and 4.2 is valid for all students starting the MSc program 'Remote Sensing and Geoinformatics' from the summer term 2024 on.

4.3 Profile Courses

1 out of 6 profile has to be selected (Each of the 6 profiles is actually a combination of 2 out of 4 sub-profiles).

Sub-profiles:

- Computer Vision
- Geoinformatics
- Remote Sensing of the Atmosphere
- Environmental Geodesy

In addition to the listed modules, in each profile there are gradded and ungradded Place Holders available in order to be able to integrate further modules.

4.3.1 Profile: Computer Vision and Geoinformatics

Module	Course No	Course	Sem.	Contact hours	CP	Condition for admission to examination	Examination type and duration
RSGI-M-P-CV							
Compulsory Modules							
Advanced Topics in Computer Vision RSGI-MPCV-1	6042103	Advanced Topics in Computer Vision	WS	4	5	Yes: Successful participation in exercises	oral $\sim$ 20 min
GeoDB GEOD-MPGI-1	6026101/ 6026102	GeoDB	WS	2+1	5	Yes: Successful participation in exercises	oral ~ 20 min.
Compulsory **Elective** Modules							
Seminar Topics of Image Analysis GEOD-MWEB-1	6042201	Seminar Topics of Image Analysis	WS	1+0	2	No	other according to SPO RSGi §4/2
Active Sensors for Computer Vision GEOD-MWEB-3	6043205	Active Sensors for Computer Vision	SS	2+0	3	No	oral $\sim$ 15 min
Tomographic Laser- and Radar Sensing GEOD-MWCV-8	6043212/ 6043213	Tomographic Laser- and Radar Sensing	SS	1+1	3	Yes: Successful Participation In Exercise	oral $\sim$ 20 min
Augmented Reality GEOD-MWGI-8	6026107/ 6026108	Augmented Reality	WS	1+2	4	Yes: Successful Participation In Exercise	oral $\sim$ 20 min
3D / 4D GIS GEOD-MPGI-2	6026201/ 6026202	3D / 4D GIS	SS	2+1	4	Yes: Successful participation in exercises	oral ~ 20 min.
Mobile GIS / Location Based Services GEOD-MWGI-2	6026206/ 6026207	Mobile GIS / Location Based Services	SS	1+1	3	No	not graded
Deep Learning for Computer Vision and Remote Sensing GEOD-MWCV-12	6041202/ 6041203	Deep Learning for Computer Vision and Remote Sensing	SS	2+2	5	Yes: Successful participation in exercises	oral ~ 30 min.

4.3.2 Profile: Computer Vision and Remote Sensing of the Atmosphere

Module	Course No	Course	Sem.	Contact hours	CP	Condition for admission to examination	Examination type and duration
RSGI-M-P-CV							
Compulsory Modules							
Advanced Topics in Computer Vision RSGI-MPCV-1	6042103	Advanced Topics in Computer Vision	WS	4	5	Yes: Successful participation in exercises	oral $\sim$ 20 min
Remote Sensing of Atmospheric Temperature, Trace Gases, Clouds, and Aerosols RSGI-MPRA	6042202	Passive Remote Sensing of Atmospheric Temperature and Composition	WS	1.5+ 0.5	2	Yes: Successful participation in exercises of course 2	oral ~ 30 min.
	6020250	Remote Sensing of Aerosols and Clouds	SS	1+1	3		
Compulsory **Elective** Modules							
Seminar Topics of Image Analysis GEOD-MWEB-1	6042201	Seminar Topics of Image Analysis	WS	1+0	2	No	other according to SPO RSGi §4/2
Active Sensors for Computer Vision GEOD-MWEB-3	6043205	Active Sensors for Computer Vision	SS	2+0	3	No	oral $\sim$ 15 min
Tomographic Laser- and Radar Sensing GEOD-MWCV-8	6043212/ 6043213	Tomographic Laser- and Radar Sensing	SS	1+1	3	Yes: Successful Participation In Exercise	oral $\sim$ 20 min
Augmented Reality GEOD-MWGI-8	6026107/ 6026108	Augmented Reality	WS	1+2	4	Yes: Successful Participation In Exercise	oral $\sim$ 20 min
Deep Learning for Computer Vision and Remote Sensing GEOD-MWCV-12	6041202/ 6041203	Deep Learning for Computer Vision and Remote Sensing	SS	2+2	5	Yes: Successful participation in exercises	oral ~ 30 min.

Module	Course No	Course	Sem.	Contact hours	CP	Condition for admission to examination	Examination type and duration
Compulsory **Elective** Modules continued							
Atmospheric Spectroscopy and Middle Atmospheric Research RSGI-MPRA-3	6048211	The Middle Atmosphere: Processes and Research Methods	SS	2	2	No	oral ~ 30 min.
	6048210	Atmospheric Radiation	SS	2	2		

The course 'The Middle Atmosphere: Processes and Research Methods' was in former semester called 'Atmospheric Spectroscopic Measurements'.

4.3.3 Profile: Computer Vision and Environmental Geodesy

Module	Course No	Course	Sem.	Contact hours	CP	Condition for admission to examination	Examination type and duration
RSGI-M-P-CV							
Compulsory Modules							
Advanced Topics in Computer Vision RSGI-MPCV-1	6042103	Advanced Topics in Computer Vision	WS	4	5	Yes: Successful participation in exercises	oral $\sim$ 20 min
Geodetic Earth Observation RSGI-MPEG-1	6042204	Mass Variations	WS	1+1	5	Yes: Successful participation in both exercises	oral ~ 30 min.
	6019404	Deformation Processes	SS	1+1			
Compulsory **Elective** Modules							
Seminar Topics of Image Analysis GEOD-MWEB-1	6042201	Seminar Topics of Image Analysis	WS	1+0	2	No	other according to SPO RSGi §4/2
Active Sensors for Computer Vision GEOD-MWEB-3	6043205	Active Sensors for Computer Vision	SS	2+0	3	No	oral $\sim$ 15 min
Tomographic Laser- and Radar Sensing GEOD-MWCV-8	6043212/ 6043213	Tomographic Laser- and Radar Sensing	SS	1+1	3	Yes: Successful Participation In Exercise	oral $\sim$ 20 min
Augmented Reality GEOD-MWGI-8	6026107/ 6026108	Augmented Reality	WS	1+2	4	Yes: Successful Participation In Exercise	oral $\sim$ 20 min
Scientific Applications of GNSS RSGI-MPEG-3	6048209	Scientific Applications of GNSS	SS	0+2	3	No	other according to SPO RSGI §4/2
Advanced Gravity Field Modelling RSGI-MPEG-4	6042205	Advanced Gravity Field Modelling	WS	1+1	3	Yes: successful participation in exercises	oral ~ 20 min.
SAR and InSAR Remote Sensing RSGI-MPEG-6	6025201/ 6025202	SAR and InSAR Remote Sensing	SS	1+1	3	Yes: successful participation in exercises	oral ~ 20 min.

Module	Course No	Course	Sem.	Contact hours	CP	Condition for admission to examination	Examination type and duration
Compulsory **Elective** Modules continued							
Recent Earth Observation Programs and Systems GEOD-MWCV-7	6048201	Recent Earth Observation Programs and Systems	SS	1+0	2	No	other according to SPO RSGI §4/2
Hyperspectral Remote Sensing GEOD-MPEA-1	6047101/ 6047102	Hyperspectral Remote Sensing	WS	1+1	3	Yes: Successful participation in exercises	oral ~ 20 min
Seminar Topics of Remote Sensing GEOD-MWEA-1	6020252	Seminar Topics of Remote Sensing	SS	1+0	2	No	other according to SPO RSGI §4/2
Seminar Environmental Geodesy RSGI-MPEG-2	6048208	Seminar Environmental Geodesy	SS	0+2	2	No	other according to SPO RSGI §4/2
Deep Learning for Computer Vision and Remote Sensing GEOD-MWCV-12	6041202/ 6041203	Deep Learning for Computer Vision and Remote Sensing	SS	2+2	5	Yes: Successful participation in exercises	oral ~ 30 min.
Integrated Geodetic Earth Observing Systems GEOD-MPGF-5	6000301	Integrated Geodetic Earth Observing Systems	WS	1+1	3	Yes: successful participation in exercises	oral ~ 20 min.

'Integrated Geodetic Earth Observing Systems' replaces 'Geodetic Sensor Fusion' from winter term 2024/25 on.

4.3.4 Profile: Geoinformatics and Remote Sensing of the Atmosphere

Module	Course No	Course	Sem.	Contact hours	CP	Condition for admission to examination	Examination type and duration
RSGI-M-P-GI							
Compulsory Modules							
GeoDB GEOD-MPGI-1	6026101/ 6026102	GeoDB	WS	2+1	5	Yes: Successful participation in exercises	oral ∼ 20 min.
Remote Sensing of Atmospheric Temperature, Trace Gases, Clouds, and Aerosols RSGI-MPRA	6042202	Passive Remote Sensing of Atmospheric Temperature and Composition	WS	1.5+ 0.5	2	Yes: Successful participation in exercises of course 2	oral ∼ 30 min.
	6020250	Remote Sensing of Aerosols and Clouds	SS	1+1	3		
Compulsory **Elective** Modules							
3D / 4D GIS GEOD-MPGI-2	6026201/ 6026202	3D / 4D GIS	SS	2+1	4	Yes: Successful participation in exercises	oral ∼ 20 min.
Mobile GIS / Location Based Services GEOD-MWGI-2	6026206/ 6026207	Mobile GIS / Location Based Services	SS	1+1	3	No	not graded
Atmospheric Spectroscopy and Middle Atmospheric Research RSGI-MPRA-3	6048211	The Middle Atmosphere: Processes and Research Methods	SS	2	2	No	oral ∼ 30 min.
	6048210	Atmospheric Radiation	SS	2	2		
Deep Learning for Computer Vision and Remote Sensing GEOD-MWCV-12	6041202/ 6041203	Deep Learning for Computer Vision and Remote Sensing	SS	2+2	5	Yes: Successful participation in exercises	oral ∼ 30 min.
Seminar Topics of Remote Sensing GEOD-MWEA-1	6020252	Seminar Topics of Remote Sensing	SS	1+0	2	No	other according to SPO RSGI §4/2

The course 'The Middle Atmosphere: Processes and Research Methods' was in former semester called 'Atmospheric Spectroscopic Measurements'.

4.3.5 Profile: Geoinformatics and Environmental Geodesy

Module	Course No	Course	Sem.	Contact hours	CP	Condition for admission to examination	Examination type and duration
RSGI-M-P-GI							
Compulsory Modules							
GeoDB GEOD-MPGI-1	6026101/ 6026102	GeoDB	WS	2+1	5	Yes: Successful participation in exercises	oral ~ 20 min.
Geodetic Earth Observation RSGI-MPEG-1	6042204	Mass Variations	WS	1+1	5	Yes: Successful participation in both exercises	oral ~ 30 min.
	6019404	Deformation Processes	SS	1+1			
Compulsory **Elective** Modules							
3D / 4D GIS GEOD-MPGI-2	6026201/ 6026202	3D / 4D GIS	SS	2+1	4	Yes: Successful participation in exercises	oral ~ 20 min.
Mobile GIS / Location Based Services GEOD-MWGI-2	6026206/ 6026207	Mobile GIS / Location Based Services	SS	1+1	3	No	not graded
Scientific Applications of GNSS RSGI-MPEG-3	6048209	Scientific Applications of GNSS	SS	0+2	3	No	other according to SPO RSGI §4/2
Advanced Gravity Field Modelling RSGI-MPEG-4	6042205	Advanced Gravity Field Modelling	WS	1+1	3	Yes: successful participation in exercises	oral ~ 20 min.
SAR and InSAR Remote Sensing RSGI-MPEG-6	6025201/ 6025202	SAR and InSAR Remote Sensing	SS	1+1	3	Yes: successful participation in exercises	oral ~ 20 min.
Hyperspectral Remote Sensing GEOD-MPEA-1	6047101/ 6047102	Hyperspectral Remote Sensing	WS	1+1	3	Yes: Successful participation in exercises	oral ~ 20 min
Seminar Environmental Geodesy RSGI-MPEG-2	6048208	Seminar Environmental Geodesy	SS	0+2	2	No	other according to SPO RSGI §4/2

Module	Course No	Course	Sem.	Contact hours	CP	Condition for admission to examination	Examination type and duration
Compulsory **Elective** Modules continued							
Recent Earth Observation Programs and Systems GEOD-MWCV-7	6048201	Recent Earth Observation Programs and Systems	SS	1+0	2	No	other according to SPO RSGI §4/2
Seminar Topics of Remote Sensing GEOD-MWEA-1	6020252	Seminar Topics of Remote Sensing	SS	1+0	2	No	other according to SPO RSGI §4/2
Integrated Geodetic Earth Observing Systems GEOD-MPGF-5	6000301	Integrated Geodetic Earth Observing Systems	WS	1+1	3	Yes: successful participation in exercises	oral ~ 20 min.

'Integrated Geodetic Earth Observing Systems' replaces 'Geodetic Sensor Fusion' from winter term 2024/25 on.

4.3.6 Profile: Remote Sensing of the Atmosphere and Environmental Geodesy

Module	Course No	Course	Sem.	Contact hours	CP	Condition for admission to examination	Examination type and duration
RSGI-M-P-RA							
Compulsory Modules							
Remote Sensing of Atmospheric Temperature, Trace Gases, Clouds, and Aerosols RSGI-MPRA	6042202	Passive Remote Sensing of Atmospheric Temperature and Composition	WS	1.5+ 0.5	2	Yes: Successful participation in exercises of course 2	oral ∼ 30 min.
	6020250	Remote Sensing of Aerosols and Clouds	SS	1+1	3		
Geodetic Earth Observation RSGI-MPEG-1	6042204	Mass Variations	WS	1+1	5	Yes: Successful participation in both exercises	oral ∼ 30 min.
	6019404	Deformation Processes	SS	1+1			
Compulsory **Elective** Modules							
Atmospheric Spectroscopy and Middle Atmospheric Research RSGI-MPRA-3	6048211	The Middle Atmosphere: Processes and Research Methods	SS	2	2	No	oral ∼ 30 min.
	6048210	Atmospheric Radiation	SS	2	2		
Scientific Applications of GNSS RSGI-MPEG-3	6048209	Scientific Applications of GNSS	SS	0+2	3	No	other according to SPO RSGI §4/2
Advanced Gravity Field Modelling RSGI-MPEG-4	6042205	Advanced Gravity Field Modelling	WS	1+1	3	Yes: successful participation in exercises	oral ∼ 20 min.
SAR and InSAR Remote Sensing RSGI-MPEG-6	6025201/ 6025202	SAR and InSAR Remote Sensing	SS	1+1	3	Yes: successful participation in exercises	oral ∼ 20 min.
Seminar Environmental Geodesy	6048208	Seminar Environmental Geodesy	SS	0+2	2	No	other according to SPO RSGI §4/2

Module	Course No	Course	Sem.	Contact hours	CP	Condition for admission to examination	Examination type and duration
Compulsory **Elective** Modules continued							
Recent Earth Observation Programs and Systems GEOD-MWCV-7	6048201	Recent Earth Observation Programs and Systems	SS	1+0	2	No	other according to SPO RSGI §4/2
Hyperspectral Remote Sensing GEOD-MPEA-1	6047101/ 6047102	Hyperspectral Remote Sensing	WS	1+1	3	Yes: Successful participation in exercises	oral ~ 20 min
Seminar Topics of Remote Sensing GEOD-MWEA-1	6047203	Seminar Topics of Remote Sensing	SS	1+0	2	No	other according to SPO RSGI §4/2
Integrated Geodetic Earth Observing Systems GEOD-MPGF-5	6000301	Integrated Geodetic Earth Observing Systems	WS	1+1	3	Yes: successful participation in exercises	oral ~ 20 min.

'Integrated Geodetic Earth Observing Systems' replaces 'Geodetic Sensor Fusion' from winter term 2024/25 on.

The course 'The Middle Atmosphere: Processes and Research Methods' was in former semester called 'Atmospheric Spectroscopic Measurements'.

4.4 Supplementary Modules

Supplementary Modules enable individual subject-specific deepening of knowledge and competencies.

4.4.1 Seminars

Each student shall successfully participate in at least one seminar. Those, who have no seminar in their profiles, can do this under "Supplementary Modules" as compulsory elective.

From winter term 2024/25 on, the Seminar "Remote Sensing and Geoinformatics" (M-BGU-106896 - Seminar Remote Sensing and Geoinformatics) is offered each semester.

Seminars offered by other faculties may be eligible. Approval by the examination commission is required.

4.4.2 Programming Skills

Within the MSc degree program and the working area "Remote Sensing and Geoinformatics" programming skills are essential. In addition during the last years, the lecturers of "Remote Sensing and Geoinformatics" have noticed in recent years, that student's performance in exercises often suffers from weak programming skills. Therefore, we have integrated lectures that address basic programming skills in an application-oriented manner. In particular, there are lectures on MATLAB and on Python. The lecturers of "Remote Sensing and Geoinformatics" strongly recommend every student to reflect on their personal programming skills (e.g., based on the learning outcomes of the MATLAB and the Python lectures). To catch up on programming skills, both lectures should be taken at an early stage of the studies. At least one has to be taken as mandatory part of Mathematics and Beyond (see, Chapter 4.2).

4.4.3 Other

Supplementary modules from any profile of this master program or the other master programs of KIT-Department of Civil Engineering,Geo and Environmental Sciences for can be chosen. Modules from programs of other faculties or international summer/autumn/winter/spring schools can be chosen but need approval by the RSGI Examination Commission.

4.5 Lab Rotation

By means of 'Lab Rotations' students will get insight in research-related lab work, deepen their subject-related knowledge, and improve their scientific-related working principles (e.g., writing, self-organization). Therefore, students choose individually for each Lab Rotation a scientific topic. This topic can either be

- proposed by students or
- selected from a list of lecturer's suggestions (ILIAS-link) or
- developed jointly (lecturer and student).

Therefore, during 'Lab Rotations' students work on a selected topic in a research group and gain important insights into scientific work. The research group is represented by a supervisor being part of the research group. The supervisor can be

- a person, who is part of the teaching unit 'Remote Sensing and Geoinformatics' or
- a person, who is not part of the teaching unit 'Remote Sensing and Geoinformatics'.

'Lab Rotations' at institutions outside of the teaching unit 'Remote Sensing and Geoinformatics'

- need a person, who is part of the teaching unit 'Remote Sensing and Geoinformatics' as co-supervisor and
- have to be accepted by the examination commission of MSc 'Remote Sensing and Geoinformatics' before the 'Lab Rotation' starts.

In order to achieve a high degree of attractiveness for non-KIT organizations, a combination of both 'Lab Rotations' is possible.

Module	Course	Sem.	CP	Condition for admission to examination	Examination type and duration
Lab Rotation I RSGI-ML-1	Lab Rotation I	WS/SS	10	45 CPs from compulsory or compulsory elective modules	other according to SPO RSGI §4/2
Lab Rotation II RSGI-ML-2	Lab Rotation II	WS/SS	10	45 CPs from compulsory or compulsory elective modules	other according to SPO RSGI §4/2

The grade of a 'Lab Rotation' is found based on a submitted scientific report (15-20 pages, 11 pt, Times New Roman, 1.15 spacing). The report includes, beside elaboration and discussion of the research question of the 'Lab Rotation',

- an Ethics statement,
- a personal motivation,
- a personal assessment on how the 'Lab Rotation' learning goals have been achieved and
- a summary.

After submitting the report, the student

- will give a presentation in order to inform students and the body of the teaching unit about the findings of the 'Lab Rotation' and
- creates a 'Lab Rotation' summary (PDF, at max. 1 page, including one representative figure).

4.6 Key Competences

Key Competences of the RSGI degree program have no effect on the grade of the degree program. They individually broaden existing Key Competences. A language course is highly recommended (see Section 2.2.3).

Please keep in mind, that at maximum four credits can be credited within the module 'Key Competences'. Further, micromodules offered, for example, by the

- House of Competence (e.g., Scientific Writing),
- Language Center (SZ),
- General Studies. Forum Science and Society (FORUM; formerly ZAK), and
- Academy for Responsible Research, Teaching, and Innovation (ARRTI), and
- Human Resources Development and Vocational Training (PEBA).

Please pay attention to the language of the courses; not all courses are offered in English.

The successfully performed achievements are regularly uploaded as 'Not assigned grades' into the student's account of KIT's student portal (`https://campus.studium.kit.edu/`). As of

winter semester 2021/22, Key Competences acquired at the above-mentioned KIT units are to be entered by the students themselves in the individual course scheme. Here, bricks labeled 'SelfAssignment-MScRSI*' are provided for ungraded resp. graded achievements within 'Modul M-BGU-104711 – Further Key Competences'. The title and credit points of the achievement are automatically transferred. Hereby, students have to decide whether a graded achievement is assigned to a graded or to an ungraded brick. Only graded bricks guarantee that a grade is available in the Transcript of Records. For crediting of achievements that could not be assigned, please provide the form *FormAssignmentKC*.pdf to Study Program Service at KIT's Department of Civil Engineering, Geo and Environmental Science.

4.7 Master Thesis

Module	Course	Sem.	CP	Condition for admission to examination	Examination type and duration
Master Thesis RSGI-MASR	Master Thesis	WS/SS	30	70 CPs (see SPO for details)	Thesis

For students enrolled from winter term 2024/5 on (1. Oct. 2024), in addition to the above listed condition, all modules of the mandatory part of the degree program (see sect 4.1 and sect 4.2) have to be successfully finalised.

The number of contact hours of the Master Thesis have to be individually fixed between the supervisor and the student.

The Master's thesis module is completed when both the submission of the written thesis and the presentation have taken place. The examination date is therefore the date of the later of the two events. Both dates have to be entered separately in CAS Campus. The submission date is entered in CAS when the thesis is submitted; the examination date when the grade is entered. If the Master's thesis is the last examination in the degree program, the date of graduation corresponds to the examination date of the Master's thesis. (Example: To ensure that the degree program is completed in a certain semester, not only the submission of the thesis but also the presentation must have taken place in this semester).

The maximum duration of the Master Thesis - from start to the submission - is twelve months. The effective processing time is six months.

4.8 Additional Examinations

In Additional Examinations, learning achievements, which are not taken into account in previous sections of this chapter, can be booked, in order to provide this additional information to the reader of the transcript of records. In Chapter 5.8, exemplary modules are listed.
The weight of modules listed in Additional Examinations on the final grade is zero.

5 Field of study structure

Mandatory	
Master's Thesis	30 CR
Profiles	20 CR
Lab Rotations	20 CR
Remote Sensing	21 CR
Mathematics and Beyond	17 CR
Supplementary Modules	8 CR
Key Competences	4 CR
Voluntary	
Additional Examinations *This field will not influence the calculated grade of its parent.*	

5.1 Master's Thesis

Credits
30

Mandatory		
M-BGU-104549	Master's Thesis	30 CR

5.2 Profiles

Credits 20

Profile (Election: 1 item)	
Profile: Computer Vision and Geoinformatics	20 CR
Profile: Computer Vision and Remote Sensing of the Atmosphere	20 CR
Profile: Computer Vision and Environmental Geodesy	20 CR
Profile: Geoinformatics and Remote Sensing of the Atmosphere	20 CR
Profile: Geoinformatics and Environmental Geodesy	20 CR
Profile: Remote Sensing of the Atmosphere and Environmental Geodesy	20 CR

5.2.1 Profile: Computer Vision and Geoinformatics

Part of: Profiles

Credits 20

Mandatory		
M-BGU-101041	GeoDB	5 CR
M-BGU-104531	Advanced Topics in Computer Vision	5 CR
Compulsory Elective Modules (Election: at least 10 credits)		
M-BGU-101042	3D / 4D GIS	4 CR
M-BGU-101045	Mobile GIS / Location Based Services	3 CR
M-BGU-101047	Augmented Reality	4 CR
M-BGU-101052	Tomographic Laser- and Radar Sensing	3 CR
M-BGU-101057	Seminar Topics of Image Analysis	2 CR
M-BGU-101099	Active Sensors for Computer Vision	3 CR
M-BGU-106343	Deep Learning for Computer Vision and Remote Sensing	5 CR
M-BGU-104436	Module Wildcard 1 Profile ComVisGeoinf	10 CR

5.2.2 Profile: Computer Vision and Remote Sensing of the Atmosphere

Part of: Profiles

Credits 20

Mandatory		
M-BGU-104531	Advanced Topics in Computer Vision	5 CR
M-BGU-104532	Remote Sensing of Atmospheric Temperature, Trace Gases, Clouds and Aerosols	5 CR
Compulsory Elective Modules (Election: at least 10 credits)		
M-BGU-101047	Augmented Reality	4 CR
M-BGU-101052	Tomographic Laser- and Radar Sensing	3 CR
M-BGU-101057	Seminar Topics of Image Analysis	2 CR
M-BGU-101099	Active Sensors for Computer Vision	3 CR
M-BGU-104533	Atmospheric Spectroscopy and Middle Atmospheric Research	4 CR
M-BGU-106343	Deep Learning for Computer Vision and Remote Sensing	5 CR
M-BGU-104437	Module Wildcard 1 Profile ComVisRemSen	10 CR

5.2.3 Profile: Computer Vision and Environmental Geodesy

Part of: Profiles

Credits 20

Mandatory		
M-BGU-104531	Advanced Topics in Computer Vision	5 CR
M-BGU-104536	Geodetic Earth Observation	5 CR
Compulsory Elective Modules (Election: at least 10 credits)		
M-BGU-101047	Augmented Reality	4 CR
M-BGU-101051	Hyperspectral Remote Sensing	3 CR
M-BGU-101052	Tomographic Laser- and Radar Sensing	3 CR
M-BGU-101054	Seminar Topics of Remote Sensing	2 CR
M-BGU-101057	Seminar Topics of Image Analysis	2 CR
M-BGU-101099	Active Sensors for Computer Vision	3 CR
M-BGU-101765	Recent Earth Observation Programs and Systems	2 CR
M-BGU-104537	Advanced Gravity Field Modelling	3 CR
M-BGU-104557	Seminar Environmental Geodesy	2 CR
M-BGU-104586	SAR and InSAR Remote Sensing	3 CR
M-BGU-104566	Scientific Applications of GNSS *First usage possible until Sep 30, 2025.*	3 CR
M-BGU-106343	Deep Learning for Computer Vision and Remote Sensing	5 CR
M-BGU-104438	Module Wildcard 1 Profile ComVisEnvGeo	10 CR
M-BGU-106859	Integrated Geodetic Earth Observing Systems *First usage possible from Oct 01, 2024.*	3 CR

5.2.4 Profile: Geoinformatics and Remote Sensing of the Atmosphere

Part of: Profiles

Credits 20

Mandatory		
M-BGU-101041	GeoDB	5 CR
M-BGU-104532	Remote Sensing of Atmospheric Temperature, Trace Gases, Clouds and Aerosols	5 CR
Compulsory Elective Modules (Election: at least 10 credits)		
M-BGU-101042	3D / 4D GIS	4 CR
M-BGU-101045	Mobile GIS / Location Based Services	3 CR
M-BGU-104533	Atmospheric Spectroscopy and Middle Atmospheric Research	4 CR
M-BGU-104439	Module Wildcard 1 Profile GeoinfRemS	10 CR
M-BGU-106343	Deep Learning for Computer Vision and Remote Sensing	5 CR
M-BGU-101054	Seminar Topics of Remote Sensing	2 CR
M-BGU-106896	Seminar Remote Sensing and Geoinformatics *First usage possible from Oct 01, 2024.*	2 CR

5.2.5 Profile: Geoinformatics and Environmental Geodesy

Part of: Profiles

Credits 20

Mandatory		
M-BGU-101041	GeoDB	5 CR
M-BGU-104536	Geodetic Earth Observation	5 CR
Compulsory Elective Modules (Election: at least 10 credits)		
M-BGU-101042	3D / 4D GIS	4 CR
M-BGU-101045	Mobile GIS / Location Based Services	3 CR
M-BGU-101051	Hyperspectral Remote Sensing	3 CR
M-BGU-101054	Seminar Topics of Remote Sensing	2 CR
M-BGU-101765	Recent Earth Observation Programs and Systems	2 CR
M-BGU-104537	Advanced Gravity Field Modelling	3 CR
M-BGU-104557	Seminar Environmental Geodesy	2 CR
M-BGU-104566	Scientific Applications of GNSS *First usage possible until Sep 30, 2025.*	3 CR
M-BGU-104586	SAR and InSAR Remote Sensing	3 CR
M-BGU-104440	Module Wildcard 1 Profile GeoinfEnvGeo	10 CR
M-BGU-106859	Integrated Geodetic Earth Observing Systems *First usage possible from Oct 01, 2024.*	3 CR

5.2.6 Profile: Remote Sensing of the Atmosphere and Environmental Geodesy

Part of: Profiles

Credits 20

Mandatory		
M-BGU-104532	Remote Sensing of Atmospheric Temperature, Trace Gases, Clouds and Aerosols	5 CR
M-BGU-104536	Geodetic Earth Observation	5 CR
Compulsory Elective Modules (Election: at least 10 credits)		
M-BGU-101051	Hyperspectral Remote Sensing	3 CR
M-BGU-101054	Seminar Topics of Remote Sensing	2 CR
M-BGU-101765	Recent Earth Observation Programs and Systems	2 CR
M-BGU-104533	Atmospheric Spectroscopy and Middle Atmospheric Research	4 CR
M-BGU-104537	Advanced Gravity Field Modelling	3 CR
M-BGU-104557	Seminar Environmental Geodesy	2 CR
M-BGU-104566	Scientific Applications of GNSS *First usage possible until Sep 30, 2025.*	3 CR
M-BGU-104586	SAR and InSAR Remote Sensing	3 CR
M-BGU-104441	Module Wildcard 1 Profile RemSenEnvGeo	10 CR
M-BGU-106859	Integrated Geodetic Earth Observing Systems *First usage possible from Oct 01, 2024.*	3 CR

5.3 Lab Rotations

Credits 20

Mandatory		
M-BGU-104588	Lab Rotation I	10 CR
M-BGU-104589	Lab Rotation II	10 CR

5.4 Remote Sensing

Credits
21

Mandatory		
M-BGU-101011	Geoinformatics	5 CR
M-BGU-104524	Remote Sensing of the Atmosphere	5 CR
M-BGU-104553	Fundamentals of Environmental Geodesy	5 CR
M-BGU-106729	Fundamentals in Remote Sensing, Image Processing and Computer Vision	6 CR

5.5 Mathematics and Beyond

Credits
17

Mandatory		
M-BGU-101013	Numerical Mathematics	6 CR
M-BGU-104530	Scientific Programming	3 CR
M-BGU-106730	Estimation and Signal Theory for Geosciences	8 CR

5.6 Supplementary Modules

Credits
8

Supplementary Modules (Election: at least 8 credits)		
M-BGU-101051	Hyperspectral Remote Sensing	3 CR
M-BGU-101057	Seminar Topics of Image Analysis	2 CR
M-BGU-101042	3D / 4D GIS	4 CR
M-BGU-101045	Mobile GIS / Location Based Services	3 CR
M-BGU-101099	Active Sensors for Computer Vision	3 CR
M-BGU-101765	Recent Earth Observation Programs and Systems	2 CR
M-BGU-104557	Seminar Environmental Geodesy	2 CR
M-BGU-101047	Augmented Reality	4 CR
M-BGU-104586	SAR and InSAR Remote Sensing	3 CR
M-BGU-104566	Scientific Applications of GNSS *First usage possible until Sep 30, 2025.*	3 CR
M-BGU-101021	Visualization of Geodata in 2D, 3D and 4D	3 CR
M-BGU-104536	Geodetic Earth Observation	5 CR
M-BGU-101037	Geodetic Application of SAR Interferometry	4 CR
M-BGU-106199	Introduction to Python	3 CR
M-BGU-106343	Deep Learning for Computer Vision and Remote Sensing	5 CR
M-BGU-101054	Seminar Topics of Remote Sensing	2 CR
M-BGU-101041	GeoDB	5 CR
M-BGU-101052	Tomographic Laser- and Radar Sensing	3 CR
M-BGU-104531	Advanced Topics in Computer Vision	5 CR
M-BGU-104532	Remote Sensing of Atmospheric Temperature, Trace Gases, Clouds and Aerosols	5 CR
M-BGU-104537	Advanced Gravity Field Modelling	3 CR
M-BGU-104944	Wildcard 1 Supplementary Modules	8 CR
M-BGU-106865	GPT for Programming in Matlab and Python *First usage possible from Oct 01, 2024.*	1 CR
M-BGU-106859	Integrated Geodetic Earth Observing Systems *First usage possible from Oct 01, 2024.*	3 CR
M-BGU-106896	Seminar Remote Sensing and Geoinformatics	2 CR

5.7 Key Competences

Credits
4

Key Competences: Elective Modules (Election: at least 4 credits)		
M-BGU-104711	Further Key Competences	4 CR
M-BGU-104712	Further Key Competences	2 CR
M-BGU-104943	Wildcard Key Competences 1	2 CR

5.8 Additional Examinations

Additional Modules (Election: at most 30 credits)		
M-BGU-104713	Further Examinations	30 CR
M-BGU-101042	3D / 4D GIS	4 CR
M-BGU-101051	Hyperspectral Remote Sensing	3 CR
M-BGU-104586	SAR and InSAR Remote Sensing	3 CR
M-BGU-104557	Seminar Environmental Geodesy	2 CR
M-BGU-106343	Deep Learning for Computer Vision and Remote Sensing	5 CR
M-BGU-106199	Introduction to Python	3 CR
M-FORUM-106753	Supplementary Studies on Science, Technology and Society *First usage possible from Oct 01, 2024.*	16 CR

6 Modules

M 6.1 Module: 3D / 4D GIS (GEOD-MPGI-2) [M-BGU-101042]

Responsible: Prof. Dr. Martin Breunig
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Profiles / Profile: Computer Vision and Geoinformatics (Compulsory Elective Modules)
Profiles / Profile: Geoinformatics and Remote Sensing of the Atmosphere (Compulsory Elective Modules)
Profiles / Profile: Geoinformatics and Environmental Geodesy (Compulsory Elective Modules)
Supplementary Modules
Additional Examinations

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

Mandatory			
T-BGU-101781	3D / 4D GIS, Prerequisite *This item will not influence the grade calculation of this parent.*	1 CR	Breunig, Liu
T-BGU-101760	3D / 4D GIS	3 CR	Breunig

Competence Certificate

- T-BGU-101781 3D / 4D GIS, Vorleistung
- T-BGU-101760 3D / 4D GIS

For details on the assessments to be performed, see the details for the partial achievements..

Prerequisites
None

Competence Goal
The students explain the problems of space and time-related issues for the development and application of 3D/4D geoinformation systems. They are able to analyze spatio-temporal extensions to existing geometric and topological data models, spatial data standards, spatial databases and geographic information systems and develop them by themselves. In particular, the students are able to devise solutions for space- and time-related issues by their own and implement them in a programing language. They are able to transfer the learned knowledge to new spatio-temporal applications.

Regarding key competences, students are able to

- present results individually,
- actively participate in scientific discussions, and
- give subject-related feedback on the results.

Content
In the module relevant spatio-temporal concepts and implementations are presented for 3D/4D geoinformation systems. This concerns for example the geometric and topological data modeling, geo-data standardization, geo-data management and geo-data analysis. The concepts are considered with reference to 3D/4D geo-scientific applications. Furthermore, current research issues in the field of 3D/4D geoinformation systems are discussed. Finally, the introduced concepts are engrossed in programming exercises in the practical part of the module.

Module grade calculation
The grade of the module is the grade of the oral exam in T-BGU-101760 3D / 4D GIS

Annotation
None

Workload
Total workload: 120 hours

Contact hours: 45 hours

- courses plus course-related examination

Self-study: 75 hours

- consolidation of subject by recapitulation of lectures
- processing of exercises
- consolidation of subject by use of references and by own inquiry
- preparations for exam

Recommendation
Knowledge in GIS and object-oriented programing is helpful.

Literature
None

M 6.2 Module: Active Sensors for Computer Vision (GEOD-MWEB-3) [M-BGU-101099]

Responsible: apl. Prof. Dr. Boris Jutzi
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Profiles / Profile: Computer Vision and Geoinformatics (Compulsory Elective Modules)
Profiles / Profile: Computer Vision and Remote Sensing of the Atmosphere (Compulsory Elective Modules)
Profiles / Profile: Computer Vision and Environmental Geodesy (Compulsory Elective Modules)
Supplementary Modules

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
3	Grade to a tenth	Each summer term	1 term	German/English	4	2

Mandatory			
T-BGU-101840	Active Sensors for Computer Vision	3 CR	Jutzi

Competence Certificate

- T-BGU-101840 Active Sensors for Computer Vision

For details on the assessments to be performed, see the details for the partial achievement.

Prerequisites
None

Competence Goal
Students reproduce the fundamentals of active sensing in Computer Vision. They describe the basic vision processing techniques. Students are able to use their knowledge and transfer it to other fields of applications.

Content
This module provides an overview on basic vision processing techniques: introduction to active sensing, measurement technique (atmosphere, navigation, puls-CW, surface & LASER beam), laserscanning (Full-Waveform , quality aspects & system), range imaging (function & systems), triangulation procedures, data pre-processing (registration of point clouds, image-based registration (SIFT)), analyses of point clouds(model and daten-driven approaches, plane detection, RANSAC, building modeling), applications.

Module grade calculation
The grade of the module is the grade of the oral exam in T-BGU-101840 Active Sensors for Computer Vision

Annotation
None

Workload
Total workload: 90 hours

Contact hours: 30 hours

- courses plus course-related examination

Self-study: 60 hours

- consolidation of subject by recapitulation of lectures
- consolidation of subject by use of references and by own inquiry
- preparations for exam

Recommendation
None

Literature
None

M 6.3 Module: Advanced Gravity Field Modelling (RSGI-MPEG-4) [M-BGU-104537]

Responsible: Dr. Kurt Seitz
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Profiles / Profile: Computer Vision and Environmental Geodesy (Compulsory Elective Modules)
Profiles / Profile: Geoinformatics and Environmental Geodesy (Compulsory Elective Modules)
Profiles / Profile: Remote Sensing of the Atmosphere and Environmental Geodesy (Compulsory Elective Modules)
Supplementary Modules

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

Mandatory			
T-BGU-109289	Advanced Gravity Field Modelling, Prerequisite *This item will not influence the grade calculation of this parent.*	2 CR	Seitz
T-BGU-109290	Advanced Gravity Field Modelling, Examination	1 CR	Seitz

Competence Certificate

- T-BGU-109289 - Advanced Gravity Field Modelling, Prerequisite
- T-BGU-109290 - Advanced Gravity Field Modelling, Examination

Prerequisites
T-BGU-109328 - Fundamentals of Environmental Geodesy Part A must have been successfully passed.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-BGU-109328 - Fundamentals of Environmental Geodesy Part A must have been passed.

Competence Goal
The students are able to describe the fields of application of highly precise regional modelling of the Earth's gravity field. They explain systems of local base functions used for representation of regional geoid or quasi-geoid models. The students are able to discuss the characteristics of the theories of Stokes and Molodenskii and the related height systems.The students are able to explain the essential reductions which have to be applied to the observations according to the theory of Stokes, in terms of the vectorial as well as the scalar free variant. In this context they are able to describe standard modifications of the Stokes kernel function. The students explain the formulation of the geodetic boundary value problem starting from the non-linear boundary condition to linearization and several levels of approximation. The students are familiar with modern techniques within high-precision geoid and quasi-geoid determination (Remove-Compute-Restore Technique, Residual Terrain Modelling, combination of terrestrial gravity anomalies and geopotential models, high resolution DHM). The students have reflected the challenges within setting up the data basis and collecting different data types. When dealing with different data sources they are sensitized for the impact of various geodetic datums. The students are able to explain the fundamental differences between regional and global gravity field modelling.

Content
This module provides advanced insight into the modelling of regional height reference surfaces of orthometric and normal heights. The respective theories of Stokes and Molodenskii are discussed considering their advantages and drawbacks. The reductions which have to be applied to the observations according to the theory of Stokes are presented and the respective hypotheses are explained. Different approaches of discretising topographic and isostatic masses are presented. The tesseroid-method, which was developed at the Geodetic Institute of the KIT, is presented in detail. Modifications of the Stokes function are explained. Their impact on the numerical solution of the disturbing potential is evaluated during a tutorial on this topic. The use of different types of gravity anomalies is discussed. Links to global gravity field modelling are pointed out. The mathematical formalism, on which the geodetic boundary value problem is based, will be explained in detail: non-linear boundary condition, linearization, explanation of several levels of approximation. Non-linear and ellipsoidal effects, as well as the impact of spherical approximation on the solution of the boundary value problem are quantified by the students within exercises. The challenge of data acquisition (digital elevation models, gravity values and anomalies, density models) is discussed. An insight into regional gravity field modelling is provided by presenting current research activities of the institute.

Module grade calculation
The grade of the module is identical with the grade of the exam T-BGU-109290 - Advanced Gravity Field Modelling, Examination.

Annotation
In mutual agreement with the students the lectures and exercises will be presented either in English or in German

Workload
Total workload: 90 hours

Contact hours: 30 hours

- course plus course-related examination

Self-study: 60 hours

- consolidation of subject by recapitulation of lectures
- processing of exercises
- consolidation of subject by use of references and by own inquiry
- preparations for exam

Recommendation
Basics of Physical Geodesy. Profile: Any, including the subprofile Environmental Geodesy. Compulsory module: Geodetic Earth Observation

M 6.4 Module: Advanced Topics in Computer Vision (RSGI-MPCV-1) [M-BGU-104531]

Responsible: Dr.-Ing. Martin Weinmann
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Profiles / Profile: Computer Vision and Geoinformatics (mandatory)
Profiles / Profile: Computer Vision and Remote Sensing of the Atmosphere (mandatory)
Profiles / Profile: Computer Vision and Environmental Geodesy (mandatory)
Supplementary Modules

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

Mandatory			
T-BGU-109280	Advanced Topics in Computer Vision, Examination	4 CR	Weinmann
T-BGU-110748	Advanced Topics in Computer Vision, Prerequisite	1 CR	Hinz, Weinmann

Competence Certificate

- T-BGU-109280 - Advanced Topics in Computer Vision, Examination
- T-BGU-110748 - Advanced Topics in Computer Vision, Prerequisite

Prerequisites
None

Competence Goal
The students are able to describe advanced topics in computer vision that are also of great interest for a variety of applications in remote sensing. This includes that the students are able to explain fundamentals of feature extraction, texture analysis, pattern recognition, segmentation, object detection, object tracking, mosaicking, 3D reconstruction, scene analysis, building modeling and change detection. Furthermore, the students are able to discuss recent challenges in machine learning and explain areas of application of techniques from traditional classification approaches to modern deep learning techniques. With the exercise, the students are able to use their knowledge and transfer it to other fields of applications.

Content
This module addresses a variety of advanced topics in computer vision:
feature extraction (e.g. shape, texture and local features), texture analysis (e.g. co-occurrence matrix, Laws filter and Gabor filter), pattern recognition (feature matching), segmentation (e.g. watershed transformation, mean-shift segmentation, normalized cuts), object detection (e.g. cars, road networks or people), object tracking (e.g. cars or people), mosaicking (e.g. creation of aerial mosaic images), 3D reconstruction (e.g. city models), scene analysis (e.g. 3D scene interpretation), change detection (e.g. land-cover and land-use monitoring) and machine learning (e.g. traditional classification approaches, deep learning techniques).

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

Workload
Total Workload: 150 hours

Contact hours: 60 hours

- courses plus course-related examination
- short presentations regarding the insights obtained during the exercises

Self-study: 90 hours

- consolidation of subject by recapitulation of lectures
- consolidation and preparation of subject by use of references and by own inquiry
- preparations for exam

M 6.5 Module: Atmospheric Spectroscopy and Middle Atmospheric Research (RSGI-MPRA-3) [M-BGU-104533]

Responsible: PD Dr. Frank Hase
Dr. Sören Johansson
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Profiles / Profile: Computer Vision and Remote Sensing of the Atmosphere (Compulsory Elective Modules)
Profiles / Profile: Geoinformatics and Remote Sensing of the Atmosphere (Compulsory Elective Modules)
Profiles / Profile: Remote Sensing of the Atmosphere and Environmental Geodesy (Compulsory Elective Modules)

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

Mandatory			
T-BGU-109284	Atmospheric Spectroscopy and Middle Atmosphere Research, Examination	4 CR	Hase, Johansson

Competence Certificate
Details regarding the exam can be found in the description of brick T-BGU-109284 – Atmospheric Spectroscopy and Middle Atmosphere Research, Examination.

Prerequisites
None

Competence Goal
Course 1 Atmospheric Spectroscopic Measurements:
Students know and are able to explain the fundamentals of atmospheric remote sensing using spectrometric techniques. Strong emphasis is given to the technique of Fourier Transform Spectroscopy, a workhorse for infrared remote sensing of the atmosphere.

Course 2 Atmospheric Radiation
Students describe atmospheric radiation phenomena and explain how they relate to physical principles.

Content
Course 1 Atmospheric Spectroscopic Measurements:

- required fundamentals of electromagnetic theory and technical (/imaging) optics;
- spectroscopic tools: gratings, prisms, heterodyne techniques, interferometers;
- Fourier transform spectroscopy:
- Fourier transforms, useful relations;
- theory of the ideal Fourier spectrometer;
- discrete sampling, FFT, and spectral data processing;
- non-ideal interferograms;
- effects of noise;
- imaging Fourier spectrometer.

Course 2 Atmospheric Radiation:

- historical outline of radiation physics and optics;
- recollection of electromagnetic theory, radiation variables;
- black-body radiation, interaction of atoms and molecules with radiation;
- radiation output of the Sun, composition of the terrestrial atmosphere;
- radiative transfer;
- optical phenomena in the atmosphere;
- atmospheric radiation in different spectral regions;
- radiation and the energy balance of the Earth;
- remarks on atmospheric remote sensing.

Module grade calculation
The grade of the module is the grade of the exam T-BGU-109284 – Atmospheric Spectroscopy and Middle Atmosphere Research, Examination.

Workload
Course 1 Atmospheric Spectroscopic Measurements:
Total Workload: 60 hours
Contact hours: 30 hours
Self study: 30 hours

- recapitulation and consolidation by own study
- preparation of exam

Course 2 Atmospheric Radiation:
Total workload: 60 hours
Contact hours: 30 hours
Self study: 30 hours

- recapitulation and consolidation by own study
- preparation of exam

Total workload of both courses: 120 hours

M 6.6 Module: Augmented Reality (GEOD-MWGI-8) [M-BGU-101047]

Responsible: Dr.-Ing. Sven Wursthorn
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Profiles / Profile: Computer Vision and Geoinformatics (Compulsory Elective Modules)
Profiles / Profile: Computer Vision and Remote Sensing of the Atmosphere (Compulsory Elective Modules)
Profiles / Profile: Computer Vision and Environmental Geodesy (Compulsory Elective Modules)
Supplementary Modules

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

Mandatory			
T-BGU-101717	Augmented Reality, Prerequisite *This item will not influence the grade calculation of this parent.*	2 CR	Wursthorn
T-BGU-101716	Augmented Reality	2 CR	Wursthorn

Competence Certificate

- T-BGU-101717 Augmented Reality, Prerequisite
- T-BGU-101716 Augmented Reality

For details on the assessments to be performed, see the details for the partial achievements.

Prerequisites
None

Competence Goal
The students reflect and deepen their previous knowledge of positioning, orientation, photogrammetry und geo information systems in the field of augmented reality.

Content
Selection of augmented reality applications in science, industry and entertainment. Sensors and technologies for positioning und orientation. Display technologies like glasses and projectors. User interaction in augmented reality.

Module grade calculation
The grade of the module is the grade of the oral exam in T-BGU-101716 Augmented Reality

Annotation
None

Workload
Total workload: 120 hours

Contact hours: 45 hours

- courses plus course-related examination

Self-study: 75 hours

- consolidation of subject by recapitulation of lectures
- consolidation of subject by use of references and by own inquiry
- preparations for exam

Recommendation
None

Literature
None

M 6.7 Module: Deep Learning for Computer Vision and Remote Sensing (GEOD-MWCV-12) [M-BGU-106343]

Responsible: Dr.-Ing. Martin Weinmann
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Profiles / Profile: Computer Vision and Geoinformatics (Compulsory Elective Modules)
Profiles / Profile: Computer Vision and Remote Sensing of the Atmosphere (Compulsory Elective Modules)
Profiles / Profile: Computer Vision and Environmental Geodesy (Compulsory Elective Modules)
Profiles / Profile: Geoinformatics and Remote Sensing of the Atmosphere (Compulsory Elective Modules)
Supplementary Modules
Additional Examinations

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

Mandatory			
T-BGU-112866	Deep Learning for Computer Vision and Remote Sensing, Prerequisites	2 CR	Weinmann
T-BGU-112865	Deep Learning for Computer Vision and Remote Sensing, Exam	3 CR	Weinmann

Competence Certificate
Details regarding the exam can be found in the description of brick T-BGU-112865 – Deep Learning for Computer Vision and Remote Sensing, Exam.

Prerequisites
none

Competence Goal
Students are able to explain the fundamentals of deep learning regarding a diversity of computer vision and remote sensing applications. They are able to use their knowledge and transfer it to other fields of applications.

Content
This module addresses a variety of advanced topics related to deep learning in the context of a diversity of computer vision and remote sensing applications, such as

- Image (patch) classification
- Image segmentation
- 3D point cloud segmentation
- 3D reconstruction
- Object detection
- Object inspection
- 6D object pose estimation
- Data fusion
- Time series analysis
- Change detection

Module grade calculation
The grade of the module is the grade of the exam T-BGU-112865 – Deep Learning for Computer Vision and Remote Sensing, Exam.

Workload
Total Workload: 150 hours

- Contact hours: 60 hours
  - courses plus course-related examination
  - short presentations regarding the insights obtained during the exercises
- Self-study: 90 hours
  - consolidation of subject by recapitulation of lectures
  - consolidation and preparation of subject by use of references and by own inquiry
  - preparations for exam

Recommendation
Basics on computer vision as e.g. provided in the following lectures

- Digitale Bildverarbeitung [MSc GuG]
- Image Processing and Computer Vision [MSc RSGI]
- Basic programming skills in Matlab / Python

Learning type
Lectures and exercises

M 6.8 Module: Estimation and Signal Theory for Geosciences (RSGI-MMCM-3) [M-BGU-106730]

Responsible: Hendrik Andersen
PD Dr. Frank Hase
apl. Prof. Dr. Boris Jutzi

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

Part of: Mathematics and Beyond

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

Mandatory			
T-BGU-106633	Data Analysis in Geoscience Remote Sensing Projects, Prerequisite *This item will not influence the grade calculation of this parent.*	2 CR	Andersen, Cermak
T-BGU-111186	Basics of Estimation Theory, Prerequisite *This item will not influence the grade calculation of this parent.*	1 CR	Hase, Hinz
T-BGU-113539	Estimation and Signal Theory for Geosciences, Examination	5 CR	Hase, Jutzi

Competence Certificate

- T-BGU-106633 - Data Analysis in Geoscience Remote Sensing Projects, Vorleistung
- T-BGU-111186 - Basics of Estimation Theory, Prerequisite
- T-BGU-113539 - Estimation and Signal Theory for Geosciences, Examination

For details on the assessments to be performed, see the details for the partial achievements.

Prerequisites

- M-BGU-101015 - Estimation Theory
- M-BGU-103314 - Data Analysis in Geoscience Remote Sensing Projects
- M-BGU-104918 - Basics of Estimation Theory and its Application in Geoscience Remote Sensing
- M-BGU-104517 - Computer Vision and Remote Sensing

have not been started

Competence Goal
Course 1: Basics of Estimation Theory and Course 2: Data Analysis in Geoscience Remote Sensing Projects

Students explain the theoretical basics and important aspects of detection, classification and parameter estimation. They apply the concepts and methods of estimation theory and deformation analysis to data recorded by geodetic, geophysical or remote sensing sensors. Students explain the application of estimation theory to data analysis problems in the geosciences. Students relate how methods in geoscientific remote sensing are developed, applied and validated. By working self-organized and reflectively the students deepen their knowledge in soft skills, e.g., organization, collaboration and communication.

Course 3 Sensors and Signals in Computer Vision and Remote Sensing:
Students reproduce the fundamentals of sensors and signals in Computer Vision and Remote Sensing. They describe the basic signal processing techniques. Students are able to use their knowledge and transfer it to other fields of applications.

Content
Contents of the module include (Course 1: Basics of Estimation Theory; Course 2: Data Analysis in Geoscience Remote Sensing Projects)

- an introduction into stochastic modelling (starting with the Bayes-Theorem)
- theoretical models and applied methods of detection of events in signals
- theoretical models and applied methods of classification of events in signals
- a variety of methods for parameter estimation, e.g. least-squares estimation, transformation of probability density and integration of a-priori knowledge about parameters and observations
- application of estimation theory explained on examples from the geosciences. Possible contents:
    - Lidar remote sensing of aerosol properties
    - Passive imager remote sensing cloud microphysics
    - Fourier-transform infrared spectroscopy for trace gase remote sensing
    - Multi-instrument land surface cover classification
    - Vegetation remote sensing and validation
    - Land surface temperature estimation and validation
    - Radar remote sensing of precipitation

Course 3 Sensors and Signals in Computer Vision and Remote Sensing:
This course provides an overview on basic signal processing techniques: Mathematical principles, Systems and signals, Fourier-series, Delta function, Convolution, Fourier-Transformation, LTI-systems and modulation, Digital signal processing, Random Signals, Signal reconstruction, Interpolation, Multi-dimensional system theory.

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

Annotation
'T-BGU-113539 - Estimation and Signal Theory for Geosciences, Examination' tests competences related to the courses 'Sensors and Signals in Computer Vision and Remote Sensing' and 'Basics of Estimation Theory'. Both courses take place in the summer terms. It is therefore recommended to take this exam after the first summer term of this degree program. Please note the requirements for participation in this examination.
In order to complete this module successfully, you must also take the ungraded assessment 'Data Analysis in Geoscience Remote Sensing Projects, Vorleistung'. The corresponding lecture takes place in winter terms.

Workload
Total workload: 240 hours

Contact hours: 105 hours

- courses plus course-related examination

Self-study: 135 hours

- consolidation of subject by recapitulation of lectures
- consolidation of subject by use of references and by own inquiry
- data analysis and data processing
- preparations for exam

Recommendation
Knowledge in statistics, parameter estimation and numerical mathematics are helpful.

M 6.9 Module: Fundamentals in Remote Sensing, Image Processing and Computer Vision (RSGI-MRRIC) [M-BGU-106729]

Responsible: Prof. Dr.-Ing. Stefan Hinz
Dr.-Ing. Uwe Weidner
Dr.-Ing. Martin Weinmann

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

Part of: Remote Sensing

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

Mandatory			
T-BGU-101759	Methods of Remote Sensing, Prerequisite *This item will not influence the grade calculation of this parent.*	1 CR	Weidner
T-BGU-113538	Fundamentals in Remote Sensing, Image Processing and Computer Vision, Examination	5 CR	Hinz, Weidner, Weinmann

Competence Certificate

- T-BGU-101759 - Methods of Remote Sensing, Prerequisite
- T-BGU-113538 - Fundamentals in Remote Sensing, Image Processing and Computer Vision, Examination (oral, ca. 30 min.)

For further details on the assessments to be performed, see the details for the partial achievements.

Prerequisites

- M-BGU-104517 - Computer Vision and Remote Sensing
- M-BGU-104918 - Basics of Estimation Theory and its Application in Geoscience Remote Sensing

have not been started.

Competence Goal
Course 1 Methods of Remote Sensing:
Students are able to explain the fundamentals of multispectral remote sensing, namely the basics of pixel- and segment-based classification approaches, their communalities and their differences. Students are able to use their knowledge and transfer it to other fields of applications.

Course 2 Image Processing and Computer Vision:
Students are able to explain the fundamentals of image processing and computer vision. They describe the basic approaches and concepts including robust techniques and are able to use their knowledge and transfer it to other fields of applications.

Content
Course 1 Methods of Remote Sensing:
This course provides an overview of multispectral remote sensing. It introduces to concepts of data processing, also including sensor aspects where required. Based on a selection of applications like land cover/used classification and change detection / monitoring approaches are presented and compared. The module consists of lectures and labs.

Course 2 Image Processing and Computer Vision:
This course provides an overview of basic approaches of image processing and computer vision, starting from image filters like linear and non-linear filters, gradient and curvature operators and leading to concepts of object extraction based on point, line and segment extraction and their applications. The module consists of lectures and labs.

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

Workload
Course 1 Methods of Remote Sensing:
Total workload: 90 hours
Contact hours: 30 hours

- courses plus course-related examination

Self-Study: 60 hours

- consolidation of subject by recapitulation of lectures
- consolidation of subject by use of references and by own inquiry
- preparation for exam

Course 2 Image Processing and Computer Vision:
Total workload: 90 hours
Contact hours: 45 hours

- courses plus course-related examination

Self-Study: 45 hours

- consolidation of subject by recapitulation of lectures
- consolidation of subject by use of references and by own inquiry
- preparation for exam

Total workload of all three courses: 180 hours

M 6.10 Module: Fundamentals of Environmental Geodesy (RSGI-MRFE) [M-BGU-104553]

Responsible: Prof. Dr.-Ing. Hansjörg Kutterer
Dr.-Ing. Michael Mayer
Dr. Kurt Seitz

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

Part of: Remote Sensing

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
5	Grade to a tenth	Each term	2 terms	English	4	5

Mandatory			
T-BGU-109328	Fundamentals of Environmental Geodesy Part A *This item will not influence the grade calculation of this parent.*	1 CR	Kutterer, Seitz
T-BGU-109329	Fundamentals of Environmental Geodesy Part B *This item will not influence the grade calculation of this parent.*	1 CR	Kutterer, Mayer
T-BGU-109330	Fundamentals of Environmental Geodesy, Examination	3 CR	Kutterer, Mayer, Seitz

Competence Certificate

- T-BGU-109328 - Fundamentals of Environmental Geodesy Part A
- T-BGU-109329 - Fundamentals of Environmental Geodesy Part B
- T-BGU-109330 - Fundamentals of Environmental Geodesy, Examination

Prerequisites
None

Competence Goal
The students understand the basic principles of geodetic satellite missions. They know geodetic reference systems as well as the mathematical representation of the Earth's gravity field and are aware of their specific characteristics and research-related problems. The learners know the basic concepts of GNSS positioning and are able to familiarize themselves with new GNSS-related topics. They analyze data from gravity field missions like GRACE-FO and discuss the interactions of the various gravity satellite missions. The students work autonomous and self-organized in the field of environmental geodesy and have communicative as well as organizational competences with respect to collaboration, presentation and discussion. The students understand how geodetic and geo-scientific observation systems and techniques contribute to environmental geodesy.

Content
The courses 1 and 2 focus on the role of geodetic observation systems in environmental geodesy.

Course 1:

- Mathematical representation of the gravity field of the Earth as well as its fundamental characteristics;
- Geodetic gravity missions like GRACE, GRACE-FO, GOCE, ICEsat;
- Orbit parameters, resolution, accuracy;

Course 2:

- Theoretical basics and research as well as praxis orientated principles of important satellite missions like GNSS, VLBI, SLR, DORIS;
- Geodetic reference frames and systems, plate tectonics;
- GNSS positioning;
- InSAR;

Module grade calculation
The grade of the module is the grade of the examination of T-BGU-109330 - Fundamentals of Environmental Geodesy, Examination.

Annotation
Course 1: Fundamentals of Environmental Geodesy Part A (winter term)
Course 2: Fundamentals of Environmental Geodesy Part B (summer term)

Workload
Total workload Course 1: 75 hours

- Contact hours: 25 hours
  - course plus course-related examination
- Self-study: 50 hours
  - consolidation of subject by recapitulation of lectures
  - processing of exercises
  - consolidation of subject by use of references and by own inquiry
  - exercises and scientific bullentin
  - preparations for the examination

Total workload Course 2: 75 hours

- Contact hours: 25 hours
  - Course plus course-related examination
- Self-study: 50 hours
  - consolidation of subject by recapitulation of lectures
  - consolidation of subject by use of references and by own inquiry
  - exercises and presentation
  - preparations for the examination

Total workload of both courses: 150 hours

M 6.11 Module: Further Examinations [M-BGU-104713]

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

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

Further Examinations (Election: at most 30 credits)			
T-BGU-109599	Wildcard Additional Examinations 1	2 CR	
T-BGU-109604	Wildcard Additional Examinations 6	5 CR	

M 6.12 Module: Further Key Competences [M-BGU-104712]

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

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

Further Key Competences (Election: at least 2 credits)			
T-BGU-109594	Wildcard Further Key Competences 1 ub	1 CR	
T-BGU-109595	Wildcard Further Key Competences 2 ub	1 CR	
T-BGU-111648	Wildcard Further Key Competences 5	1 CR	
T-BGU-111649	Wildcard Further Key Competences 6	1 CR	

Prerequisites
none

M 6.13 Module: Further Key Competences [M-BGU-104711]

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

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

Further Key Competences (Election: at least 4 credits)			
T-BGU-109594	Wildcard Further Key Competences 1 ub	1 CR	
T-BGU-109595	Wildcard Further Key Competences 2 ub	1 CR	
T-BGU-109596	Wildcard Further Key Competences 3 ub	1 CR	
T-BGU-109597	Wildcard Further Key Competences 4 ub	1 CR	
T-BGU-111648	Wildcard Further Key Competences 5	1 CR	
T-BGU-111649	Wildcard Further Key Competences 6	1 CR	
T-BGU-111706	SelfAssignment-MScRSGI-1-graded	2 CR	
T-BGU-111707	SelfAssignment-MScRSGI-2-graded	2 CR	
T-BGU-111708	SelfAssignment-MScRSGI-3-ungraded	2 CR	
T-BGU-111709	SelfAssignment-MScRSGI-4-ungraded	2 CR	

Prerequisites
none

M 6.14 Module: GeoDB (GEOD-MPGI-1) [M-BGU-101041]

Responsible: Prof. Dr. Martin Breunig
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Profiles / Profile: Computer Vision and Geoinformatics (mandatory)
Profiles / Profile: Geoinformatics and Remote Sensing of the Atmosphere (mandatory)
Profiles / Profile: Geoinformatics and Environmental Geodesy (mandatory)
Supplementary Modules

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
5	Grade to a tenth	Each winter term	1 term	German/English	4	2

Mandatory			
T-BGU-101754	GeoDB, Prerequisite *This item will not influence the grade calculation of this parent.*	1 CR	Breunig
T-BGU-101753	GeoDB	4 CR	Breunig

Competence Certificate

- T-BGU-101754 GeoDB, Vorleistung
- T-BGU-101753 GeoDB

For details on the assessments to be performed, see the details for the partial achievements..

Prerequisites
None

Competence Goal
The students explain the basic concepts of spatial data management. They are able to analyze object-oriented spatial data models, the structure and algorithms of spatial access methods. They know how to use geo-database management systems in theory and in practice. They are able to apply the mediated concepts and implementations to related problems. The students are able to transfer the learned knowledge to advanced topics such as 3D or spatio-temporal geo-databases.

Content
The module provides students with an insight into the essential concepts and the state of the art in geo-data management. Standardized geospatial data models are introduced. The effect of multi-dimensional indexing of spatial data is explained and the structure and algorithms of specific spatial access methods are explained (e.g. quadtree, grid files, R trees, Generalized Search Tree). The theoretical aspects are implemented in practical exercises, for example, using object-relational spatial database systems (e.g PostGIS). Finally, the module refers to more advanced topics (e.g. topological databases) and current research in the field of geo-databases.

Module grade calculation
The grade of the module is the grade of the oral exam in T-BGU-101753 GeoDB.

Annotation
None

Workload
Total workload: 120 hours

Contact hours: 45 hours

- courses plus course-related examination

Self-study: 75 hours

- consolidation of subject by recapitulation of lectures
- processing of exercises
- consolidation of subject by use of references and by own inquiry
- preparations for exam

Recommendation
Knowledge in database systems is helpful.

Literature
None

M 6.15 Module: Geodetic Application of SAR Interferometry (GEOD-MWGF-4) [M-BGU-101037]

Responsible: Dr.-Ing. Thomas Grombein
Dr.-Ing. Andreas Schenk
Alison Larissa Seidel

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

Part of: Supplementary Modules

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

Mandatory			
T-BGU-103501	Geodetic Application of SAR Interferometry, Prerequisite *This item will not influence the grade calculation of this parent.*	2 CR	Grombein, Schenk, Seidel
T-BGU-101711	Geodetic Application of SAR Interferometry	2 CR	Grombein, Schenk, Seidel

Competence Certificate

- T-BGU-103501 Geodetic Application of SAR Interferometry, Vorleistung
- T-BGU-101711 Geodetic Application of SAR Interferometry

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

Prerequisites
The module M-BGU-101828 Interferometric and Tomographic Laser- and Radar Sensing must not have started.

Competence Goal
The students describe the basic principles as well as advanced concepts of SAR-interferometry. They are able to explain the deterministic and stochastic constituents of the interferometric phase. They explain the fundamental philosophy and the different approaches of multi-temporal SAR-interferometry (i.e. persistent scatterer SAR-interferometry, *PSI*). The students gained practical experience with the PS-interferometric software package StaMPS. They name important processing parameters and are able to assess their impact on the results. They perform a SAR-interferometric project, evaluate and present the essential results in a proper way. The students are able to discuss the strengths and weaknesses of the method and to address current research questions.

Content
The module elaborates the basic principles imparted in the module SAR- and InSAR remote sensing. It provides the students with a detailed insight into the concepts of multitemporal SAR-interferometry. Persistent scatterer approaches with special attention to the processing software StaMPS are in the focus of the module. Further aspects of SAR-interferometry like atmospheric corrections, unwrapping, geocoding and DEM-generation are deepened. Current research topics and projects conducted at GIK/IPF are included into the subject matter. The practical part of the course consists of a project-like PSI exercise with a geodynamical focus (e.g. postseismic and volcanic deformations in central Chile). The students' project covers 50% of the contact hours. Report and presentation of the main results including a discussion of the chosen processing steps are an integral part of the final exam.

Module grade calculation
The grade of the module is the grade of the oral exam in T-BGU-101711 Geodetic Application of SAR Interferometry

Workload
Total workload: 120 hours

Contact hours: 45 hours

- courses plus course-related examination

Self-study: 75 hours

- unsupervised processing of an InSAR-project
- consolidation of subject by recapitulation of lectures
- consolidation of subject by use of references and by own inquiry
- preparations for exam

Recommendation
Basics of SAR und InSAR-Fernerkundung are helpful.

M 6.16 Module: Geodetic Earth Observation (RSGI-MPEG-1) [M-BGU-104536]

Responsible: Prof. Dr.-Ing. Hansjörg Kutterer
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Profiles / Profile: Computer Vision and Environmental Geodesy (mandatory)
Profiles / Profile: Geoinformatics and Environmental Geodesy (mandatory)
Profiles / Profile: Remote Sensing of the Atmosphere and Environmental Geodesy (mandatory)
Supplementary Modules

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

Mandatory			
T-BGU-109287	Mass Variations	2 CR	Kutterer, Seitz
T-BGU-109404	Deformation Processes	2 CR	Kutterer
T-BGU-109288	Geodetic Earth Observation, Examination	1 CR	Kutterer, Seitz

Competence Certificate

- T-BGU-109287 - Mass Variations
- T-BGU-109404 - Deformation Processes
- T-BGU-109288 - Geodetic Earth Observation, Examination

Prerequisites
None

Competence Goal
The students have a deepened knowledge about the mathematical representation of the gravity field of the Earth and its temporal variations. They know how to process and to analyze relevant terrestrial or satellite data and are familiar with fundamental methods to derive models for changing environmental parameters. The students understand active deformation processes of the 'rigid' Earth as a prominent source of changes in the Earth system. They know the special demands on measurement techniques and the basic methods to derive reliable estimations of surface displacements. 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 (e.g., sensing the atmosphere).

Content
Course 1 Mass Variations:

- Investigation of temporal gravity variations
- Derivation of mass variations in the Earth system
- Geodetic contribution in the field of environmental changes with a focus on ground water storage
- Accompanying methods like Radar altimetry

Course 2 Deformation Processes:

- Deformation processes of the Earth
- Interseismic, coseismic and postseismic deformations at plate margins;
- Anthropogenic surface displacements due to mining activites and fluid extraction;
- Advanced methods of deformation measurements (e.g., SAR interferometry, GNSS)
- Properties and challenges of the International Terrestrial Reference Frame (ITRF)

Module grade calculation
The grade of the module is the grade of the oral exam.Thereby both courses are weighted equally.

Annotation
In mutual agreement with the students the lectures and exercises will be presented either in English or in German

Workload
Total workload Course 1 Mass Variations: 75 hours

Contact hours: 25 hours

- courses plus course-related examination

Self-study: 50 hours

- consolidation of subject by recapitulation of lectures
- processing of exercises
- consolidation of subject by use of references and by own inquiry
- preparations for exam

Total workload Course 2 Deformation Processes: 75 hours

Contact hours: 25 hours

- courses plus course-related examination

Self-study: 50 hours

- consolidation of subject by recapitulation of lectures
- processing of exercises
- consolidation of subject by use of references and by own inquiry
- preparations for exam

Total workload of both courses: 150 hours

Recommendation
Course 1 Mass Variations: Fundamentals of Environmental Geodesy (Part A)
Course 2 Deformation Processes: Fundamentals of Environmental Geodesy (Part B)

M 6.17 Module: Geoinformatics (GEOD-MAGI-2) [M-BGU-101011]

Responsible: Prof. Dr. Martin Breunig
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Remote Sensing

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
5	Grade to a tenth	Each winter term	2 terms	English	4	3

Mandatory			
T-BGU-110321	Geoinformatics, Prerequisite SoSe	1 CR	Breunig
T-BGU-110322	Geoinformatics, Prerequisite WiSe	1 CR	Breunig
T-BGU-101742	Geoinformatics	3 CR	Breunig

Competence Certificate

- T-BGU-101742 Geoinformatics
- T-BGU-110322 Geoinformatics, Prerequisite WiSe
- T-BGU-110321 Geoinformatics, Prerequisite SoSe

For details on the assessments to be performed, see the details for the partial achievements.

Prerequisites
The module M-BGU-101010 must not have startet.

Modeled Conditions
The following conditions have to be fulfilled:

1. The following conditions have to be fulfilled:

Competence Goal
The students explain the fundamental concepts of Geoinformatics and their implementations, i.e. they penetrate them in theory and practice. Furthermore, they transform them to geo-applications. In particular, geo-data models and methods for geo-data management are analszed. The students transfer the learned content on advanced topics of Geoinformatics.

Regarding key competences, students are able to

- present results individually,
- actively participate in scientific discussions, and
- give subject-related feedback on the results.

Content
The module provides students with an insight into concepts and practical methods of Geoinformatics based on data models, geo-referenced data structures and algorithms, database systems, access methods, etc. In the practical part, the proposed methods are implemented in a programing language using relevant tools of Geoinformatics.

Module grade calculation
The grade of the module is the grade of the oral exam in T-BGU-101742 Geoinformatics.

Annotation
None

Workload
Total workload: 150 hours

Contact hours: 60 hours

- courses plus course-related examination

Self-study: 90 hours

- consolidation of subject by recapitulation of lectures
- processing of exercises
- consolidation of subject by use of references and by own inquiry
- preparations for exam

Literature
None

M 6.18 Module: GPT for Programming in Matlab and Python (RSGI-SUPPL-1) [M-BGU-106865]

Responsible: PD Dr.-Ing. Uwe Ehret
Dr. Julia Fuchs
Dr. Mirko Mälicke

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

Part of: Supplementary Modules (Usage from 10/1/2024)

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

Mandatory			
T-BGU-113739	GPT for Programming in Matlab and Python *This item will not influence the grade calculation of this parent.*	1 CR	Mälicke, Vüllers

Competence Certificate
Task-based homework: completion of four programming tasks during and at the end of the lecture period (workload per task: ca. 4 hours)

Prerequisites
One of the following achievements must have been started:

- T-BGU-106765 - Introduction to Matlab
- T-BGU-112598 - Introduction to Python

Modeled Conditions
You have to fulfill one of 2 conditions:

1. The course T-BGU-106765 - Introduction to Matlab must have been started.
2. The course T-BGU-112598 - Introduction to Python must have been started.

Competence Goal
The students use Large Language Models (LLM) for efficient and responsible programming. The students discuss poblems and limitations of using GPT.

Content
This course uses the example of bwGPT to teach how Large Language Models (LLM) can be used for programming in Matlab or Python, e.g.

- Prompt-based code generation,
- Debugging with GPT,
- GPT as translator Matlab <-> Python,
- GPT for familiarisation with new functionality.

Problems and limitations of using GPT are discussed. The course is application-orientated, i.e. the topics are mainly taught on the basis of applications that are worked on by the course participants. The main course objectives are: independent, efficient and responsible usage of LLMs for programming.

Module grade calculation
The grade of the module is the grade of the coursework in T-BGU-113739 - GPT for Programming in Matlab and Python; the assessment can only be "passed" or "failed".

Annotation
Basic knowledge in - at minimum - one of the following programming languages are strongly recommended:

- Matlab,
- Python.

Workload
Total Workload: 30 hours

- Participating in lectures: 5 hours
- Self-study (25 hours)
  - Worksheets and project work

M 6.19 Module: Hyperspectral Remote Sensing (GEOD-MPEA-1) [M-BGU-101051]

Responsible: Dr.-Ing. Uwe Weidner
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Profiles / Profile: Computer Vision and Environmental Geodesy (Compulsory Elective Modules)
Profiles / Profile: Geoinformatics and Environmental Geodesy (Compulsory Elective Modules)
Profiles / Profile: Remote Sensing of the Atmosphere and Environmental Geodesy (Compulsory Elective Modules)
Supplementary Modules
Additional Examinations

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

Mandatory			
T-BGU-101721	Hyperspectral Remote Sensing, Prerequisite *This item will not influence the grade calculation of this parent.*	1 CR	Weidner
T-BGU-101720	Hyperspectral Remote Sensing	2 CR	Weidner

Competence Certificate

- T-BGU-101721 Hyperspectral Remote Sensing, Prerequisite
- T-BGU-101720 Hyperspectral Remote Sensing

For details on the assessments to be performed, see the details for the partial achievements..

Prerequisites
none

Competence Goal
Students are able to explain the fundamentals of hyperspectral remote sensing, its possibilities and challenges with respect to multispectral remote sensing, including data processing specifically designed for hyperspectral data. Students are able to use their knowledge and transfer it to other fields of applications.

Content
This module provides an overview of hyperspectral remote sensing. It introduces students to sensor systems and concepts of data processing. A selection of approaches is presented and compared to classical approaches for the processing and classification of multispectral data. The module consists of lectures and labs.

Module grade calculation
The grade of the module is the grade of the oral exam in T-BGU-101720 Hyperspectral Remote Sensing.

Workload
Total workload: 90 hours

Contact hours: 30 hours

- courses plus course-related examination

Self-study: 60 hours

- consolidation of subject by recapitulation of lectures
- consolidation of subject by use of references and by own inquiry
- preparations for exam

Recommendation
Knowledge in multispectral remote sensing is recommended.

M 6.20 Module: Integrated Geodetic Earth Observing Systems (GEOD-MPGF-5) [M-BGU-106859]

Responsible: Prof. Dr.-Ing. Hansjörg Kutterer
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Profiles / Profile: Computer Vision and Environmental Geodesy (Compulsory Elective Modules) (Usage from 10/1/2024)
Profiles / Profile: Geoinformatics and Environmental Geodesy (Compulsory Elective Modules) (Usage from 10/1/2024)
Profiles / Profile: Remote Sensing of the Atmosphere and Environmental Geodesy (Compulsory Elective Modules) (Usage from 10/1/2024)
Supplementary Modules (Usage from 10/1/2024)

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

Mandatory			
T-BGU-113743	Integrated Geodetic Earth Observing Systems, Prerequisite	2 CR	Kutterer
T-BGU-113744	Integrated Geodetic Earth Observing Systems, Examination	1 CR	Kutterer

Competence Certificate

- T-BGU-113743 – Integrated Geodetic Earth Observing Systems, Prerequisite
- T-BGU-113744 – Integrated Geodetic Earth Observing Systems, Examination (oral, ca. 20 min.)

For further details on the assessments to be performed, see the details for the partial achievements.

Prerequisites
M-BGU-104561 – Geodetic Sensor Fusion must not have been started.

Competence Goal
The students discuss the strengths and weaknesses of different geodetic observation techniques at global and regional scales. They understand and evaluate strategies to derive improved products from a multi technique integration which is an important field of recent and future geodetic research. Students apply their knowledge and transfer it to other fields of applications. They sharpen their research interests with respect to topics to be worked upon during individual project work and master thesis.

Content

- Integration of physical and geometrical sensors and observation techniques
- Multi-technique approaches
- Parameter estimation, collocation, filtering, and prediction
- Existing observing systems, such as
  - Global Geodetic Observing System (GGOS)
  - International Terrestrial Reference Frame (ITRF)

Module grade calculation
The grade of the module is the grade of the exam T-BGU-113744 – Integrated Geodetic Earth Observing Systems, Examination

Workload
Total workload: 90 hours

- Contact hours: 21 hours
  - course plus course-related examination
- Self-study: 69 hours
  - consolidation of subject by recapitulation of lectures
  - processing of exercises
  - consolidation of subject by use of references and by own inquiry
  - preparations for exam

Recommendation
Fundamentals of Environmental Geodesy, Part A+B

M 6.21 Module: Introduction to Python (RSGI-MMCE-2) [M-BGU-106199]

Responsible: Prof. Dr. Jan Cermak
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Supplementary Modules
Additional Examinations

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

Mandatory			
T-BGU-112598	Introduction to Python	3 CR	Cermak, Fuchs, Vüllers

Competence Certificate
The assessment of success takes place in the form of a course achievement (§ 4 para. 3 SPO).

Prerequisites
None

Competence Goal
The aim of this course is providing knowledge on the basic syntax and structure of the programming language Python. Students can adapt and write basic Python code following a workflow in their individual working environment. By the end of this course students are capable implementing simple algorithms and visualizing scientific data in Python.

Content

- Setup a working environment in Python (installation, virtual environments)
- Python fundamentals (syntax, data types, control flow, functions, objects)
- Working with and visualizing scientific datasets in Python

Module grade calculation
Ungraded course achievement (§ 4 para. 3 SPO) related to T-BGU-112598 – Introduction to Python. Further details will be communicated in the lecture.

Annotation
None

Workload
Total workload: 90 hours

- Contact hours: 20 hours
- Self-study: 70 hours
  - consolidation of subject by recapitulation of lectures, by use of references and by own inquiry (20 hours)
  - working on exercises (30 hours)
  - preparation of take-home exam (20 hours)

Base for
Programming in Python is of fundamental importance in the field of 'Remote Sensing and Geoinformatics'. Therefore, in various lectures (e.g., Data Analysis in Geoscience Remote Senesing Projects) Python will be applied.

M 6.22 Module: Lab Rotation I (RSGI-ML-1) [M-BGU-104588]

Responsible: Prof. Dr. Martin Breunig
Prof. Dr. Jan Cermak
Prof. Dr.-Ing. Stefan Hinz
apl. Prof. Dr. Boris Jutzi
Prof. Dr.-Ing. Hansjörg Kutterer
Prof. Dr.-Ing. Markus Ulrich

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

Part of: Lab Rotations

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

Mandatory			
T-BGU-109412	Lab Rotation I	10 CR	

Competence Certificate
T-BGU-109412 - Lab Rotation I (graded, type: other)

Prerequisites
At least 45 CP shall have been acquired before a lab rotation is started.

Modeled Conditions
The following conditions have to be fulfilled:

1. You need to have earned at least 45 credits in your course of studies.

Competence Goal
The student will get insight in lab work, will learn to work in a selforganized way. Further the student will deepen his or her knowledge in the topic of choice and will then be better qualified to select the topic and the research groups which fits best to his or her personal interest.

Content
The student works on a selected topic in one of the research groups of the involved institutes. Lab rotations at external institutions are allowable. The selection of the topic is made in agreement of the supervisor and the student. The student familiarizes his or herself with the topic, carries out the lab work, and prepares a report.

Module grade calculation
The grade of the module is the grade of T-BGU-109412 - Lab Rotation I

Annotation
Please take into account the information regarding Lab Rotations provided in sect. 4.5 of the module hand book.

Workload
Total workload: 300 hours

- Literature study: 50 hours
- Lab work: 190 hours
- Preparation of report and presentation: 60 hours

M 6.23 Module: Lab Rotation II (RSGI-ML-1) [M-BGU-104589]

Responsible: Prof. Dr. Jan Cermak
Prof. Dr.-Ing. Stefan Hinz
apl. Prof. Dr. Boris Jutzi
Prof. Dr.-Ing. Hansjörg Kutterer
Prof. Dr.-Ing. Markus Ulrich

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

Part of: Lab Rotations

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
10	Grade to a tenth	Each term	1 term	English	5	3

Mandatory			
T-BGU-109413	Lab Rotation II	10 CR	

Competence Certificate
T-BGU-109413 - Lab Rotation II (graded, type: other)

Prerequisites
At least 45 CP shall have been acquired before a lab rotation is started.

Modeled Conditions
The following conditions have to be fulfilled:

1. You need to have earned at least 45 credits in your course of studies.

Competence Goal
The student will get insight in lab work, will learn to work in a selforganized way. Further the student will deepen his or her knowledge in the topic of choice and will then be better qualified to select the topic and the research groups which fits best to his or her personal interest.

Content
The student works on a selected topic in one of the research groups of the involved institutes. Lab rotations at external institutions are allowable. The selection of the topic is made in agreement of the supervisor and the student. The student familiarizes his or herself with the topic, carries out the lab work, and prepares a report.

Module grade calculation
The grade of the module is the grade of T-BGU-109413 - Lab Rotation II.

Annotation
Please take into account the information regarding Lab Rotations provided in sect. 4.5 of the module hand book.

Workload
Total workload: 300 hours

- Literature study: 50 hours
- Lab work: 190 hours
- Preparation of report and presentation: 60 hours

M 6.24 Module: Master's Thesis (RSGI-M) [M-BGU-104549]

Responsible: Prof. Dr. Jan Cermak
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Master's Thesis

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
30	Grade to a tenth	Each term	1 term	English	5	2

Mandatory			
T-BGU-109321	Master's Thesis	30 CR	Cermak

Competence Certificate
Written, T-BGU-109321 - Master's Thesis

Prerequisites
At least 70 CP shall have been acquired before the master thesis is started.

Modeled Conditions
You have to fulfill one of 2 conditions:

1. The following conditions have to be fulfilled:
    1. You need to have earned at least 70 credits in your course of studies.
    2. The field Remote Sensing must have been passed.
    3. The field Mathematics and Beyond must have been passed.
2. You need to have earned at least 70 credits in the following fields:

Competence Goal
The student gets further insight in lab work and will learn to work in a self-organized way. The student analyzes the given task, understands related problems, evaluates available methods to solve these problems and applies the method finally chosen. With this, the student will deepen his/her knowledge in the topic of choice and will then be better qualified to select the topic and the research groups which fits best to his/her personal interest.

Learning outcomes:

- Application of the subject-specific knowledge and methods learned during the studies.
- Self-organized conception and independent execution of a scientific project.
- Explanation and analysis of results.
- Interpretation and communication of the obtained results in written form.

Content
Execution of a scientific project under supervision.

Module grade calculation
The grade of the module is the grade of the thesis (T-BGU-109321 - Master's Thesis)

The thesis will be evaluated by the supervisor and another examiner of the faculty. In the case of disagreeing grades the arithmetic mean is calculated.

Workload
Total workload: 6 months, appr. 900 hours

Since 1 October 2024, students have 12 months to complete the specified workload. This period can be extended by a maximum of one month upon application to the Examination Commission.

M 6.25 Module: Mobile GIS / Location Based Services (GEOD-MWGI-2) [M-BGU-101045]

Responsible: Prof. Dr. Martin Breunig
Dr.-Ing. Paul Vincent Kuper

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

Part of: Profiles / Profile: Computer Vision and Geoinformatics (Compulsory Elective Modules)
Profiles / Profile: Geoinformatics and Remote Sensing of the Atmosphere (Compulsory Elective Modules)
Profiles / Profile: Geoinformatics and Environmental Geodesy (Compulsory Elective Modules)
Supplementary Modules

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
3	pass/fail	Each summer term	1 term	German/English	4	5

Mandatory			
T-BGU-101713	Mobile GIS / Location Based Services, Prerequisite	3 CR	Breunig, Kuper, Landgraf

Competence Certificate

- T-BGU-101713 Mobile GIS / Location Based Services, Prerequisite

For details of the performance assessment to be carried out, see the information provided with achievement.

Prerequisites
none

Competence Goal
The students explain the basics of mobile GIS and Location Based Services (LBS) including suitable transaction concepts. In practical use, they can, for example, acquire geodata with different hardware, manage them in a mobile database and synchronize them with a central database. Furthermore, students are able to develop an exemplary LBS application.

Regarding key competences, students are able to

- plan and implement a subject-related task in a team,
- present results and next steps individually and
- give subject-related feedback on the results of other teams.

Content
The project-oriented module elaborates and discusses the history and basics of mobile GIS and Location Based Services. The corresponding techniques are applied in practical use with different hardware. Examples are mobile geodata acquisition and mobile geodata management as well as synchronization with a central database. Furthermore, the students learn about the principles of exemplary developments and to apply them in practice.

Module grade calculation
The grade of the modul is identical with the ungraded coursework of T-BGU-101713 Mobile GIS / Location Based Services, Prerequisite.

Annotation
In mutual agreement with the students the lecture will be presented either in English or in German.

Workload
Total amount of work: 90 hours

Attendance time: 20 hours

- Courses

Self study: 70 hours

- Deepening of the study contents by reworking the lecture content at home
- Processing of exercises and preparation of status presentations
- Deepening of the study contents on the basis of suitable literature and internet research

Literature

- *Song Gao, Gengchen Mai. (2018) Mobile GIS and Location-Based Services. In Bo Huang, Thomas J. Cova, and Ming-Hsiang Tsou et al.(Eds): Comprehensive Geographic Information Systems, Vol 1, pp. 384-397, Elsevier. Oxford, UK. DOI: 10.1016/B978-0-12-409548-9.09710-4.*
- *Haosheng Huang, Georg Gartner, Jukka M. Krisp, Martin Raubal & Nico Van de Weghe (2018) Location based services: ongoing evolution and research agenda, Journal of Location Based Services, 12:2, 63-93, DOI: 10.1080/17489725.2018.1508763*

M 6.26 Module: Module Wildcard 1 Profile ComVisEnvGeo [M-BGU-104438]

Organisation: University
Part of: Profiles / Profile: Computer Vision and Environmental Geodesy (Compulsory Elective Modules)

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

Wildcard (Election: at least 1 item)			
T-BGU-109070	Wildcard 1 Profile 3	0 CR	
T-BGU-109071	Wildcard 2 Profile 3	10 CR	

Prerequisites
None

M 6.27 Module: Module Wildcard 1 Profile ComVisGeoinf [M-BGU-104436]

Organisation: University
Part of: Profiles / Profile: Computer Vision and Geoinformatics (Compulsory Elective Modules)

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

Wildcard (Election: at least 1 item)			
T-BGU-109066	Wildcard 1 Profile 1	0 CR	
T-BGU-109067	Wildcard 2 Profile 1	10 CR	

Prerequisites
None

M 6.28 Module: Module Wildcard 1 Profile ComVisRemSen [M-BGU-104437]

Organisation: University

Part of: Profiles / Profile: Computer Vision and Remote Sensing of the Atmosphere (Compulsory Elective Modules)

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

Wildcard (Election: at least 1 item)			
T-BGU-109068	Wildcard 1 Profile 2	0 CR	
T-BGU-109069	Wildcard 2 Profile 2	10 CR	

Prerequisites
None

M 6.29 Module: Module Wildcard 1 Profile GeoinfEnvGeo [M-BGU-104440]

Organisation: University
Part of: Profiles / Profile: Geoinformatics and Environmental Geodesy (Compulsory Elective Modules)

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

Wildcard (Election: at least 1 item)			
T-BGU-109074	Wildcard 1 Profile 5	0 CR	
T-BGU-109075	Wildcard 2 Profile 5	10 CR	

Prerequisites
None

M 6.30 Module: Module Wildcard 1 Profile GeoinfRemS [M-BGU-104439]

Organisation: University
Part of: Profiles / Profile: Geoinformatics and Remote Sensing of the Atmosphere (Compulsory Elective Modules)

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

Wildcard (Election: at least 1 item)			
T-BGU-109072	Wildcard 1 Profile 4	0 CR	
T-BGU-109073	Wildcard 2 Profile 4	10 CR	

Prerequisites
None

M 6.31 Module: Module Wildcard 1 Profile RemSenEnvGeo [M-BGU-104441]

Organisation: University

Part of: Profiles / Profile: Remote Sensing of the Atmosphere and Environmental Geodesy (Compulsory Elective Modules)

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

Wildcard (Election: at least 1 item)			
T-BGU-109076	Wildcard 1 Profile 6	0 CR	
T-BGU-109077	Wildcard 2 Profile 6	10 CR	

Prerequisites
None

M 6.32 Module: Numerical Mathematics (GEOD-MANM-2) [M-BGU-101013]

Responsible: Dr. rer. nat. Patrick Erik Bradley
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Mathematics and Beyond

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

Mandatory			
T-BGU-111174	Numerical Mathematics, Prerequisite *This item will not influence the grade calculation of this parent.*	1 CR	Bradley
T-BGU-111175	Numerical Mathematics, Exam	5 CR	Bradley

Competence Certificate

- T-BGU-111175 – Numerical Mathematics, Exam
- T-BGU-111174 – Numerical Mathematics, Prerequisite

For details on the assessment to be performed, see the details for the partial achievement.

Prerequisites
The module M-BGU-101012 must not have started.

Competence Goal
Students can explain the basics of numerical mathematics as well as name, formally describe, critically evaluate and apply basic numerical methods.

Content
This module provides an overview of basic numerical methods like floating point arithmetic, non-linear equations, polynomials, linear algebra, topology, approximation, partial differential equations, and numerical integration. Some applications in various disciplines are shown. The module consists of lectures and exercise sessions.

Module grade calculation
The grade of the module is the grade of the oral exam T-BGU-111175 – Numerical Mathematics, Exam

.

Annotation
None

Workload
Total workload: 180 hours

Contact hours: 60 hours

- courses plus course-related examination

Self-study: 120 hours

- consolidation of subject by recapitulation of lectures
- consolidation of subject by use of references and by own inquiry
- preparations for exam

Literature
None

M 6.33 Module: Recent Earth Observation Programs and Systems (GEOD-MWCV-7) [M-BGU-101765]

Responsible: Dr.-Ing. Uwe Weidner
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Profiles / Profile: Computer Vision and Environmental Geodesy (Compulsory Elective Modules)
Profiles / Profile: Geoinformatics and Environmental Geodesy (Compulsory Elective Modules)
Profiles / Profile: Remote Sensing of the Atmosphere and Environmental Geodesy (Compulsory Elective Modules)
Supplementary Modules

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

Mandatory			
T-BGU-103407	Recent Earth Observation Programs and Systems	2 CR	Weidner

Competence Certificate

- T-BGU-103407 Recent Earth Observation Programs and Systems

For details on the assessments to be performed, see the details for partial achivement.

Prerequisites
The module M-BGU-101824 Missions and Methods of Remote Sensing must not have started.

Competence Goal
Students are aware of recent and planned Earth observation missions and able to relate the programs and sensors to each other, but also to former Earth observation programs and systems.

Content
This module provides an introduction to recent and planned Earth observation programs and systems. The module addresses aspects of the sensors, but also planned and possible applications.

Module grade calculation
The grade of the module is the grade of the oral exam in T-BGU-103407 Recent Earth Observation Programs and Systems

Workload
Total workload: 60 hours

Contact hours: 15 hours

- courses plus course-related examination

Self-study: 45 hours

- consolidation of subject by recapitulation of lectures
- consolidation of subject by use of references and by own inquiry
- preparations for exam

Recommendation
Knowledge in remote sensing sensors is recommended.

M 6.34 Module: Remote Sensing of Atmospheric Temperature, Trace Gases, Clouds and Aerosols (RSGI-MPRA) [M-BGU-104532]

Responsible: Prof. Dr. Jan Cermak
apl. Prof. Dr. Thomas Clarmann von Clarenau
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Profiles / Profile: Computer Vision and Remote Sensing of the Atmosphere (mandatory)
Profiles / Profile: Geoinformatics and Remote Sensing of the Atmosphere (mandatory)
Profiles / Profile: Remote Sensing of the Atmosphere and Environmental Geodesy (mandatory)
Supplementary Modules

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

Mandatory			
T-BGU-111184	Remote Sensing of Aerosols and Clouds, Prerequisite *This item will not influence the grade calculation of this parent.*	1 CR	Cermak
T-BGU-109282	Remote Sensing of Atmospheric Temperature, Trace Gases, Clouds and Aerosols, Examination	4 CR	Cermak, Clarmann von Clarenau

Competence Certificate

- T-BGU-111184 - Remote Sensing of Aerosols and Clouds, Prerequisite
- T-BGU-109282 - Remote Sensing of Atmospheric Temperature, Trace Gases, Clouds and Aerosols, Examination (oral ca. 30 min.)

For details on the assessments to be performed, see the details for the partial achievements.

Prerequisites
None

Competence Goal
Course 1 Passive Remote Sensing of Atmospheric Temperature and Composition:
The students can explain the basics of passive remote sensing of atmospheric temperature and composition and the underlying radiative transfer principles. They know the advantages and drawbacks of different observation geometries, frequency ranges, and technical realizations. They know the common methods of data analysis and data characterization. Knowledge of the technical terminology enables them to read technical literature, to participate in related discussions and to prepare a master thesis in this field.

Course 2 Remote Sensing of Aerosols and Clouds:
Students explain techniques used in remote sensing of aerosols and clouds, and their specific advantages. They relate how remote sensing assessments help improve the understanding of processes involving aerosols and clouds. Students independently choose and apply methods and data sets suited for the analysis of aerosols and clouds.

Content
Course 1 Passive Remote Sensing of Atmospheric Temperature and Composition:
The use of remote sensing techniques for atmospheric measurements will be motivated. An introduction into the technical terminology is given. Measurement geometries (nadir, upward, limb, in emission and absorption) are presented and discussed. The fundamentals of radiative transfer will be recapitulated. Advantages and drawbacks of different spectral regions (UV, visible, infrared, microwave) are discussed. Exemplar satellite missions are presented. Data analysis by inverse methods applied to ill-posed problems is explained, as well as data characterization in terms of uncertainties and spatial resolution. Validation approaches are presented. An overview over career opportunities in this field is given.

Course 2 Remote Sensing of Aerosols and Clouds:

- Passive-sensor remote sensing of aerosols
- Passive-sensor remote sensing of clouds
- Active-sensor remote sensing of aerosols
- Active-sensor remote sensing of clouds
- Assessment of cloud processes and aerosol-cloud interactions

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

Workload
Total workload course 1 Passive Remote Sensing of Atmospheric Temperature and Composition: 75 hours

Contact hours: 40 hours

- courses plus course-related examination

Self-study: 35 hours

- consolidation of subject by recapitulation of lectures
- processing of exercises
- consolidation of subject by use of references and by own inquiry
- preparations for exam

Total workload course 2 Remote Sensing of Aerosols and Clouds: 75 hours

Contact hours: 30 hours

- courses plus course-related examination

Self-study: 45 hours

- consolidation of subject by preparation of presentations
- consolidation of subject by use of references and by own inquiry
- processing of exercises
- preparations for exam

Recommendation
Basics of physics and basics of matrix algebra are required. Knowledge in geosciences/climate and statistics are helpful.

M 6.35 Module: Remote Sensing of the Atmosphere (RSGI-MRRA) [M-BGU-104524]

Responsible: Prof. Dr. Jan Cermak
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Remote Sensing

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

Mandatory			
T-BGU-110304	Satellite Climatology: Remote Sensing of a Changing Climate, Prerequiste *This item will not influence the grade calculation of this parent.*	1 CR	Andersen, Cermak
T-BGU-111185	Atmospheric Remote Sensing Infrastructures, Prerequisite *This item will not influence the grade calculation of this parent.*	1 CR	Cermak
T-BGU-109274	Remote Sensing of the Atmosphere, Examination	3 CR	Cermak

Competence Certificate

- T-BGU-110304 - Satellite Climatology: Remote Sensing of a Changing Climate, Prerequiste
- T-BGU-111185 - Atmospheric Remote Sensing Infrastructures, Prerequisite
- T-BGU-109274 - Remote Sensing of the Atmosphere, Examination

For details on the assessments to be performed, see the details for the partial achievements.

Prerequisites

- M-BGU-105095 - Satellite Climatology: Remote Sensing of a Changing Climate
- M-BGU-103313 - Remote Sensing of a Changing Climate

have not been started

Competence Goal
Students explain the contribution of remote sensing to the assessment of climate change and its consequences in time and space. They relate how remote sensing assessments help further the understanding of processes driving global change. Students independently choose and apply methods and data sets suited for the analysis of specific aspects of global change.

Content

- Basics of global change: Mechanisms and patterns
- Remote sensing approaches to analysing patterns of global change:
  - Land and ocean surface
  - Atmosphere
- Remote sensing approaches to analysing mechanisms of global change:
  - Land and ocean surface
  - Atmosphere
- Links between remote sensing and other methods in global change research
- Infrastructures and systems for atmospheric remote sensing

Module grade calculation
The grade of the module is the grade of the exam T-BGU-109274 – Remote Sensing of the Atmosphere, Examination

Workload
Total workload: 150 hours
Contact hours: 55 hours

- courses plus course-related examination
- visits of atmospheric remote sensing infrastructures

Self-study: 95 hours

- consolidation of subject matters by recapitulation of lectures
- consolidation of subject matters by use of references and by own inquiry
- data analysis and data processing
- preparations for exam

Recommendation
Knowledge in geosciences/climate and statistics are helpful.

M 6.36 Module: SAR and InSAR Remote Sensing (RSGI-MPEG-6) [M-BGU-104586]

Responsible: Dr.-Ing. Thomas Grombein
Prof. Dr.-Ing. Stefan Hinz
Dr. Malte Westerhaus

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

Part of: Profiles / Profile: Computer Vision and Environmental Geodesy (Compulsory Elective Modules)
Profiles / Profile: Geoinformatics and Environmental Geodesy (Compulsory Elective Modules)
Profiles / Profile: Remote Sensing of the Atmosphere and Environmental Geodesy (Compulsory Elective Modules)
Supplementary Modules
Additional Examinations

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

Mandatory			
T-BGU-109409	SAR and InSAR Remote Sensing, Prerequisite *This item will not influence the grade calculation of this parent.*	2 CR	Grombein, Hinz, Seidel, Thiele, Westerhaus
T-BGU-109410	SAR and InSAR Remote Sensing, Examination	1 CR	Grombein, Hinz, Westerhaus

Competence Certificate

- T-BGU-109409 - SAR and InSAR Remote Sensing, Prerequisite
- T-BGU-109410 - SAR and InSAR Remote Sensing, Examination

Prerequisites
None

Competence Goal
The students understand the basic concepts of SAR remote sensing as well as SAR interferometry. They explain important aspects of SAR image generation with special focus on synthetic aperture and signal focusing. They are familiar with the basics of the interferometric processing of SAR images with public domain tools like SNAP. They know important applications of SAR and are able to identify and interpret fundamental signatures caused by deformations of the Earth's surface or moving objects. The students know the different characteristics of frequency bands used by the three satellite based SAR systems (X-, C- and L-band) and assess their fields of application. They are familiar with the ordering procedure of SAR scenes via the ESA or TerraSAR-X archives. With this lecture, the learners acquire the necessary knowledge to conduct a SAR/InSAR project from the planning phase until the interpretation of results.

Content
The module delivers basic knowledge about the use of radar satellite imagery in the frame of Remote Sensing and Geodesy. The contents reach from technical aspects concerning image generation until the evaluation of results. Focus of the lectures and exercises is the whole processing chain, including signal focusing, interferometric processing and geocoding. Further emphasis is put on the "reading" of amplitude and phase images as well as the interpretation of different signal contributions. The theoretical concepts are accompanied by practical exercises with a total fraction of 50%, which foster the ability of the learners to process and visualize SAR data. Recent and former SAR missions whose data archives form the basis of most researchand application-orientated projects, are discussed. In the frame of a praxis-orientated scenario, the students gain insight into the ordering process of SAR scenes via the software EOLI-AS which is provided by the European Space Agency (ESA).

Module grade calculation
The grade of the module is the grade of the exam T-BGU-109410 - SAR and InSAR Remote Sensing, Examination

Annotation
In mutual agreement with the students, lectures and exercises will be presented either in English or in German.

Workload
Total workload: 90 hours

Contact hours: 25 hours

- course plus course-related examination

Self-study: 65 hours

- consolidation of subject by recapitulation of lectures
- consolidation of subject by use of references and by own inquiry (e.g., literature and internet research)
- work on the content of the exercises
- preparations for exam

Recommendation
Knowledge that is taught, for example, in the courses Numerical Mathematics, Signal Processing and Remote Sensing Methods is assumed.

M 6.37 Module: Scientific Applications of GNSS (RSGI-MPEG-3) [M-BGU-104566]

Responsible: Dr.-Ing. Michael Mayer
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Profiles / Profile: Computer Vision and Environmental Geodesy (Compulsory Elective Modules) (Usage until 9/30/2025)
Profiles / Profile: Geoinformatics and Environmental Geodesy (Compulsory Elective Modules) (Usage until 9/30/2025)
Profiles / Profile: Remote Sensing of the Atmosphere and Environmental Geodesy (Compulsory Elective Modules) (Usage until 9/30/2025)
Supplementary Modules (Usage until 9/30/2025)

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

Mandatory			
T-BGU-109349	Scientific Applications of GNSS, Examination	3 CR	Mayer

Competence Certificate
other according to SPO RSGI x4/2

Prerequisites
None

Competence Goal
Subject-related competencies:

- The students are enabled to process GNSS data using scientific software (e.g., Bernese GNSS software) and to evaluate derived results.
- The learners are aware of characteristics of scientific GNSS software, especially in contrast to non-scientific software resp. online services. Therefore, they are able to adequately problem-orientated choose the most suitable software.
- The students are sensitized to datum-related GNSS aspects within Scientific Applications of GNSS (e.g. products, antenna modelling) and enabled to estimate their effects results-orientated.
- The learners realize recent research related to scientific GNSS data processing within regional GNSS networks.

Multi-disciplinary competencies:

- The learners are enabled to work self-organized, independently and reflectively. They have a good command of communication and organization skills, especially related to collaboration, presentation and discussion.
- The students recognize, re-order and explain complex GNSS contexts from a general perspective.
- The learners handle, organize and analyze large data sets.

Content
The main goal of this module is to generate deep insight into the processing of GNSS data of regional networks using scientific GNSS software. Therefore, basic fundamentals of geodetic datum in the context of products and antenna modelling are treated. The effects of selected modelling and processing strategies are analyzed in the coordinate domain with respect to strongly correlated parameters, such as tropospheric parameters.

Module grade calculation
The grade of the module is the grade of the assessment of success of other type.

Annotation
In mutual agreement with the students the lectures and exercises will be presented either in English or in German

Workload
Total workload: 90 hours

Classroom lectures: 7,5 hours

Taking the subject-related competencies of the students into account, in the beginning of the module the recent status of Scientific Applications of GNSS is presented in order to establish a fundamental basis for the project work.

Self-study: 20 hours

Taking the individual GNSS knowledge of the learners into account, scientific papers are used to deepen and advance the subject-related knowledge. Therefore, the students have to carry out individually

- consolidation by recapitulation of lectures,
- consolidation by use of references and by own inquiry.

Project meetings: 4,5 hours

During the project work, team meetings are regularly held in order to give status reports and discuss recent challenges. These meetings are of fundamental importance regarding scrutiny and systematic collaborative progress of the project.

Project work: 58 hours

The main workload is on the joint project dealing with a scientific question related to the scope of the module.

Learning type
The fundamental requirement for the assessment is the significant contribution to the project work carried out in the framework of the module. The project is conducted in teams (head count per team: max. 3). The assessment takes into account individual (in particular portfolio-based reflection) and team-related (in particular joint research project) achievements. The results of the project work have to be presented and discussed constructively (Audience: Academic staff).

M 6.38 Module: Scientific Programming (RSGI-MMCE-1) [M-BGU-104530]

Responsible: Prof. Dr. Jan Cermak
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Mathematics and Beyond

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

Scientific Programming (Election: 3 credits)			
T-BGU-112598	Introduction to Python	3 CR	Cermak, Fuchs, Vüllers
T-BGU-106765	Introduction to Matlab	3 CR	Ehret

Competence Certificate
Please see the description of the chosen compulsory elective achievement.

Prerequisites
None

Competence Goal
The students know the syntax and structure of the selected programming language and are able to apply it in the sense of programming scientific algorithms

Content
Students who have little programming experience regarding matlab/python are strongly encouraged to attend a course where they can deepen these skills (e.g., Introduction to Matlab/Python). It is strongly recommended to take a programming-related course in the first semester, therefore in summer as well as in winter terms a Matlab lecture is provided.
Instead of focusing on Matlab, students are allowed to take the winter term lecture Introduction to Python (module number 106199). Students who have more advanced programming skills and therefore wish to attend another course are advised to consult with the student advisor of the study program.

Module grade calculation
Ungraded assignment. For details please see the description of the chosen compulsory elective achievement.

Workload
ca. 90 hours. For details please see the description of the chosen compulsory elective achievement.

Recommendation
It is recommended to select a programming language which is actually used in the groups where lab rotation or master thesis in made, if such courses are available.

M 6.39 Module: Seminar Environmental Geodesy (RSGI-MPEG-2) [M-BGU-104557]

Responsible: Prof. Dr.-Ing. Hansjörg Kutterer
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Profiles / Profile: Computer Vision and Environmental Geodesy (Compulsory Elective Modules)
Profiles / Profile: Geoinformatics and Environmental Geodesy (Compulsory Elective Modules)
Profiles / Profile: Remote Sensing of the Atmosphere and Environmental Geodesy (Compulsory Elective Modules)
Supplementary Modules
Additional Examinations

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

Mandatory			
T-BGU-109338	Seminar Environmental Geodesy, Exam	2 CR	Kutterer

Competence Certificate
T-BGU-109338 - Seminar Environmental Geodesy, Exam

Prerequisites
None

Competence Goal
Subject-related competences:

- The students describe fundamental recent concepts of Earth observation and are aware of the width of this research field.
- The students are able to explore detailed technical literature with different foci, collect and structure the information provided, and are able to explain its content.
- The students contribute to the learning outcome of the seminar group by subject-specific arguments.

Inter-disciplinary competences:

- The students are able to self-responsibly organize their work and to carry it out in an independent and selfcritical manner.
- They have communication and organization skills in the fields of scientific presentation and discussion.
- The students can give and receive constructive feedback.
- The students are able to understand and analyze technical literature in English language.

Content
This course provides detailed and focused insight to the student in recent fields of Geodetic Earth system observation. To achieve this, the students participate in a (series of) scientific poster walks. The field of Earth system observation is of high current relevance, leading to a rapid change of the foci of research. This dynamical characteristic is accounted for and the most up-to-date issues find their way into the seminar which vary from semester to semester. The topical focus will be agreed with the student and is of the fields of global navigation satellite systems (GNSS), gravity field missions, or geodynamics (e.g. InSAR) with a special focus on environmental geodesy.

Module grade calculation
The grade of the module is the grade of T-BGU-109338 - Seminar Environmental Geodesy, Exam.

Annotation
In mutual agreement with the students the seminar will be held either in English of in German.

Workload
Total workload: 60 hours

- Contact time: 10 hours
  - During the contact hours individually selected topics will be explored and presented to the other students. Active participation in the seminars is compulsory.
- Self-study: 50 hours
  - Independent and focused assessment of the content; preparation and presentation of a poster including defense.

Recommendation
The students shall hold advanced knowledge in at least one topic (space-borne geodesy, physical geodesy, geodynamics).

M 6.40 Module: Seminar Remote Sensing and Geoinformatics (RSGI-SUPPL-2) [M-BGU-106896]

Responsible: Dr. Susanne Benz
Patricia Elisabeth Glocke
Dr.-Ing. Michael Mayer

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

Part of: Profiles / Profile: Geoinformatics and Remote Sensing of the Atmosphere (Compulsory Elective Modules)
(Usage from 10/1/2024)
Supplementary Modules

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

Mandatory			
T-BGU-113819	Seminar Remote Sensing and Geoinformatics, Exam	2 CR	Benz, Glocke, Mayer

Competence Certificate
T-BGU-113819 – Seminar Remote Sensing and Geoinformatics, Exam

Prerequisites
The seminars

- M-BGU-101031 - Seminar Erdsystembeobachtung
- M-BGU-101054 - Seminar Topics of Remote Sensing
- M-BGU-101057 - Seminar Topics of Image Analysis
- M-BGU-104557 - Seminar Environmental Geodesy

must not have been started.

In addition, the participants must have successfully ended at minimum seven (out of twelve) mandatory prerequisite achievements

- T-BGU-111174 - Numerical Mathematics, Prerequisite
- T-BGU-106633 - Data Analysis in Geoscience Remote Sensing Projects, Vorleistung
- T-BGU-111186 - Basics of Estimation Theory, Prerequisite
- T-BGU-110321 - Geoinformatics, Prerequisite SoSe
- T-BGU-110322 - Geoinformatics, Prerequisite WiSe
- T-BGU-110304 - Satellite Climatology: Remote Sensing of a Changing Climate, Prerequiste
- T-BGU-111185 - Atmospheric Remote Sensing Infrastructures, Prerequisite
- T-BGU-109328 - Fundamentals of Environmental Geodesy Part A
- T-BGU-109329 - Fundamentals of Environmental Geodesy Part B
- T-BGU-101759 - Methods of Remote Sensing, Prerequisite
- T-BGU-112598 - Introduction to Python
- T-BGU-106765 - Introduction to Matlab

Modeled Conditions
You have to fulfill 7 of 12 conditions:

1. The course T-BGU-106765 - Introduction to Matlab must have been passed.
2. The course T-BGU-112598 - Introduction to Python must have been passed.
3. The course T-BGU-111174 - Numerical Mathematics, Prerequisite must have been passed.
4. The course T-BGU-106633 - Data Analysis in Geoscience Remote Sensing Projects, Prerequisite must have been passed.
5. The course T-BGU-111186 - Basics of Estimation Theory, Prerequisite must have been passed.
6. The course T-BGU-110321 - Geoinformatics, Prerequisite SoSe must have been passed.
7. The course T-BGU-110322 - Geoinformatics, Prerequisite WiSe must have been passed.
8. The course T-BGU-110304 - Satellite Climatology: Remote Sensing of a Changing Climate, Prerequiste must have been passed.
9. The course T-BGU-111185 - Atmospheric Remote Sensing Infrastructures, Prerequisite must have been passed.
10. The course T-BGU-109328 - Fundamentals of Environmental Geodesy Part A must have been passed.
11. The course T-BGU-109329 - Fundamentals of Environmental Geodesy Part B must have been passed.
12. The course T-BGU-101759 - Methods of Remote Sensing, Prerequisite must have been passed.

Competence Goal
By the end of the seminar, students will be able to:

- Independently prepare a subject based on introductory lectures, references, and their inquiries.
- Search and evaluate scientific literature.
- Understand and analyze English-language scientific literature.
- Summarize the key methods described in this literature.
- Compare and evaluate these methods regarding various aspects (e.g., applicability, performance, transferability, runtime).
- Apply software tools used in this literature.
- Develop and present didactically well-structured presentations or posters.
- Provide and receive constructive feedback.
- Work independently, in a self-organized and reflective manner.

Content
This module provides insights into selected topics of remote sensing, Earth system observation, and image analysis among others. The topics are closely aligned with current research topics. Subject-specific focal points are chosen independently. Preparation includes oral presentations and the principles of good scientific practice.

Module grade calculation
The grade of the module is the grade of the coursework in T-BGU-113819 – Seminar Remote Sensing and Geoinformatics, Exam; the assessment can only be "passed" or "failed".

Annotation
Depending on the number of participants, the presentation type can vary (e.g., oral presentation in lecture hall, poster presentation).

Workload
Total workload: 60 hours

- Contact hours: 10 hours
  - Introductory courses
  - Presentations
- Self-study: 50 hours
  - Consolidation of the subject by recapitulation of introductory lectures
  - Consolidation and preparation of the subject using references and personal inquiry
  - Preparation for the final presentation

M 6.41 Module: Seminar Topics of Image Analysis (GEOD-MWEB-1) [M-BGU-101057]

Responsible: Dr. Susanne Benz
Prof. Dr.-Ing. Stefan Hinz

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

Part of: Profiles / Profile: Computer Vision and Geoinformatics (Compulsory Elective Modules)
Profiles / Profile: Computer Vision and Remote Sensing of the Atmosphere (Compulsory Elective Modules)
Profiles / Profile: Computer Vision and Environmental Geodesy (Compulsory Elective Modules)
Supplementary Modules

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

Mandatory			
T-BGU-101725	Seminar Topics of Image Analysis	2 CR	Benz, Glocke, Hinz

Competence Certificate

- T-BGU-101725 Seminar Topics of Image Analysis

For details on the assessment to be performed, see the details for the partial achievement..

Prerequisites
none

Competence Goal
At the end of the seminar, students will be able to:

- Search, read, and understand scientific articles related to image analysis
- Compile the essential methods described in those articles
- Compare and assess these methods regarding different aspects (e.g., applicability, performance, transferability, runtime)
- Apply software tools and testing methods of image analysis
- Design a didactically well-structured presentation
- Give and receive constructive feedback

Content
Contents of the module include

- introduction into selected topic
- Introduction to scientific communication and disscussions
- investigating and selecting important literature
- condensing the nucleus of the respective topic
- preparing hand-out and oral presentation

Module grade calculation
The grade of the module is the grade of the oral exam in T-BGU-101725 Seminar Topics of Image Analysis.

Annotation
None

Workload
Total workload: 60 hours

Contact hours: 15 hours

- introductory courses
- course-related examination
- presentations of other participants

Self-study: 45 hours

- consolidation of subject by recapitulation of introductory lectures
- consolidation and preparation of subject by use of references and by own inquiry
- preparations for individual exam

Recommendation
None

Literature
None

M 6.42 Module: Seminar Topics of Remote Sensing (GEOD-MWEA-1) [M-BGU-101054]

Responsible: Dr. Susanne Benz
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Profiles / Profile: Computer Vision and Environmental Geodesy (Compulsory Elective Modules)
Profiles / Profile: Geoinformatics and Remote Sensing of the Atmosphere (Compulsory Elective Modules)
Profiles / Profile: Geoinformatics and Environmental Geodesy (Compulsory Elective Modules)
Profiles / Profile: Remote Sensing of the Atmosphere and Environmental Geodesy (Compulsory Elective Modules)
Supplementary Modules

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

Mandatory			
T-BGU-101722	Seminar Topics of Remote Sensing	2 CR	Benz, Glocke

Competence Certificate

- T-BGU-101722 Seminar Topics of Remote Sensing

For details on the assessment to be performed, see the details for the partial achievement.

Prerequisites
None

Competence Goal
Students are able to prepare a subject on their own based on introductory lectures, given references and their own inquiry.

Content
This module gives insight in selected topics of remote sensing. Topics are close to actual research topics of interest and recent research of the Institute.

Module grade calculation
The grade of the module is the grade of the exam in T-BGU-101722 Seminar Topics of Remote Sensing.

Annotation
Knowledge of fundamentals in remote sensing sensors is recommended.

Workload
Total workload: 60 hours

Contact hours: 8 hours

- introductory courses plus course-related examination
- presentations

Self-study: 52 hours

- consolidation of subject by recapitulation of introductory lectures
- consolidation and preparation of subject by use of references and by own inquiry
- preparations for exam

Recommendation
None

Literature
None

M 6.43 Module: Supplementary Studies on Science, Technology and Society [M-FORUM-106753]

Responsible: Dr. Christine Mielke
Christine Myglas
Organisation: General Studies. Forum Science and Society (FORUM)
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	4	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-aktuellland 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 6.44 Module: Tomographic Laser- and Radar Sensing (GEOD-MWCV-8) [M-BGU-101052]

Responsible: Prof. Dr.-Ing. Stefan Hinz
Dr.-Ing. Andreas Schenk

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

Part of: Profiles / Profile: Computer Vision and Geoinformatics (Compulsory Elective Modules)
Profiles / Profile: Computer Vision and Remote Sensing of the Atmosphere (Compulsory Elective Modules)
Profiles / Profile: Computer Vision and Environmental Geodesy (Compulsory Elective Modules)
Supplementary Modules

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

Mandatory			
T-BGU-101724	Tomographic Laser- and Radar Sensing, Prerequisite *This item will not influence the grade calculation of this parent.*	1 CR	Hinz, Schenk
T-BGU-101723	Tomographic Laser- and Radar Sensing	2 CR	Hinz, Schenk

Competence Certificate

- T-BGU-101724 Tomographic Laser- and Radar Sensing, Vorleistung
- T-BGU-101723 Tomographic Laser- and Radar Sensing

For details on the assessments to be performed, see the details for the partial achievements..

Prerequisites
The module M-BGU-101828 Interferometric and Tomographic Laser- and Radar Sensing must not have started

Competence Goal
Students can describe the basics of tomography applied to remote sensing data. They understand how (quasi-)volumetric scattering are reconstructed from remote sensing data. Further they understand the advanced processing of Synthetic Aperture Radar (SAR) data and multi-echo or full waveform Laser data applied to tasks like automatic object characterization, atmospheric sounding and forest parameter estimation.

Content
Contents of the module include

- introduction into tomography
- SAR-Tomography
- GNSS-Tomography
- Full waveform Laserscanning
- 3D atmospheric sounding

The theoretical aspects are applied to best-practise examples during labs and home work.

Module grade calculation
The grade of the module is the grade of the oral exam in T-BGU-101723 Tomographic Laser- and Radar Sensing

Annotation
None

Workload
Total workload: 90 hours

Contact hours: 30 hours

- introductory courses plus course-related examination
- presentations

Self-study: 60 hours

- consolidation of subject by recapitulation of introductory lectures
- consolidation and preparation of subject by use of references and by own inquiry
- preparations for exam

Literature
None

M 6.45 Module: Visualization of Geodata in 2D, 3D and 4D (GEOD-MWCV-5) [M-BGU-101021]

Responsible: Dr.-Ing. Sven Wursthorn
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Supplementary Modules

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

Mandatory			
T-BGU-101703	Visualization of Geodata in 2D, 3D and 4D, Prerequisite *This item will not influence the grade calculation of this parent.*	1 CR	Wursthorn
T-BGU-101702	Visualization of Geodata in 2D, 3D and 4D	2 CR	Wursthorn

Competence Certificate

- T-BGU-101703 Visualization of Geodata in 2D, 3D and 4D, Prerequisite
- T-BGU-101702 Visualization of Geodata in 2D, 3D and 4D

For details on the assessments to be performed, see the details for the partial achievements.

Prerequisites
Module M-BGU-101096:Visualization of Spatial Data in 2D, 3D and 4D must not have started.

Competence Goal
The students describe the visualization basics and possibilities of two and three dimensional spatial data and objects. For this purpose, they use design means such as color or transparency in addition to lighting and shading models. Furthermore, they explain and implement markup languages for 3D models and programming interfaces for developing 2D as well as 3D visualizations. The students are familiar with the basic concepts of representing temporal profiles (4D). The impart knowledge of visualization concepts and methods can transferred by the students on new issues.

Content
The module provides students an overview of the main concepts in the field of visualization of two and three dimensional spatial objects. The effects of lighting and shading models will mediated. The module focuses on the use and application of programming interfaces such as OpenGL for 2D and 3D representation. Based on OpenGL skills, the module introduces the Web Graphics Library (WebGL) for a browser-based visualization of spatial objects. Above that an markup language for 3D models (e.g. X3D) as well as the rendering process at all (e.g. OGC Styled Layer Descriptor (SLD) for 2D, Blender for 3D and 4D) will introduced. The theoretical aspects are put into practice by concrete applications and examples and work on a small project.

Module grade calculation
The grade of the module is the grade of the oral exam in T-BGU-101702 Visualisierung von Geodaten in 2D, 3D und 4D

Annotation
None

Workload
Total workload: 90 hours

Contact hours: 30 hours

- courses plus course-related examination

Self-study: 60 hours

- consolidation of subject by recapitulation of lectures
- consolidation of subject by use of references and by own inquiry
- work on a project
- preparations for exam

Recommendation
Programming skills as well as knowledge of projective geometry and markup languages, such as XML, are helpful.

Literature
None

M 6.46 Module: Wildcard 1 Supplementary Modules [M-BGU-104944]

Organisation: University
Part of: Supplementary Modules

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

PH 1 Supplementary Modules (Election: at least 1 item)			
T-BGU-110049	Wildcard 1.1 Supplementary Modules	8 CR	

M 6.47 Module: Wildcard Key Competences 1 [M-BGU-104943]

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

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

Election notes
SelfAssignment included

Wildcard (Election: at least 2 credits)			
T-BGU-110047	Wildcard Key Competences 1.1 ub	1 CR	
T-BGU-110048	Wildcard Key Competences 1.2 ub	1 CR	
T-BGU-111650	Wildcard Further Key Competences 7	1 CR	
T-BGU-111651	Wildcard Further Key Competences 8	1 CR	

Prerequisites
none

7 Courses

T 7.1 Course: 3D / 4D GIS [T-BGU-101760]

Responsible: Prof. Dr. Martin Breunig
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-101042 - 3D / 4D GIS

Type	Credits	Grading scale	Recurrence	Version
Oral examination	3	Grade to a third	Each term	1

Events					
ST 2025	6026201	3D/4D GIS	2 SWS	Lecture / 🗣	Breunig
ST 2025	6026202	3D/4D GIS, Exercises	1 SWS	Practice / 🗣	Kuper, Liu

Legend: 💻 Online, 🖧 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Oral exam (about 20 min.)

Prerequisites
The part T-BGU-101781 3D / 4D GIS, Vorleistung must be passed.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-BGU-101781 - 3D / 4D GIS, Prerequisite must have been passed.

Recommendation
Knowledge in GIS and object-oriented programing is helpful.

Workload
90 hours

T 7.2 Course: 3D / 4D GIS, Prerequisite [T-BGU-101781]

Responsible: Prof. Dr. Martin Breunig
Ruiqi Liu
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-101042 - 3D / 4D GIS
Prerequisite for: T-BGU-101760 - 3D / 4D GIS

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

Events					
ST 2025	6026201	3D/4D GIS	2 SWS	Lecture / 🗣	Breunig
ST 2025	6026202	3D/4D GIS, Exercises	1 SWS	Practice / 🗣	Kuper, Liu

Legend: 📱 Online, 🌼 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
The assessment consists of an ungraded coursework based on elaboration of worksheets (number: 2, workload per worksheet: 10-15 hours) and an individual contribution to the final presentation.

Prerequisites
none

Recommendation
Knowledge in GIS and object-oriented programing is helpful.

Annotation
None

Workload
30 hours

T 7.3 Course: Active Sensors for Computer Vision [T-BGU-101840]

Responsible: apl. Prof. Dr. Boris Jutzi
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-101099 - Active Sensors for Computer Vision

Type	Credits	Grading scale	Recurrence	Version
Oral examination	3	Grade to a third	Each term	3

Competence Certificate
The assessment consists of an oral exam (about 15 min.).

Prerequisites
none

Annotation
Depending on the number of participants, the type of the exam can be changed from oral to written.

Workload
90 hours

T 7.4 Course: Advanced Gravity Field Modelling, Examination [T-BGU-109290]

Responsible: Dr. Kurt Seitz
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-104537 - Advanced Gravity Field Modelling

Type	Credits	Grading scale	Recurrence	Version
Oral examination	1	Grade to a third	Each term	1

Competence Certificate
oral (ca. 20 min.)

Prerequisites
Successfully completed exercises as prerequisite

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-BGU-109289 - Advanced Gravity Field Modelling, Prerequisite must have been passed.

T 7.5 Course: Advanced Gravity Field Modelling, Prerequisite [T-BGU-109289]

Responsible: Dr. Kurt Seitz
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-104537 - Advanced Gravity Field Modelling
Prerequisite for: T-BGU-109290 - Advanced Gravity Field Modelling, Examination

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	2	pass/fail	Each winter term	2

Competence Certificate
The assessment of performance is in the form of ungraded coursework based on the preparation of three exercises.

Prerequisites
None

Workload
60 hours

T 7.6 Course: Advanced Topics in Computer Vision, Examination [T-BGU-109280]

Responsible: Dr.-Ing. Martin Weinmann
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-104531 - Advanced Topics in Computer Vision

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each term	2

Competence Certificate
oral (ca. 20 min.)

Prerequisites
Successful completion of the exercises

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-BGU-110748 - Advanced Topics in Computer Vision, Prerequisite must have been passed.

Annotation
Depending on the number of participants, the type of the exam can be changed from oral to written.

T 7.7 Course: Advanced Topics in Computer Vision, Prerequisite [T-BGU-110748]

Responsible: Prof. Dr.-Ing. Stefan Hinz
Dr.-Ing. Martin Weinmann
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-104531 - Advanced Topics in Computer Vision
Prerequisite for: T-BGU-109280 - Advanced Topics in Computer Vision, Examination

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

Competence Certificate
Ungraded coursework: For the successful completion, 50% of the achieveable points of work sheets are needed. More details will be clearly communicated in the lectures and exercises as well as in the materials available in ILIAS.

Prerequisites
None

Workload
30 hours

T 7.8 Course: Atmospheric Remote Sensing Infrastructures, Prerequisite [T-BGU-111185]

Responsible: Prof. Dr. Jan Cermak
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-104524 - Remote Sensing of the Atmosphere
Prerequisite for: M-BGU-106896 - Seminar Remote Sensing and Geoinformatics
T-BGU-109274 - Remote Sensing of the Atmosphere, Examination

Type	Credits	Grading scale	Recurrence	Expansion	Version
Completed coursework	1	pass/fail	Each summer term	1 terms	3

Events					
ST 2025	4052201	Atmospheric Remote Sensing Infrastructures.	2 SWS	Lecture / 🗣	Cermak, Handwerker

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

Competence Certificate
The assessment consists of an ungraded coursework according based on successfully completed exercises wrt Atmospheric Remote Sensing Infrastructures. The students create a scientific presentation on a research instrument, research question and/or field campaign, and present it to their peers. The focus of the presentation is on atmospheric remote sensing infrastructures as used at KIT and elsewhere. The total time required is approximately 15 hours.

Prerequisites
none

Workload
30 hours

T 7.9 Course: Atmospheric Spectroscopy and Middle Atmosphere Research, Examination [T-BGU-109284]

Responsible: PD Dr. Frank Hase
Dr. Sören Johansson
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-104533 - Atmospheric Spectroscopy and Middle Atmospheric Research

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each term	2

Competence Certificate
oral (duration ca. 30 minutes)

Prerequisites
None

Workload
120 hours

T 7.10 Course: Augmented Reality [T-BGU-101716]

Responsible: Dr.-Ing. Sven Wursthorn
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-101047 - Augmented Reality

Type	Credits	Grading scale	Version
Oral examination	2	Grade to a third	1

Events					
WT 24/25	6026107	Augmented Reality	1 SWS	Lecture / 🗣	Wursthorn
WT 24/25	6026108	Augmented Reality, Exercises	2 SWS	Practice	Wursthorn

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

Competence Certificate
Oral exam (about 20 min.).

Prerequisites
The part T-BGU-101717 Augmented Reality, Vorleistung must be passed.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-BGU-101717 - Augmented Reality, Prerequisite must have been passed.

Workload
60 hours

T 7.11 Course: Augmented Reality, Prerequisite [T-BGU-101717]

Responsible: Dr.-Ing. Sven Wursthorn
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-101047 - Augmented Reality
Prerequisite for: T-BGU-101716 - Augmented Reality

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	2	pass/fail	Each winter term	2

Events					
WT 24/25	6026107	Augmented Reality	1 SWS	Lecture / 🗣	Wursthorn
WT 24/25	6026108	Augmented Reality, Exercises	2 SWS	Practice	Wursthorn

Legend: 📱 Online, 🎲 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Success is assessed in the form of ungraded coursework based on active participation in practical exercises, the preparation of exercise-related elaborations and the presentation of group work. Individual participation in the practical exercises is a fundamental basis for acquiring the stated application-related qualification objectives (e.g. due to the necessary hardware). The exact conditions will be announced in the lecture and ILIAS.

Prerequisites
none

Recommendation
None

Annotation
None

Workload
60 hours

T 7.12 Course: Basic Seminar Supplementary Studies on Science, Technology and Society - Self Registration [T-FORUM-113579]

Responsible: Dr. Christine Mielke
Christine Myglas
Organisation: General Studies. Forum Science and Society (FORUM)
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 studies
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 7.13 Course: Basics of Estimation Theory, Prerequisite [T-BGU-111186]

Responsible: PD Dr. Frank Hase
Prof. Dr.-Ing. Stefan Hinz

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

Part of: M-BGU-106730 - Estimation and Signal Theory for Geosciences

Prerequisite for: M-BGU-106896 - Seminar Remote Sensing and Geoinformatics
T-BGU-113539 - Estimation and Signal Theory for Geosciences, Examination

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

Prerequisites
None

Workload
30 hours

T 7.14 Course: Data Analysis in Geoscience Remote Sensing Projects, Prerequisite [T-BGU-106633]

Responsible: Hendrik Andersen
Prof. Dr. Jan Cermak
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-106730 - Estimation and Signal Theory for Geosciences
Prerequisite for: M-BGU-106896 - Seminar Remote Sensing and Geoinformatics

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	2	pass/fail	Each winter term	4

Competence Certificate
The assessment consists of a coursework based on a successful data analysis to address a geoscientific question. The analysis and the discussion of the results are submitted in a Jupyter Notebook. The detailed conditions will be announced in the lecture.

Prerequisites
None

Recommendation
None

Annotation
None

Workload
60 hours

T 7.15 Course: Deep Learning for Computer Vision and Remote Sensing, Exam [T-BGU-112865]

Responsible: Dr.-Ing. Martin Weinmann
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-106343 - Deep Learning for Computer Vision and Remote Sensing

Type	Credits	Grading scale	Recurrence	Expansion	Version
Oral examination	3	Grade to a third	Each term	1 terms	2

Competence Certificate
oral (duration ca. 30 minutes) according to SPO §4 (2) 2

Prerequisites
Completed prerequisites regarding T-BGU-112866 – Deep Learning for Computer Vision and Remote Sensing, Prerequisites

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-BGU-112866 - Deep Learning for Computer Vision and Remote Sensing, Prerequisites must have been passed.

Annotation
Depending on the number of participants, the type of the exam can be changed from oral to written.

Workload
90 hours

T 7.16 Course: Deep Learning for Computer Vision and Remote Sensing, Prerequisites [T-BGU-112866]

Responsible: Dr.-Ing. Martin Weinmann
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-106343 - Deep Learning for Computer Vision and Remote Sensing
Prerequisite for: T-BGU-112865 - Deep Learning for Computer Vision and Remote Sensing, Exam

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

Competence Certificate
Completed coursework accoring to SPO $4 (3). For the successfull completion of work sheets, 50% of the achieveable points are needed. More details will be clearly communicated in the exercises.

Prerequisites
none

Workload
60 hours

T 7.17 Course: Deformation Processes [T-BGU-109404]

Responsible: Prof. Dr.-Ing. Hansjörg Kutterer
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-104536 - Geodetic Earth Observation
Prerequisite for: T-BGU-109288 - Geodetic Earth Observation, Examination

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

Events					
ST 2025	6019404	Deformation Processes	2 SWS	Lecture / Practice (/	Kutterer, Mayer, Seidel

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
The assessment consists of a coursework based on successfully completed exercises. Students have to complete the following

- ITRF-related exercise sheet and related presentation (approx. 10 min, team effort)
- 2 practical exercises (ca. 3 hours per exercise, including onsite demo)

Prerequisites
None

Workload
60 hours

T 7.18 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: General Studies. Forum Science and Society (FORUM)

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 studies
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 7.19 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: General Studies. Forum Science and Society (FORUM)

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 studies
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 7.20 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: General Studies. Forum Science and Society (FORUM)

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 studies
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 7.21 Course: Estimation and Signal Theory for Geosciences, Examination [T-BGU-113539]

Responsible: PD Dr. Frank Hase
apl. Prof. Dr. Boris Jutzi
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-106730 - Estimation and Signal Theory for Geosciences

Type	Credits	Grading scale	Recurrence	Expansion	Version
Oral examination	5	Grade to a third	Each term	1 terms	1

Competence Certificate
oral (ca. 30 min.); focussing on the courses

- Basics of Estimation Theory
- Sensors and Signals in Computer Vision and Remote Sensing

Prerequisites

- T-BGU-111186 - Basics of Estimation Theory, Prerequisite

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-BGU-111186 - Basics of Estimation Theory, Prerequisite must have been passed.

Annotation
The content of the course Data Analysis in Geoscience Remote Sensing Projects will not be treated in this exam.

Workload
150 hours

T 7.22 Course: Fundamentals in Remote Sensing, Image Processing and Computer Vision, Examination [T-BGU-113538]

Responsible: Prof. Dr.-Ing. Stefan Hinz
Dr.-Ing. Uwe Weidner
Dr.-Ing. Martin Weinmann

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

Part of: M-BGU-106729 - Fundamentals in Remote Sensing, Image Processing and Computer Vision

Type	Credits	Grading scale	Recurrence	Expansion	Version
Oral examination	5	Grade to a third	Each term	1 terms	1

Competence Certificate
oral (ca. 30 min.)

Prerequisites
Successfully completed exercises in T-BGU-101759 – Methods of Remote Sensing, Prerequisite

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-BGU-101759 - Methods of Remote Sensing, Prerequisite must have been passed.

Annotation
Depending on the number of participants, the type of the exam can be changed from oral to written.

Workload
150 hours

T 7.23 Course: Fundamentals of Environmental Geodesy Part A [T-BGU-109328]

Responsible: Prof. Dr.-Ing. Hansjörg Kutterer
Dr. Kurt Seitz

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

Part of: M-BGU-104553 - Fundamentals of Environmental Geodesy

Prerequisite for: M-BGU-104537 - Advanced Gravity Field Modelling
M-BGU-106896 - Seminar Remote Sensing and Geoinformatics
T-BGU-109330 - Fundamentals of Environmental Geodesy, Examination

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

Competence Certificate

- Individual assessment: Written scientific protfolio: 7 learning logs, each 1 page
- Group assessment (3-4 students): scientific project report, 10-12 pages

Workload
30 hours

T 7.24 Course: Fundamentals of Environmental Geodesy Part B [T-BGU-109329]

Responsible: Prof. Dr.-Ing. Hansjörg Kutterer
Dr.-Ing. Michael Mayer

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

Part of: M-BGU-104553 - Fundamentals of Environmental Geodesy

Prerequisite for: M-BGU-106896 - Seminar Remote Sensing and Geoinformatics
T-BGU-109330 - Fundamentals of Environmental Geodesy, Examination

Type	Credits	Grading scale	Recurrence	Expansion	Version
Completed coursework	1	pass/fail	Each summer term	1 terms	3

Events					
ST 2025	6020151	Fundamentals of Environmental Geodesy - Part B	2 SWS	Lecture / Practice (/ 🗣	Mayer

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
Submission of worksheets (pages per worksheet: ca. 5, number of worksheets: 3); worksheets have to be treated individually and team-related.

Prerequisites
none

Workload
30 hours

T 7.25 Course: Fundamentals of Environmental Geodesy, Examination [T-BGU-109330]

Responsible: Prof. Dr.-Ing. Hansjörg Kutterer
Dr.-Ing. Michael Mayer
Dr. Kurt Seitz

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

Part of: M-BGU-104553 - Fundamentals of Environmental Geodesy

Type	Credits	Grading scale	Recurrence	Expansion	Version
Oral examination	3	Grade to a third	Each term	1 terms	4

Competence Certificate
Oral (ca. 30 minutes)

Prerequisites
Successfully completed prerequisites of

- T-BGU-109328 – Fundamentals of Environmental Geodesy Part A
- T-BGU-109329 – Fundamentals of Environmental Geodesy Part B

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-BGU-109328 - Fundamentals of Environmental Geodesy Part A must have been passed.
2. The course T-BGU-109329 - Fundamentals of Environmental Geodesy Part B must have been passed.

Annotation
If there are more than 10 participants, the form of the examination can be changed to a written examination (duration: 90 minutes).

Workload
90 hours

T 7.26 Course: GeoDB [T-BGU-101753]

Responsible: Prof. Dr. Martin Breunig
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-101041 - GeoDB

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	2

Events					
WT 24/25	6026101	GeoDB, Lecture	2 SWS	Lecture /	Breunig
WT 24/25	6026102	GeoDB, Exercises	1 SWS	Practice /	Kuper

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
Oral exam (about 20 min.)

Prerequisites
The part T-BGU-101754 - GeoDB, Vorleistung must be passed.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-BGU-101754 - GeoDB, Prerequisite must have been passed.

Workload
120 hours

T 7.27 Course: GeoDB, Prerequisite [T-BGU-101754]

Responsible: Prof. Dr. Martin Breunig
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-101041 - GeoDB
Prerequisite for: T-BGU-101753 - GeoDB

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	1	pass/fail	Each winter term	3

Events					
WT 24/25	6026101	GeoDB, Lecture	2 SWS	Lecture / 🗣	Breunig
WT 24/25	6026102	GeoDB, Exercises	1 SWS	Practice / 🗣	Kuper

Legend: 💻 Online, 🎲 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
The assessment of performance is in the form of ungraded coursework based on the preparation of exercises (7 session, approx. workload per session: 90-180 min.). The detailed conditions will be announced during the course and in the corresponding ILIAS course at the beginning of the current semester.

Prerequisites
None

Recommendation
Knowledge of database systems is helpful.

Workload
30 hours

T 7.28 Course: Geodetic Application of SAR Interferometry [T-BGU-101711]

Responsible: Dr.-Ing. Thomas Grombein
Dr.-Ing. Andreas Schenk
Alison Larissa Seidel

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

Part of: M-BGU-101037 - Geodetic Application of SAR Interferometry

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

Events					
WT 24/25	6025106	Geodetic Application of SAR Interferometry, Lecture	2 SWS	Lecture / 🗣	Seidel
WT 24/25	6025107	Geodetic Application of SAR Interferometry, Exercises	1 SWS	Practice / 🗣	Seidel

Legend: 📱 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Oral exam (about 20 min.)

Prerequisites
The part T-BGU-103501 Geodetic Application of SAR Interferometry, Vorleistung must be passed.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-BGU-103501 - Geodetic Application of SAR Interferometry, Prerequisite must have been passed.

Workload
60 hours

T 7.29 Course: Geodetic Application of SAR Interferometry, Prerequisite [T-BGU-103501]

Responsible: Dr.-Ing. Thomas Grombein
Dr.-Ing. Andreas Schenk
Alison Larissa Seidel

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

Part of: M-BGU-101037 - Geodetic Application of SAR Interferometry

Prerequisite for: T-BGU-101711 - Geodetic Application of SAR Interferometry

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	2	pass/fail	Each winter term	2

Events					
WT 24/25	6025106	Geodetic Application of SAR Interferometry, Lecture	2 SWS	Lecture /	Seidel
WT 24/25	6025107	Geodetic Application of SAR Interferometry, Exercises	1 SWS	Practice /	Seidel

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
The assessment consists of an ungraded coursework. The students attend at practical computer training and compile three scientific reports (length: approx. 10 pages). Depending on the number of participants, students either prepare, hold (duration: approx. 20 minutes) and defend (duration: approx. 10 minutes) a scientific presentation or compile a scientific report (length: approx. 15 pages).

Prerequisites
none

Annotation
Basic of SAR- and InSAR remote sensing are helpful.

Workload
60 hours

T 7.30 Course: Geodetic Earth Observation, Examination [T-BGU-109288]

Responsible: Prof. Dr.-Ing. Hansjörg Kutterer
Dr. Kurt Seitz
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-104536 - Geodetic Earth Observation

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

Competence Certificate
oral exam (ca. 30 min.)

Prerequisites
Successfully completed exercises

- T-BGU-109287 - Mass Variations
- T-BGU-109404 - Deformation Processes

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-BGU-109287 - Mass Variations must have been passed.
2. The course T-BGU-109404 - Deformation Processes must have been passed.

Workload
30 hours

T 7.31 Course: Geoinformatics [T-BGU-101742]

Responsible: Prof. Dr. Martin Breunig
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-101011 - Geoinformatics

Type	Credits	Grading scale	Recurrence	Version
Oral examination	3	Grade to a third	Each winter term	2

Events					
WT 24/25	6022106	Geoinformatics (Part A), Exercises	1 SWS	Practice / 🗣	Landgraf, Liu

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

Competence Certificate
The assessment consists of a oral exam (about 30 min.).

Prerequisites
The parts T-BGU-110321 - Geoinformatics, Prerequisite SoSe and T-BGU-110322 - Geoinformatics, Prerequisite WiSe must both be passed.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-BGU-110321 - Geoinformatics, Prerequisite SoSe must have been passed.
2. The course T-BGU-110322 - Geoinformatics, Prerequisite WiSe must have been passed.

Workload
90 hours

T 7.32 Course: Geoinformatics, Prerequisite SoSe [T-BGU-110321]

Responsible: Prof. Dr. Martin Breunig
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-101011 - Geoinformatics
Prerequisite for: M-BGU-106896 - Seminar Remote Sensing and Geoinformatics
T-BGU-101742 - Geoinformatics

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

Competence Certificate
The assessment consists of a coursework based on successfully completed exercises. Students have to complete the following

- 2 exercise sheets (approx. 5 resp. 15 hours per exercise sheet)
- per exercise sheet: presentation (approx. 5 min, team effort)

Prerequisites
none

Workload
30 hours

T 7.33 Course: Geoinformatics, Prerequisite WiSe [T-BGU-110322]

Responsible: Prof. Dr. Martin Breunig
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-101011 - Geoinformatics
Prerequisite for: M-BGU-106896 - Seminar Remote Sensing and Geoinformatics
T-BGU-101742 - Geoinformatics

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

Events					
WT 24/25	6022106	Geoinformatics (Part A), Exercises	1 SWS	Practice / 🗣	Landgraf, Liu

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

Competence Certificate
The assessment consists of a coursework based on successfully completed exercises. Students have to complete the following

- 2 exercise sheets (approx. 10 hours per exercise sheet)
- final presentation (approx. 20 min, team effort)

Prerequisites
none

Workload
30 hours

T 7.34 Course: GPT for Programming in Matlab and Python [T-BGU-113739]

Responsible: Dr. Mirko Mälicke
Dr. Jutta Vüllers
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-106865 - GPT for Programming in Matlab and Python

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

Events					
WT 24/25	6224909	GPT for Programming in Matlab and Python	1 SWS	Lecture /	Mälicke, Ehret, Fuchs

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
task-based homework: completion of 4 programming tasks during and at the end of the lecture period, time investment appr. 3-4 h per task

Prerequisites
One of the 'Teilleistungen' Introduction to Matlab (T-BGU-106765) or Introduction to Python (T-BGU-112598) must have been started.

Recommendation
none

Annotation
in addition to courses "Introduction to Matlab", 6224907, and "Introduction to Python", 6020130;

only selectable as additional accomplishment in the module Further Examinations;

participation limit: 100 students;

priority is given to students of *Water Science and Engineering* and *Remote Sensing and Geoinformatics* according to the progress of studywho are taking one of the two courses "Introduction to Matlab", 6224907, or "Introduction to Python", 6020130, in the current semester

Workload
30 hours

T 7.35 Course: Hyperspectral Remote Sensing [T-BGU-101720]

Responsible: Dr.-Ing. Uwe Weidner
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-101051 - Hyperspectral Remote Sensing

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

Events					
WT 24/25	6047101	Hyperspectral Remote Sensing, Lecture	1 SWS	Lecture / 🗣	Weidner
WT 24/25	6047102	Hyperspectral Remote Sensing, Exercises	1 SWS	Practice / 🗣	Weidner

Legend: 📱 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Oral exam (about 20 min.)

Prerequisites
The partial achievement T-BGU-101721 - Hyperspectral Remote Sensing, Prerequisite must be passed.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-BGU-101721 - Hyperspectral Remote Sensing, Prerequisite must have been passed.

Recommendation
Knowledge in multispectral remote sensing is recommended.

Annotation
None

Workload
60 hours

T 7.36 Course: Hyperspectral Remote Sensing, Prerequisite [T-BGU-101721]

Responsible: Dr.-Ing. Uwe Weidner
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-101051 - Hyperspectral Remote Sensing
Prerequisite for: T-BGU-101720 - Hyperspectral Remote Sensing

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	1	pass/fail	Each winter term	2

Events					
WT 24/25	6047101	Hyperspectral Remote Sensing, Lecture	1 SWS	Lecture / 🗣	Weidner
WT 24/25	6047102	Hyperspectral Remote Sensing, Exercises	1 SWS	Practice / 🗣	Weidner

Legend: 📱 Online, 🌐 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
The individual assessment consists of an ungraded coursework and is based on active participation in excercises and a ca. 5 min. presentation of a recent paper related to a topic of the lecture. The active participation in the exercises in necessary to achieve the competence goals of the lecture (e.g., software-based data analysis). The detailed conditions will be announced in the lecture and in the ILIAS course of the lecture.

Prerequisites
None

Recommendation
None

Annotation
None

Workload
30 hours

T 7.37 Course: Integrated Geodetic Earth Observing Systems, Examination [T-BGU-113744]

Responsible: Prof. Dr.-Ing. Hansjörg Kutterer
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-106859 - Integrated Geodetic Earth Observing Systems

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

Competence Certificate
oral (ca. 20 min.)

Prerequisites
Successfully completed exercises in T-BGU-113743 – Integrated Geodetic Earth Observing Systems, Prerequisite

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-BGU-113743 - Integrated Geodetic Earth Observing Systems, Prerequisite must have been passed.

Workload
30 hours

T 7.38 Course: Integrated Geodetic Earth Observing Systems, Prerequisite [T-BGU-113743]

Responsible: Prof. Dr.-Ing. Hansjörg Kutterer
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-106859 - Integrated Geodetic Earth Observing Systems
Prerequisite for: T-BGU-113744 - Integrated Geodetic Earth Observing Systems, Examination

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

Competence Certificate
3 oral presentations (ca. 10-15 min. each) on a dedicated scientific publication (e.g., journal, proceedings paper), attendance of all presentations of students attending this course, active participation in the respective discussions.

Prerequisites
None

Workload
60 hours

T 7.39 Course: Introduction to Matlab [T-BGU-106765]

Responsible: PD Dr.-Ing. Uwe Ehret
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-104530 - Scientific Programming
Prerequisite for: M-BGU-106896 - Seminar Remote Sensing and Geoinformatics

Type	Credits	Grading scale	Recurrence	Expansion	Version
Completed coursework	3	pass/fail	Each winter term	1 terms	1

Events					
WT 24/25	6224907	Introduction to Matlab	2 SWS	Lecture / Practice (/	Ehret, Wienhöfer

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
Implementation of a Matlab code within a class exercise

Prerequisites
none

Recommendation
none

Annotation
The course is limited to 60 participants. Please register via the student portal (Studierendenportal). Only in case that this should not be possible: Please register via e-mail to the responsible lecturer. Participants are selected according to their progress of study considering the following order: students of Water Science and Engineering, then students of Civil Engineering with focus 'Water and Environment', then other students.

The workload (total: 90 h, contact hours: 1 HpW = 1 h x 15 weeks) is composed as follows:

- lecture/exercise: 30 h
- independent study:
  - preparation and follow-up lecture/exercises: 10 h
  - homework: 30 h
  - take-home exam: 20 h

Workload
90 hours

Below you will find excerpts from events related to this course:

V Introduction to Matlab

6224907, WS 24/25, 2 SWS, Language: English, Open in study portal

Lecture / Practice (VÜ)
Online

Content

- Universal programming basics: Programing strategies, program structures, control structures, operators and variables, functions and objects, matrix calculations
- Basics of Matlab: History, installation, graphical user interface, tool boxes, using help
- Matlab programming basics: syntax, debugging, reading and writing of files, data visualization

Organizational issues
ONLINE CLASS!

Fr: Lecture; Wed: Tutorial

The course is limited to 60 participants. Please register for the course via Campus Management. Only in case that this should not be possible: Please register via e-mail to the responsible lecturer.

Participants are selected according to the progress in their studies and in the following order: Students of Water Science and Engineering, then students of Civil Engineering with focus Water and Environment, then other students.

T 7.40 Course: Introduction to Python [T-BGU-112598]

Responsible: Prof. Dr. Jan Cermak
Dr. Julia Fuchs
Dr. Jutta Vüllers

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

Part of: M-BGU-104530 - Scientific Programming
M-BGU-106199 - Introduction to Python

Prerequisite for: M-BGU-106896 - Seminar Remote Sensing and Geoinformatics

Type	Credits	Grading scale	Recurrence	Expansion	Version
Completed coursework (practical)	3	pass/fail	Each winter term	1 terms	2

Events					
WT 24/25	6020130	Introduction to Python	2 SWS	Lecture / Practice (/	Fuchs, Bork-Unkelbach

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
Successfully completed exercises focussing on implementation and documentation of a Python code.

Prerequisites
None

Recommendation
None

Annotation
The associated lecture is especially intended for students of the

- MSc Geodäsie und Geoinformatik and MSc Remote Sensing and Geoinformatics and
- MSc Environmental Informatics and Earth Observation.

External students may attend the course if there is sufficient capacity. External students communicate their individual interest to participate in this lecture at the latest one week before the start of the lectures via e-mail to anja.carle@kit.edu receive positive/ negative feedback regarding the possibility of participation.

The total workload is 90 hours and has to be invested in

- Contact hours: 20 hours
- Self-study: 70 hours
  - consolidation of subject by recapitulation of lectures, by use of references and by own inquiry (40 hours)
  - working on exercises (30 hours)

Workload
90 hours

T 7.41 Course: Lab Rotation I [T-BGU-109412]

Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-104588 - Lab Rotation I

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	10	Grade to a third	Each term	1

Competence Certificate

- written scientific report (ca. 20 pages)
- oral presentation of work (ca. 20 min.)
- scientific defense of work (ca. 10 min.)

Prerequisites
at least 45 CP shall have been acquired before a lab rotation is started.

Modeled Conditions
You have to fulfill one of 2 conditions:

1. You need to have earned at least 45 credits in the following fields:
2. You need to have earned at least 45 credits in the following fields:
    - Key Competences
    - Mathematics and Beyond
    - Profiles
    - Remote Sensing
    - Supplementary Modules

Workload
300 hours

T 7.42 Course: Lab Rotation II [T-BGU-109413]

Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-104589 - Lab Rotation II

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	10	Grade to a third	Each term	1

Competence Certificate

- written scientific report (ca. 20 pages)
- oral presentation of work (ca. 20 min.)
- scientific defense of work (ca. 10 min.)

Prerequisites
at least 45 CP shall have been acquired before a lab rotation is started.

Modeled Conditions
You have to fulfill one of 2 conditions:

1. You need to have earned at least 45 credits in the following fields:
2. You need to have earned at least 45 credits in the following fields:
    - Key Competences
    - Mathematics and Beyond
    - Profiles
    - Remote Sensing
    - Supplementary Modules

Workload
300 hours

T 7.43 Course: Lecture Series Supplementary Studies on Science, Technology and Society - Self Registration [T-FORUM-113578]

Responsible: Dr. Christine Mielke
Christine Myglas
Organisation: General Studies. Forum Science and Society (FORUM)
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 studies
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 7.44 Course: Mass Variations [T-BGU-109287]

Responsible: Prof. Dr.-Ing. Hansjörg Kutterer
Dr. Kurt Seitz
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-104536 - Geodetic Earth Observation
Prerequisite for: T-BGU-109288 - Geodetic Earth Observation, Examination

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	2	pass/fail	Each winter term	2

Competence Certificate
Successful completion of three exercise sheets.

Prerequisites
None

Workload
60 hours

T 7.45 Course: Master's Thesis [T-BGU-109321]

Responsible: Prof. Dr. Jan Cermak
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-104549 - Master's Thesis

Type	Credits	Grading scale	Recurrence	Expansion	Version
Final Thesis	30	Grade to a third	Each term	1 terms	3

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

Submission deadline	12 months
Maximum extension period	1 months
Correction period	8 weeks

Workload
900 hours

T 7.46 Course: Methods of Remote Sensing, Prerequisite [T-BGU-101759]

Responsible: Dr.-Ing. Uwe Weidner
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-106729 - Fundamentals in Remote Sensing, Image Processing and Computer Vision
Prerequisite for: M-BGU-106896 - Seminar Remote Sensing and Geoinformatics
T-BGU-113538 - Fundamentals in Remote Sensing, Image Processing and Computer Vision, Examination

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	1	pass/fail	Each winter term	2

Events					
WT 24/25	6048101	Methods of Remote Sensing, Lecture	1 SWS	Lecture / 🗣	Weidner
WT 24/25	6048102	Methods of Remote Sensing, Exercises	1 SWS	Practice / 🗣	Weidner

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

Competence Certificate
Assessment of success is in the form of an ungraded coursewoork based on active participation during excercisees and performing a classification within the excercises. Individual active participation in the practical exercises is a fundamental prerequisite for acquiring the qualification objectives and due to hardware and software. The exact conditions will be announced in the lecture and ILIAS.

Prerequisites
none

Recommendation
None

Annotation
None

Workload
30 hours

T 7.47 Course: Mobile GIS / Location Based Services, Prerequisite [T-BGU-101713]

Responsible: Prof. Dr. Martin Breunig
Dr.-Ing. Paul Vincent Kuper
Steven Landgraf

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

Part of: M-BGU-101045 - Mobile GIS / Location Based Services

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	3	pass/fail	Each summer term	3

Events					
ST 2025	6026206	Mobile GIS/Location Based Services	1 SWS	Lecture / 🗣	Kuper
ST 2025	6026207	Mobile GIS/Location Based Services, Exercises	1 SWS	Practice / 🗣	Kuper

Legend: 📱 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
The control of success is carried out as an ungraded study achievement based on project-based software development in teams of 2-5 students (status presentations: duration ca. 10 min.; final posterpresentation: ca. 20 min.). In the context of ensuring the key competence related qualification objectives, attendance at project meetings is mandatory. Further conditions will be announced in the lecture and ILIAS in detail.

Prerequisites
None

Recommendation
None

Annotation
None

Workload
90 hours

T 7.48 Course: Numerical Mathematics, Exam [T-BGU-111175]

Responsible: Dr. rer. nat. Patrick Erik Bradley
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-101013 - Numerical Mathematics

Type	Credits	Grading scale	Recurrence	Expansion	Version
Written examination	5	Grade to a third	Each term	1 terms	3

Events					
WT 24/25	6061101	Numerische Mathematik	3 SWS	Lecture / 🗣	Bradley

Legend: 📱 Online, 🎭 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
The assessment consists of a written exam (duration 60 min.).

Prerequisites
T-BGU-111174 – Numerical Mathematics, Prerequsite (Version 1)

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-BGU-111174 - Numerical Mathematics, Prerequisite must have been passed.

Workload
150 hours

T 7.49 Course: Numerical Mathematics, Prerequisite [T-BGU-111174]

Responsible: Dr. rer. nat. Patrick Erik Bradley
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-101013 - Numerical Mathematics
Prerequisite for: M-BGU-106896 - Seminar Remote Sensing and Geoinformatics
T-BGU-111175 - Numerical Mathematics, Exam

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

Events					
WT 24/25	6061101	Numerische Mathematik	3 SWS	Lecture / 🗣	Bradley

Legend: 📱 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
The following prerequisites must be met in order to pass the ungraded assessment:

- At least 50% of the total score on the exercise sheets (incl. matlab tasks) must be achieved.

Workload
30 hours

T 7.50 Course: Recent Earth Observation Programs and Systems [T-BGU-103407]

Responsible: Dr.-Ing. Uwe Weidner
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-101765 - Recent Earth Observation Programs and Systems

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

Events					
ST 2025	6048201	Recent Earth Observation Programs and Systems	1 SWS	Lecture /	Weidner

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
The assessment consists of an examination of another type. A presentation (about 20-25 minutes) including a discussion about a given topic is the basis for the grading.

Prerequisites
None

Modeled Conditions
The following conditions have to be fulfilled:

1. The following conditions have to be fulfilled:

Recommendation
None

Annotation
Knowledge of sensors and apllications in remote sensing are recommended.

Workload
60 hours

T 7.51 Course: Registration for Certificate Issuance - Supplementary Studies on Science, Technology and Society [T-FORUM-113587]

Responsible: Dr. Christine Mielke
Christine Myglas
Organisation: General Studies. Forum Science and Society (FORUM)
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 7.52 Course: Remote Sensing of Aerosols and Clouds, Prerequisite [T-BGU-111184]

Responsible: Prof. Dr. Jan Cermak
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-104532 - Remote Sensing of Atmospheric Temperature, Trace Gases, Clouds and Aerosols
Prerequisite for: T-BGU-109282 - Remote Sensing of Atmospheric Temperature, Trace Gases, Clouds and Aerosols, Examination

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

Prerequisites
None

T 7.53 Course: Remote Sensing of Atmospheric Temperature, Trace Gases, Clouds and Aerosols, Examination [T-BGU-109282]

Responsible: Prof. Dr. Jan Cermak
apl. Prof. Dr. Thomas Clarmann von Clarenau
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-104532 - Remote Sensing of Atmospheric Temperature, Trace Gases, Clouds and Aerosols

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each term	2

Competence Certificate
oral (ca. 30 min.)

Prerequisites
Successful completion of exercise of course 2

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-BGU-111184 - Remote Sensing of Aerosols and Clouds, Prerequisite must have been passed.

Workload
120 hours

T 7.54 Course: Remote Sensing of the Atmosphere, Examination [T-BGU-109274]

Responsible: Prof. Dr. Jan Cermak
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-104524 - Remote Sensing of the Atmosphere

Type	Credits	Grading scale	Recurrence	Version
Oral examination	3	Grade to a third	Each term	4

Competence Certificate
oral (ca. 20 min.)

Prerequisites
T-BGU-110304 - Satellite Climatology: Remote Sensing of a Changing Climate, Prerequiste and T-BGU-111185 - Atmospheric Remote Sensing Infrastructures, Prerequisite have to be successfully passed

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-BGU-110304 - Satellite Climatology: Remote Sensing of a Changing Climate, Prerequiste must have been passed.
2. The course T-BGU-111185 - Atmospheric Remote Sensing Infrastructures, Prerequisite must have been passed.

Annotation
If there are more than 15 students participating in this exam, there will be a written exam (duration: 90 minutes).

Workload
90 hours

T 7.55 Course: SAR and InSAR Remote Sensing, Examination [T-BGU-109410]

Responsible: Dr.-Ing. Thomas Grombein
Prof. Dr.-Ing. Stefan Hinz
Dr. Malte Westerhaus

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

Part of: M-BGU-104586 - SAR and InSAR Remote Sensing

Type	Credits	Grading scale	Expansion	Version
Oral examination	1	Grade to a third	1 terms	1

Competence Certificate
oral (ca. 20 min.).

Prerequisites
Prerequisite in SAR and InSAR Remote Sensing

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-BGU-109409 - SAR and InSAR Remote Sensing, Prerequisite must have been passed.

Workload
30 hours

T 7.56 Course: SAR and InSAR Remote Sensing, Prerequisite [T-BGU-109409]

Responsible: Dr.-Ing. Thomas Grombein
Prof. Dr.-Ing. Stefan Hinz
Alison Larissa Seidel
Dr.-Ing. Antje Thiele
Dr. Malte Westerhaus

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

Part of: M-BGU-104586 - SAR and InSAR Remote Sensing

Prerequisite for: T-BGU-109410 - SAR and InSAR Remote Sensing, Examination

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

Competence Certificate
The assessment consists of an ungraded coursework based on successfully completed exercises. The students participate successfully in the exercises data research and InSAR data analysis:

- Data research: processing, presentation (duration: approx. 15 min) and discussion of the results,
- InSAR data analysis: practical PC-based exercise with onsite demo (3 hours), leading question-based report (~ 5 pages).

Prerequisites
none

Workload
60 hours

T 7.57 Course: Satellite Climatology: Remote Sensing of a Changing Climate, Prerequiste [T-BGU-110304]

Responsible: Hendrik Andersen
Prof. Dr. Jan Cermak

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

Part of: M-BGU-104524 - Remote Sensing of the Atmosphere

Prerequisite for: M-BGU-106896 - Seminar Remote Sensing and Geoinformatics
T-BGU-109274 - Remote Sensing of the Atmosphere, Examination

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

Events					
ST 2025	6043106	Satellite Climatology: Remote Sensing of a Changing Climate, Lecture	2 SWS	Lecture /	Cermak
ST 2025	6043107	Satellite Climatology: Remote Sensing of a Changing Climate, Exercises	1 SWS	Practice /	Andersen

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
Success is assessed in the form of an ungraded coursework. Analysis and evaluation of remote sensing datasets in scripts written by the students. The students will hand in their results in the form of scripts and/or a report on the findings. Approximately four such exercises are to be completed, the overall time demand is about 15 hours. The detailed conditions will be announced in the lecture and ILIAS.

Prerequisites
The parts T-BGU-106333 - Remote Sensing of a Changing Climate, Vorleistung and T-BGU-101732 - Image Processing and Computer Vision must not haved started.

Workload
30 hours

T 7.58 Course: Scientific Applications of GNSS, Examination [T-BGU-109349]

Responsible: Dr.-Ing. Michael Mayer
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-104566 - Scientific Applications of GNSS

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

Competence Certificate
report (ca. 10 pages) on self-selected research question

Prerequisites
None

Workload
90 hours

T 7.59 Course: SelfAssignment-MScRSGI-1-graded [T-BGU-111706]

Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-104711 - Further Key Competences

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

Competence Certificate
according to the assignment to be credited

Prerequisites
none

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

- House of Competence
- Sprachenzentrum
- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- Studienkolleg
- Personalentwicklung und Berufliche Ausbildung

Recommendation
none

Annotation
'Not assigned grades' can be assigned by the students themselves; titel and credit points of the grades are transferred.

Workload
60 hours

T 7.60 Course: SelfAssignment-MScRSGI-2-graded [T-BGU-111707]

Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-104711 - Further Key Competences

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

Competence Certificate
according to the assignment to be credited

Prerequisites
none

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

- House of Competence
- Sprachenzentrum
- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- Studienkolleg
- Personalentwicklung und Berufliche Ausbildung

Recommendation
none

Annotation
'Not assigned grades' can be assigned by the students themselves; titel and credit points of the grades are transferred.

Workload
60 hours

T 7.61 Course: SelfAssignment-MScRSGI-3-ungraded [T-BGU-111708]

Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-104711 - Further Key Competences

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

Competence Certificate
according to the assignment to be credited

Prerequisites
none

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

- House of Competence
- Sprachenzentrum
- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- Studienkolleg
- Personalentwicklung und Berufliche Ausbildung

Recommendation
none

Annotation
'Not assigned achievements' can be assigned by the students themselves; titel and credit points of the grades are transferred.

Workload
60 hours

T 7.62 Course: SelfAssignment-MScRSGI-4-ungraded [T-BGU-111709]

Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-104711 - Further Key Competences

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

Competence Certificate
according to the assignment to be credited

Prerequisites
none

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

- House of Competence
- Sprachenzentrum
- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- Studienkolleg
- Personalentwicklung und Berufliche Ausbildung

Recommendation
none

Annotation
'Not assigned achievements' can be assigned by the students themselves; titel and credit points of the grades are transferred.

Workload
60 hours

T 7.63 Course: Seminar Environmental Geodesy, Exam [T-BGU-109338]

Responsible: Prof. Dr.-Ing. Hansjörg Kutterer
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-104557 - Seminar Environmental Geodesy

Type	Credits	Grading scale	Recurrence	Expansion	Version
Examination of another type	2	Grade to a third	Each summer term	1 terms	3

Competence Certificate
The assessment consists in the independent thorough scientific treatment of a recent research topic within the field of Earth system observation. Starting from a seminal article in a scientific journal the student acquires new topical competences and presents these in a didactically adequate manner, e.g. as an oral poster presentation of 5 (+/-1) minutes to the other students and the scientific staff. It follows a defense of the content of the presentation. Further, active participation in seminar events of this module is compulsory in order to guarantee the achievement of the qualification goals (e.g., discussion skills). The grade is determined based on:

- correctness & selection of presented information (40%)
- keeping in time (obligatory criterion)
- performance in discussion (30%)
- scientific work during the preparation phase (20%)
- 2 page abstract of own topic (10%)
- active participating in discussion wrt (at least 1) presentation of other students (obligatory criterion)
- summary (1/2 page per presentation) of presentations of other participants (obligatory criterion)

Prerequisites
none

Workload
60 hours

T 7.64 Course: Seminar Remote Sensing and Geoinformatics, Exam [T-BGU-113819]

Responsible: Dr. Susanne Benz
Patricia Elisabeth Glocke
Dr.-Ing. Michael Mayer

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

Part of: M-BGU-106896 - Seminar Remote Sensing and Geoinformatics

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

Competence Certificate
The assessment consists of an ungraded examination. A short presentation (oral: ca. 20 minutes; poster: ca. 5 minutes) including a discussion about a given topic is the basis for the grading.

The assessment is based on the independent thorough scientific treatment of a recent research topic within the field of Remote Sensing and Geoinformatics. The student presents findings in a didactically adequate manner to students and scientific staff. It follows a defense of the content of the presentation. Further, active participation in seminar events of this module is compulsory. The grade is determined based on:

- correctness & selection of presented information (40%)
- keeping in time (obligatory criterion)
- performance in discussion (20%)
- presentation in accordance with checklist (30%)
- scientific work during the preparation phase (10%)
- active participating in discussion wrt presentations of other participants (obligatory)
- summerizing of presentations of at minimum two other participants (oligatory)

Further details will be provided at beginning of seminar (e.g., ILIAS, lecture).

Prerequisites
see description of module

Workload
60 hours

T 7.65 Course: Seminar Topics of Image Analysis [T-BGU-101725]

Responsible: Dr. Susanne Benz
Patricia Elisabeth Glocke
Prof. Dr.-Ing. Stefan Hinz

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

Part of: M-BGU-101057 - Seminar Topics of Image Analysis

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	2	Grade to a third	Each winter term	3

Competence Certificate
The assessment consists of an exam of type Other. A presentation (approx. 20 - 25 minutes) followed by a discussion on an image analysis related topic and the active participation in the discussion on topics of other participants are basis for the grade. Active participation in the course is essential for achieving the qualification objectives (e.g. giving and accepting feedback). The exact conditions will be announced in the course and in the corresponding ILIAS course.

Prerequisites
none

Workload
60 hours

T 7.66 Course: Seminar Topics of Remote Sensing [T-BGU-101722]

Responsible: Dr. Susanne Benz
Patricia Elisabeth Glocke
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-101054 - Seminar Topics of Remote Sensing

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	2	Grade to a third	Each summer term	3

Competence Certificate
The assessment consists of an examination of another type according. A short presentation (about 20-25 minutes) including a discussion about a given topic is the basis for the grading. Details will be provided at beginning of seminar.

Prerequisites
None

Recommendation
Knowledge of fundamentals in remote sensing sensors is recommended.

Annotation
none

Workload
60 hours

T 7.67 Course: Tomographic Laser- and Radar Sensing [T-BGU-101723]

Responsible: Prof. Dr.-Ing. Stefan Hinz
Dr.-Ing. Andreas Schenk
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-101052 - Tomographic Laser- and Radar Sensing

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

Events					
ST 2025	6043212	Tomographic Laser- and Radar Sensing	1 SWS	Lecture / 🗣	Schenk, Hinz
ST 2025	6043213	Tomographic Laser- and Radar Sensing, Tutorial	1 SWS	Practice / 🗣	Schenk

Legend: 📱 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Oral exam (about 20 min.)

Prerequisites
The part T-BGU-101724 Tomographic Laser- and Radar Sensing, Prerequisite must be passed.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-BGU-101724 - Tomographic Laser- and Radar Sensing, Prerequisite must have been passed.

Workload
60 hours

T 7.68 Course: Tomographic Laser- and Radar Sensing, Prerequisite [T-BGU-101724]

Responsible: Prof. Dr.-Ing. Stefan Hinz
Dr.-Ing. Andreas Schenk
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-101052 - Tomographic Laser- and Radar Sensing
Prerequisite for: T-BGU-101723 - Tomographic Laser- and Radar Sensing

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

Events					
ST 2025	6043212	Tomographic Laser- and Radar Sensing	1 SWS	Lecture /	Schenk, Hinz
ST 2025	6043213	Tomographic Laser- and Radar Sensing, Tutorial	1 SWS	Practice /	Schenk

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
The assessment consists of a coursework based on elaboration of one excercise sheet, a short presentation of a publication (ca. 10 min.), project work and presentation of the project work (ca. 10 min. incl. discussion). Participation all simultaneously held sessions (e.g., presentations) is individually compulsory. Further conditions regarding the assessment will be announced in the lecture.

Prerequisites
None

Recommendation
None

Annotation
None

Workload
30 hours

T 7.69 Course: Visualization of Geodata in 2D, 3D and 4D [T-BGU-101702]

Responsible: Dr.-Ing. Sven Wursthorn
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-101021 - Visualization of Geodata in 2D, 3D and 4D

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

Events					
ST 2025	6043206	Visualization of Geodatas in 2D, 3D and 4D	1 SWS	Lecture / 🗣	Wursthorn
ST 2025	6043207	Visualization of Geodatas in 2D, 3D and 4D, Exercises	1 SWS	Practice / 🗣	Wursthorn

Legend: 📱 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Oral exam (about 20 min.)

Prerequisites
The part T-BGU-101703 Visualisierung von Geodaten in 2D, 3D und 4D, Vorleistung must be passed.

Workload
60 hours

T 7.70 Course: Visualization of Geodata in 2D, 3D and 4D, Prerequisite [T-BGU-101703]

Responsible: Dr.-Ing. Sven Wursthorn
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-101021 - Visualization of Geodata in 2D, 3D and 4D

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

Events					
ST 2025	6043206	Visualization of Geodatas in 2D, 3D and 4D	1 SWS	Lecture / 🗣	Wursthorn
ST 2025	6043207	Visualization of Geodatas in 2D, 3D and 4D, Exercises	1 SWS	Practice / 🗣	Wursthorn

Legend: 📱 Online, 🌀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
The assessment consists of an ungraded coursework based on elaborations of excercise sheets. The detailled conditions will be announced in the lecture and in the associated ILIAS-course.

Prerequisites
None

Recommendation
None

Annotation
None

Workload
30 hours

T 7.71 Course: Wildcard 1 Profile 1 [T-BGU-109066]

Organisation: University
Part of: M-BGU-104436 - Module Wildcard 1 Profile ComVisGeoinf

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

T 7.72 Course: Wildcard 1 Profile 2 [T-BGU-109068]

Organisation: University
Part of: M-BGU-104437 - Module Wildcard 1 Profile ComVisRemSen

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

T 7.73 Course: Wildcard 1 Profile 3 [T-BGU-109070]

Organisation: University
Part of: M-BGU-104438 - Module Wildcard 1 Profile ComVisEnvGeo

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

T 7.74 Course: Wildcard 1 Profile 4 [T-BGU-109072]

Organisation: University
Part of: M-BGU-104439 - Module Wildcard 1 Profile GeoinfRemS

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

T 7.75 Course: Wildcard 1 Profile 5 [T-BGU-109074]

Organisation: University
Part of: M-BGU-104440 - Module Wildcard 1 Profile GeoinfEnvGeo

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

T 7.76 Course: Wildcard 1 Profile 6 [T-BGU-109076]

Organisation: University
Part of: M-BGU-104441 - Module Wildcard 1 Profile RemSenEnvGeo

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

T 7.77 Course: Wildcard 1.1 Supplementary Modules [T-BGU-110049]

Organisation: University
Part of: M-BGU-104944 - Wildcard 1 Supplementary Modules

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	8	Grade to a third	Each term	1

T 7.78 Course: Wildcard 2 Profile 1 [T-BGU-109067]

Organisation: University
Part of: M-BGU-104436 - Module Wildcard 1 Profile ComVisGeoinf

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	10	Grade to a third	Each term	1

T 7.79 Course: Wildcard 2 Profile 2 [T-BGU-109069]

Organisation: University
Part of: M-BGU-104437 - Module Wildcard 1 Profile ComVisRemSen

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	10	Grade to a third	Each term	1

T 7.80 Course: Wildcard 2 Profile 3 [T-BGU-109071]

Organisation: University
Part of: M-BGU-104438 - Module Wildcard 1 Profile ComVisEnvGeo

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	10	Grade to a third	Each term	1

T 7.81 Course: Wildcard 2 Profile 4 [T-BGU-109073]

Organisation: University
Part of: M-BGU-104439 - Module Wildcard 1 Profile GeoinfRemS

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	10	Grade to a third	Each term	1

T 7.82 Course: Wildcard 2 Profile 5 [T-BGU-109075]

Organisation: University
Part of: M-BGU-104440 - Module Wildcard 1 Profile GeoinfEnvGeo

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	10	Grade to a third	Each term	1

T 7.83 Course: Wildcard 2 Profile 6 [T-BGU-109077]

Organisation: University
Part of: M-BGU-104441 - Module Wildcard 1 Profile RemSenEnvGeo

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	10	Grade to a third	Each term	1

T 7.84 Course: Wildcard Additional Examinations 1 [T-BGU-109599]

Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-104713 - Further Examinations

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

T 7.85 Course: Wildcard Additional Examinations 6 [T-BGU-109604]

Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-104713 - Further Examinations

Type	Credits	Grading scale	Version
Examination of another type	5	Grade to a third	1

T 7.86 Course: Wildcard Further Key Competences 1 ub [T-BGU-109594]

Organisation: University

Part of: M-BGU-104711 - Further Key Competences
M-BGU-104712 - Further Key Competences

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

T 7.87 Course: Wildcard Further Key Competences 2 ub [T-BGU-109595]

Organisation: University

Part of: M-BGU-104711 - Further Key Competences
M-BGU-104712 - Further Key Competences

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

T 7.88 Course: Wildcard Further Key Competences 3 ub [T-BGU-109596]

Organisation: University
Part of: M-BGU-104711 - Further Key Competences

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

T 7.89 Course: Wildcard Further Key Competences 4 ub [T-BGU-109597]

Organisation: University
Part of: M-BGU-104711 - Further Key Competences

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

T 7.90 Course: Wildcard Further Key Competences 5 [T-BGU-111648]

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

Part of: M-BGU-104711 - Further Key Competences
M-BGU-104712 - Further Key Competences

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

T 7.91 Course: Wildcard Further Key Competences 6 [T-BGU-111649]

Organisation: University

Part of: M-BGU-104711 - Further Key Competences
M-BGU-104712 - Further Key Competences

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

T 7.92 Course: Wildcard Further Key Competences 7 [T-BGU-111650]

Organisation: University
Part of: M-BGU-104943 - Wildcard Key Competences 1

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

T 7.93 Course: Wildcard Further Key Competences 8 [T-BGU-111651]

Organisation: University
Part of: M-BGU-104943 - Wildcard Key Competences 1

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

T 7.94 Course: Wildcard Key Competences 1.1 ub [T-BGU-110047]

Organisation: University
Part of: M-BGU-104943 - Wildcard Key Competences 1

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

T 7.95 Course: Wildcard Key Competences 1.2 ub [T-BGU-110048]

Organisation: University
Part of: M-BGU-104943 - Wildcard Key Competences 1

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

Chapter 8

Contacts

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