Departmental Study Regulations for the

Master of Geomatics

of the Neubrandenburg University of Applied Sciences
dated 20 May 2021

First amendment statute dated: 22 May 2023

On the basis of the Framework Examination Regulations of the Neubrandenburg University of Applied Sciences dated 16 August 2017 combined with section 2(1) and section 39(1) of the State University Act of Mecklenburg-Vorpommern in the version of the notification dated 25 January 2011 (Official Gazette of the State of Mecklenburg-Vorpommern, GVOBl. M-V, p 18), last amended by Article 1 of the Act dated 28 September 2020 (GVOBl. M-V, p 878), the Neubrandenburg University of Applied Sciences has issued the following Departmental Study Regulations for the Master of Geomatics as a statute.

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Section 1
Scope

These Departmental Study Regulations regulate the objective, contents and structure of the course and major fields of study based on the Framework Examination Regulations and the Departmental Examination Regulations for the Master of Geomatics of the Neubrandenburg University of Applied Sciences dated 20 May 2021.

Section 2
Study objectives

The aim of the Master of Geomatics is to independently complete tasks in geodesy and geoinformatics as well as industrial metrology within a specified time frame on a scientific basis. The Master's course enables optional in-depth study in a specialist area in the majors geodesy and land surveying, geoinformatics, engineering surveying and measuring technology. The Master's course provides students with broad specialist knowledge based on applied theory as well as the ability to accountably identify practical problems in the field of geodesy and geoinformatics, develop cost-effective solutions that are compliant with regulations, critically weigh them up against one another and successfully implement a chosen solution in practice. Taking on accountable tasks requires confidence and decisiveness as well as professional expertise and the ability to cooperate. Accordingly, students are also taught key qualifications and encouraged to develop personal awareness.

Section 3
Start of the course

(1) The course can be started in the summer or winter semester. Students must enrol by the deadlines specified each year by the administration of the Neubrandenburg University of Applied Sciences. Applications are generally made online on the University portal.

(2) If the Examination Board has defined a preliminary semester according to section 3(5) of the Departmental Examination Regulations, students are informed of the specific prerequisites and associated pass requirements through a notification from the Enrolments and Examination Office. The notification is used as the basis for choosing modules for the normal Master's course.

Section 4

Structure of the course

(1) The course is divided as a rule into three semesters with a course duration of up to 37 semester credit hours (CH). In the case of section 3(5) of the Departmental Examination Regulations, the normal duration of study is four semesters. As defined by the European system for calculating credits for academic achievements, 30 ECTS credits are assigned to each semester, giving a total of 90 ECTS credits for three semesters or 120 ECTS credits for four semesters.

(2) The course is divided into modules. Modules are completed teaching units that combine thematically related teaching material. Successfully completing a module is documented by a module examination, which must be passed as a requirement for awarding the ECTS credits designated for this module.

(3) The individual modules in each semester are listed in the course structure that forms part of these Departmental Study Regulations (Appendix 1). The course structure is a didactically justified recommendation that enables completion of the course within the normal study period.

Section 5
Organisation and contents of the course

(1) The course is structured as follows, with a normal duration of study of three semesters (see Appendix 1):

1. In the first and second semester a total of ten modules must be selected. The modules include one compulsory module and nine compulsory elective modules. The compulsory elective modules are offered in one of the three majors, in mathematics and in the general subjects at Master's level.

2. To specify a major to complete the course, students choose four modules in one of the majors geodesy and land surveying, geoinformatics, engineering surveying and measuring technology as well as one module from the mathematics subjects and one module from the general subjects. Details about the number and choice of modules are regulated in section 6a of the Departmental Examination Regulations.

3. As a rule, the Master's thesis must be written in the third semester. The time required to complete the Master's thesis is five months. Along with the Master's thesis, another requirement for successful completion of the course is participation in a Master's colloquium.

(2) The modules are equivalent to six ECTS credits. The exception to this with 30 ECTS credits is the Master's thesis with a colloquium that totals 30 (23 + 7) ECTS credits.

(3) A detailed description of the modules (contents, qualification objectives, prerequisites for participation, time required, and the assessment prerequisites and assessments to be completed) is included in the module descriptions in Appendix 2.

Section 6
Teaching and learning formats

(1) The teaching formats are:

1. Lecture: Teaching of course materials in a presentation
2. Tuition in seminars: Teaching of course materials in presentations, interactive discourse and discussions
3. Seminar: Discussion of special topics, if applicable, with presentations by participants
4. Tutorial: Classes that work through course materials in greater depth using theoretical and practical application
5. Field trip: Student excursion to companies, institutions, trade fairs, etc.
6. Project: Course with project-related classes.

(2) The curriculum (Appendix 1) and the module handbook (Appendix 2) define which of these types of learning and teaching formats make up the individual modules.

Section 7
Course advice

(1) Students have access to course advice during the course. The Dean of Studies of the faculty ensures that students are provided with appropriate counselling and advice.

(2) The representative of the Examination Board or the deputy provides advice and responds to questions about the Departmental Examination Regulations, such as assessments, examination periods, recognition of assessments and so on.

(3) The teaching staff for the Geomatics course are available during their consultation hours for all questions related to the course.

Section 8
Effective date

(1) These Departmental Study Regulations come into effect after publication within the Neubrandenburg University of Applied Sciences.

(2) These Departmental Study Regulations apply for the first time for those students who are enrolled in the Master of Geomatics in winter semester 2021/2022.

Issued on the basis of the decision by the Senate of the Neubrandenburg University of Applied Sciences dated 12 May 2021 and the approval of the Chancellor of the Neubrandenburg University of Applied Sciences dated 20 May 2021.

The Chancellor
of the Neubrandenburg University of Applied Sciences
Prof. Dr Gerd Teschke

Appendix 1 to the first statute to amend the Departmental Study and Departmental Examination Regulations for the Master of Geomatics

- Study and examination schedule

Module ID	Module name	Module type	Allocated semester	Teaching format	CH	Credits	Assessment	Graded/ relevant for final grade[2]
Compulsory elective modules (at least four modules must be selected from each of one of the majors geodesy, geoinformatics, and engineering surveying and measuring technology)								
Geodesy								
GEO.21.006	Physical Geodesy	CEM	1	V S	2 2	6	M30 or SCH120	yes/yes
GEO.21.009	Real Estate Registry	CEM	2	V S	2 2	6	M30	yes/yes
GEO.21.015	Engineering Geodesy	CEM	2	V Ü	2 2	6	M30	yes/yes
GEO.21.016	Special Methods of Adjustment and Statistics	CEM	1	V Ü	2 2	6	SCH120 or M30 or AHA50	yes/yes
GEO.23.031	Measuring Technology	CEM	1	V Ü	2 2	6	M30	yes/yes
GEO.21.032	Land Readjustment	CEM	1	V S	2 2	6	M30	yes/yes
GEO.21.046	Unmanned Aerial Vehicles	CEM	1	V Ü	2 1	6	SCH120	yes/yes
GEO.21.047	Advanced Surveying 1	CEM	1	V S	2 2	6	M30	yes/yes
GEO.21.048	Advanced Surveying 2	CEM	2	V S	2 2	6	M30	yes/yes
GEO.21.013	Computer Graphics Project in Geoscience	CEM	2	V Ü	2 2	6	SCH120	yes/yes
GEO.21.026	Multimedia	CEM	1	V Ü	2 2	6	AP	yes/yes
GEO.21.025	Geostatistics	CEM	1	V S	2 2	6	AHA15	yes/yes
Geoinformatics								
GEO.23.005	Spatial Databases	CEM	2	V Ü	2 2	6	AR15	yes/yes
GEO.21.008	Spatial Data Infrastructure	CEM	1	V Ü	2 2	6	M30	yes/yes
GEO.23.017	GI Technologies	CEM	2	S	4	6	AR15	yes/yes
GEO.21.040	Remote Sensing	CEM	2	V Ü	2 2	6	M30	yes/yes
GEO.23.050	GIS and Remote Sensing for Sustainable Land and Risk Management	CEM	1	V S	1 2	6	AR15	yes/yes

Module ID	Module name	Module type	Allocated semester	Teaching format	CH	Credits	Assessment	Graded/ relevant for final grade[2]
				Ü	1			
GEO.23.053	Earth Observation and Space Weather Impact	CEM	1	S	2	6	AR30	yes/yes
GEO.21.022	Data Mining	CEM	1	V Ü	2 2	6	AHA8	yes/yes
GEO.23.033	Software Project	CEM	2	S	1	6	AR30	yes/yes
GEO.23.034	Practical Computer Science	CEM	2	S Ü	2 2	6	AP6 and AP15	yes/yes
GEO.21.045	IT Security	CEM	1	V Ü	2 2	6	SCH120 or AHA15	yes/yes
GEO.23.014	Marine GIS	CEM	1	V Ü	2 2	6	AR15	yes/yes
GEO.23.035	Geoinformatics Excursion	CEM	2	V Ü	2 2	6	AHA15	yes/yes
Engineering Surveying and Measuring Technology								
GEO.21.016	Special Methods of Adjustment and Statistics	CEM	1	V Ü	2 2	6	M30	yes/yes
GEO.21.031	Measuring Technology	CEM	1	V Ü	2 2	6	M30	yes/yes
GEO.21.046	Unmanned Aerial Vehicles	CEM	1	V Ü	2 1	6	SCH120	yes/yes
GEO.21.047	Advanced Surveying 1	CEM	1	V S	2 2	6	M30	yes/yes
GEO.21.048	Advanced Surveying 2	CEM	2	V S	2 2	6	M30	yes/yes
GEO.21.013	Computer Graphics Project in Geoscience	CEM	2	V Ü	2 2	6	SCH120	yes/yes
GEO.21.026	Multimedia	CEM	1	V Ü	2 2	6	AP	yes/yes
GEO.21.033	Software Project	CEM	2	S	1	6	AR30	yes/yes
Mathematics (at least one module from the group must be selected)								
GEO.21.001	Higher Mathematics	CEM	1	V Ü	2 2	6	SCH120	yes/yes
GEO.21.028	Differential Geometry	CEM	2	V S	2 2	6	SCH120	yes/yes
GEO.21.052	Numerical Analysis	CEM	1	V Ü	2 2	6	AP6 and AP15	yes/yes
GEO.21.025	Geostatistics	CEM	1	V S	2 2	6	AHA15	yes/yes
GEO.23.034	Practical Computer Science	CEM	2	S Ü	2 2	6	AP6 and AP15	yes/yes
General (at least one module from the group must be selected)								
GEO.23.049	German Language	CEM	1	S	4	6	K120	yes/yes
GEO.21.045	IT Security	CEM	1	V Ü	2 2	6	SCH120 or AHA15	yes/yes
GEO.21.002	Management in Business and Authorities	CEM	2	V Ü	2 2	6	SCH120	yes/yes

Module ID	Module name	Module type	Allocated semester	Teaching format	CH	Credits	Assessment	Graded/ relevant for final grade[2]
Compulsory modules								
GEO.23.007	Application Project	CM	S 1–2		1	6	AP and AHA15	yes/yes
GEO.23.090	Master's thesis with Master's colloquium	CM	3	-	-	30	MA60 and AKQ45	yes/yes

Explanations:
Module type (abbreviations):
CM = compulsory module
CEM = compulsory elective module

Assessments (abbreviations):
SCH n = written assessment (written examination) in minutes
AHA = alternative assessment – assignment/research project/project work
AR = alternative assessment – presentation with paper
AP = additional alternative assessments as per section 15 of the Framework Examination Regulations and section 6 of the Departmental Examination Regulations – type and scope are specified in the module description
M n = oral examination
MA = Master's thesis
AKQ = Master's colloquium

Teaching formats (abbreviations):
V = lecture
S = seminar
SU = tuition in seminars
Ü = tutorial

Sem. = semester
CH = semester credit hours
Credits = credit points that are awarded in the module upon successful completion of assessments; 1 credit ≙ 30 contact hours (student workload)

Hochschule Neubrandenburg
University of Applied Sciences

Appendix 2 to the first statute to amend the
Departmental Study Regulations for the

Master of Geomatics

Module descriptions

Contents

Compulsory elective modules

GEO.21.045	**IT Security**
Module title (German)	IT-Sicherheit
Responsibilities	Professor of measuring technology and informatics 6
Credits	
Courses	GEO Geomatics 2021 Compulsory elective module in semester 1 LGM Landscape Studies and 2020 Greenspace Management Compulsory elective module in semester 2
Cycle and duration	Starts every summer semester over one semester
Prerequisite	None

Prerequisites for awarding credit points

Grade and calculation	The module is graded. The weighting of the module grade in the overall grade calculation can be found in the corresponding examination schedule.
Assessment	SCH120 Written examination of 120 minutes' duration or AHA15 Assignment of approx. 15 pages The type of assessment is announced at the start of the semester by the examiner.
Assessment prerequisite	Successful completion of the tutorials

Classes and workload

I	GEO.21.045.10	IT Security Lecture, 2 CH	32 h
II	GEO.21.045.20	IT Security Tutorial, 2 CH	32 h
III		Independent preparation and follow-up incl. exam preparation	116 h
		Total:	180 h

Teaching staff	Professor of measuring technology and informatics, professor of applied and practical informatics
Teaching language	English
Contents	The classes cover: - mathematical principles - cryptosystems and cryptoprotocols - encryption methods - technological aspects - security objectives and threats - integrity and availability - authentication and authorisation - network and industrial IT protection - enterprise IT security - regulatory frameworks and audits - mobile device management, ISMS

	- responses to threat scenarios.
Learning objectives/outcomes	After completing the module, students will be able to: - recognise basic threats to IT security and evaluate their essential features - evaluate basic procedures for IT security regarding their applicability and effectiveness - define security objectives for data security and data safety and analyse operational IT situations in terms of existing risks - describe the proportion of human factors in IT security and instructively influence employees' preventive behaviour in the workplace.
Teaching/learning formats*	Lecture on whiteboard, projector and computer lab to present the contents Tutorials, in some cases laboratory exercises for device configuration/programming using concrete examples from industry and authorities for practical completion Self-study for preparation and follow-up
Literature*	Additional literature will be announced in the first lecture.
Further information*	[...]

GEO.23.049	**German Language**		
Module title (German)	Deutsch für Studierende		
Responsibilities	Language Centre		
Credits	6		
Courses	GEO	Geomatics Compulsory elective module in semester 1	2021
Cycle and duration	Starts every summer semester over one semester		
Prerequisite	None		

Prerequisites for awarding credit points

Grade and calculation	The module is graded. The weighting of the module grade in the overall grade calculation can be found in the corresponding examination schedule.
Assessment	SCH120 Written examination of 120 minutes' duration The examiner will announce the type of assessment at the start of the semester.
Assessment prerequisite	None

Classes and workload

I	SPZ.21.049.10	German Language Tuition in seminars, 4 CH	64 h
II		Independent preparation and follow-up including exam preparation	116 h
		Total:	180 h

Teaching staff	Language Centre
Teaching language	German
Contents	German. Expansion of language skills to level B1: learning to communicate from B1 onward; consolidation of linguistic competence and consideration of quality of expression
Learning objectives/outcomes	Acquisition of advanced knowledge of German as a foreign language, consolidation and expansion of linguistic and cultural knowledge, specialist language skills. From B1 level: acquiring the ability to move at an international level
Teaching and learning formats	Teaching aids will be organised in many cases by the students based on experience: projection of audio and visual documents (projector), audio texts using qualitative technical facilities. The Moodle learning platform will be used intensively in all languages.
Literature	Textbooks based on level, issues from journals, audio documents from the internet, BBC Mundo
Further information	Additional literature available in German and English

GEO.21.006	**Physical Geodesy**		
Module title (German)	Physikalische Geodäsie		
Responsibilities	Prof. of practical geodesy, geodetic computations, land surveying, satellite geodesy		
Credits	6		
Courses	GEO Master of Geodesy and Geoinformatics Compulsory elective module in semester 1		2021
Cycle and duration	Starts every summer semester over one semester		
Prerequisite	Foundational knowledge of coordinate systems, position, altitude, gravity, GNSS recommended		

Prerequisites for awarding credit points

Grade and calculation	The module is graded. The weighting of the module grade in the overall grade calculation can be found in the corresponding examination schedule.
Assessment	M30 Oral examination of approx. 30 minutes' duration or SCH120 Written examination of 120 minutes' duration The examiner will announce the type of assessment at the start of the semester.
Assessment prerequisite	I TNW Evidence of attendance at seminars and II AHA Accepted seminar assignments. Review by the tutors. More detailed provisions are given in section 4 of the Departmental Examination Regulations.

Classes and workload

I	GEO.21.006.10	Physical Geodesy Lecture, 2 CH	32 h
II	GEO.21.006.20	Physical Geodesy Seminar, 2 CH	32 h
III		Independent preparation and follow-up including exam preparation	116 h
		Total:	180 h

Teaching staff	Prof. of practical geodesy, geodetic computations, land surveying, satellite geodesy Prof. of mathematics, geometry, applied informatics
Teaching language	German
Contents	The classes cover: - principles of potential theory - earth's gravity field - gravity reductions - altitudes - geometry of the earth - gravity field outside the earth - satellite methods.

Learning objectives/outcomes	After successfully completing the module, students will have foundational knowledge of physical geodesy and geodetic modelling. They will know how to describe the earth's gravity field, explain gravity reductions and differentiate various altitude systems. They will be familiar with various satellite missions that can be used to obtain information about the earth's gravity field.
Teaching and learning formats	Lecture on whiteboard and projector to present the contents Guided self-study for preparation and follow-up Development and presentation of selected subjects
Literature	Hofmann-Wellenhof, Moritz: Physical Geodesy, Springer, 2005 Additional literature will be announced in the lecture (current research articles, etc.).
Further information	–

GEO.21.009	Real Estate Registry		
Module title (German)	Liegenschaftskataster		
Responsibilities	Prof. of evaluation, land registry, planning		
Credits	6		
Courses	GEO	Master of Geomatics Compulsory elective module in semester 2	2021
Cycle and duration	Starts every winter semester over one semester		
Prerequisite	Basic knowledge of the land registry recommended		

Prerequisites for awarding credit points

Grade and calculation	The module is graded. The weighting of the module grade in the overall grade calculation can be found in the corresponding examination schedule.
Assessment	M30 Oral examination of approx. 30 minutes' duration
Assessment prerequisite	AHA Successful submission of papers Review by the tutors

Classes and workload

I	GEO.21.009.10	Real Estate Registry Lecture, 2 CH	32 h
II	GEO.21.009.20	Real Estate Registry Seminar, 2 CH	32 h
III		Independent preparation and follow-up including exam preparation and papers	116 h
		Total:	180 h

Teaching staff	Prof. evaluation, land registry, planning
Teaching language	German
Contents	The classes cover: - boundary definition and demarcation procedures (term boundary, procedures to define land parcel boundaries, demarcation procedures) - handling objections - handling legally valid boundary changes.
Learning objectives/outcomes	After successfully completing the module, students can carry out boundary definition and demarcation procedures. They can process objections and implement legally valid boundary changes.
Teaching and learning formats	Lecture on whiteboard and projector to present the module contents. Tutorials and seminars on the subjects dealt with in the lecture. The e-learning platform of the University will be used for supplementary information and tasks and to assess the practical papers.
Literature	Kriegel, Herzfeld: Katasterkunde in Einzeldarstellungen, loose-leaf binder Bengel, Simmerding (2000): Grundbuch, Grundstück, Grenze Kummer, Möllering (2005): Kommentar zum Vermessungs- und Geoinformationsrecht Sachsen-Anhalt

	Gomille (2008): Kommentar zum Niedersächsischen Vermessungsgesetz Kummer/Frankenberg (2010): Das Deutsche Vermessungs- und Geoinformationswesen Current literature on the issues being discussed in each case.
Further information	–

GEO.21.015	Engineering Geodesy		
Module title (German)	Ingenieurgeodäsie		
Responsibilities	Prof. of practical geodesy and engineering surveying		
Credits	6		
Courses	GEO	Master of Geomatics Compulsory elective module in semester 2	2021
Cycle and duration	Starts every winter semester over one semester		
Prerequisite	Foundational knowledge equivalent to a Bachelor of Geodesy assumed		

Prerequisites for awarding credit points

Grade and calculation	The module is graded. The weighting of the module grade in the overall grade calculation can be found in the corresponding examination schedule.
Assessment	M30 Oral examination of approx. 30 minutes' duration
Assessment prerequisite	AP Accepted paper on the student's own project Review by the tutors

Classes and workload

I	GEO.21.015.10	Engineering Geodesy Lecture, 2 CH	32 h
II	GEO.21.015.20	Engineering Geodesy Tutorial, 2 CH	32 h
III		Independent project work	20 h
IV		Independent preparation and follow-up including exam preparation	96 h
		Total:	180 h

Teaching staff	Professor of practical geodesy and engineering surveying
Teaching language	English
Contents	The classes cover: - introduction to inertial technology - consolidation of the single-axis inertial sensors (inclinometer, accelerometer and north finder) with special reference to north-finder systems - data collection, manual and digital; in-situ calibration and error monitoring - strategy for underground and tunnel measurement - various designs of surveying gyroscopes with possible errors and application - automatic data collection while monitoring; filter techniques and data processing.
Learning objectives/outcomes	After completing the module, students will be able to - master the use of modern surveying methods and systems in engineering geodesy, specifically inertial technology and gyroscopes - describe manual and automatic systems to record deformations - process generated measurement data (data collection and filtration) - use low-cost sensors (MEMS)

	- master the application and assessment of specific procedures for micro-tunnelling and tunnel construction.
Teaching and learning formats	Lecture on whiteboard and projector to present the contents Tutorials using concrete examples for practical execution Guided self-study for preparation and follow-up Completion and presentation of the student's own project and an underground measurement
Literature	Jekeli, Christopher; Inertial Navigation Systems with Geodetic Applications: De Gruyter, 1st edition 2000; ISBN-10: 3110159031 (English) Von Fabeck, Wolf; Kreiselgeräte, Vogel-Verlag; 1st edition 1980; ISBN-3-8023-0612-0 Gyro-principles, Gyro-basics, Gyro-training, Presentations from the Gyro-Symposium Joburg 2010 DVW conference proceedings: Geomonitoring
Further information	–

GEO.21.016	Special Methods of Adjustment and Statistics		
Module title (German)	Ausgewählte Methoden der Ausgleichungsrechnung und Statistik		
Responsibilities	Prof. of adjustment theory, statistics and practical geodesy		
Credits	6		
Courses	GEO	Master of Geomatics Compulsory elective module in semester 1	2021
Cycle and duration	Starts every summer semester over one semester		
Prerequisite	I	Mathematics at higher education entrance level recommended	
	II	Successful completion of GMT.077 Error Theory and Statistics	
	III	Successful completion of GMT.019 Adjustment Theory	

Prerequisites for awarding credit points

Grade and calculation	The module is graded. The weighting of the module grade in the overall grade calculation can be found in the corresponding examination schedule.
Assessment	SCH120 Written examination of 120 minutes' duration or M30 Oral examination of approx. 30 minutes' duration or AHA50 Assignment of 50 pages The type of assessment will be defined at the start of the module and announced by the examiner.
Assessment prerequisite	Successful completion of the tutorials Review by the tutors

Classes and workload

I	GEO.21.016.10	Special Methods of Adjustment and Statistics Lecture, 2 CH	32 h
II	GEO.21.016.20	Special Methods of Adjustment and Statistics Tutorial, 2 CH	32 h
III		Independent preparation and follow-up including exam preparation	116 h
		Total:	180 h

Teaching staff	Professor of adjustment theory, statistics and practical geodesy
Teaching language	German
Contents	The classes cover: - functional modelling using constraint equations

	- stochastic modelling - adjustment algorithms of constrained observations as well as the universal model (Gauß–Helmert model) - regression models - collocation - KALMAN filters - selected test methods.
Learning objectives/outcomes	After completing the module, students will be able to - master the use of adjustment approaches using constraint equations for adjusting constrained observations as well as the universal model for adjustment theory (Gauß–Helmert model) - handle selected statistical methods (regression models, collocation, KALMAN filtering, specific test methods).
Teaching/learning formats*	Lecture on whiteboard or with tablet, projector, computer Computational exercises with free and commercial software Self-study for preparation and follow-up
Literature*	Foppe (2010): Repetitorium zur Fehlerlehre und Statistik und Ausgleichungsrechnung Pelzer (1985): Geodätische Netze in der Landes- und Ingenieurvermessung Niemeier (2011): Ausgleichungsrechnung Additional literature will be announced in the lecture.
Further information*	[...]

GEO.21.031	Measuring Technology		
Module title (German)	Messtechnik		
Responsibilities	Professor of measuring technology and informatics		
Credits	6		
Courses	GEO	Master of Geomatics Compulsory elective module in semester 1	2021
Cycle and duration	Starts every summer semester over one semester		
Prerequisite	None		

Prerequisites for awarding credit points

Grade and calculation	The module is graded. The weighting of the module grade in the overall grade calculation can be found in the corresponding examination schedule.
Assessment	M30 Oral examination of approx. 30 minutes' duration
Assessment prerequisite	AP Accepted paper on the student's own project Review by the tutors

Classes and workload

I	GEO.21.031.10	Measuring Technology Lecture, 2 CH	32 h
II	GEO.21.031.20	Measuring Technology Tutorial, 2 CH	32 h
III		Independent project work	20 h
IV		Independent preparation and follow-up including exam preparation	96 h
		Total:	180 h

Teaching staff	Professor of measuring technology and informatics
Teaching language	English
Contents	The classes cover: - definitions as per ISO, EN, DIN - regulatory aspects of measuring technology - data collection: sensors, signal processing, scanning, quantisation and discretisation errors, transfer functions, measurement uncertainty - data transmission: sensor interfaces, analogue and digital transmission, speed vs distance vs data integrity, serial vs parallel transmission, signal processing, UART, I2C, SPI, one wire, CAN, field buses, TCP/UDP, IP, ADFX, bus capability, networks and protocols, collision and traffic control, multiplexing, error detection and data recovery, safety and security aspects - data evaluation: alerting, process controls, logging, monitoring, human–machine interfaces, archiving.
Learning objectives/outcomes	After completing the module, students will be able to - describe the knowledge and skills needed to determine complex measurement tasks and their framework conditions for subsequent assumption of managerial responsibilities in the engineering sector - be aware of the challenges associated with global or multinational measuring technology projects - be familiar with in-house/international metrological standardisation

	initiatives for their solution - deal with the typical complexities of pro and contra, including of a financial nature, that are associated with the various options for data collection, transmission and evaluation - develop initiative and teamwork skills through in-depth group project work - develop proposals to solve complex metrology tasks within businesses or authorities - estimate enterprise and regulatory risks relating to measurement processes and propose mitigating measures - limit major causes of metrological failures and develop strategies to recover the ability to perform metrological processes.
Teaching and learning formats	Lecture on whiteboard, projector and metrology lab to present the contents Consulting on the websites of calibration laboratories, national and international organisations with metrological functions Exercises (computations/programming) using concrete examples for practical completion Guided self-study for preparation and follow-up Development and presentation of selected subjects
Literature	International and in-house metrological standards, each in the current version, data sheets, white papers with metrological reference Additional literature will be announced in the lecture.
Further information	–

GEO.21.032	Land Readjustment		
Module title (German)	Bodenordnung		
Responsibilities	Professor of evaluation, land registry and planning 6		
Credits			
Courses	GEO	Master of Geomatics Compulsory elective module in semester 1	2021
Cycle and duration	Starts every summer semester over one semester		
Prerequisite	Knowledge of land and planning law is recommended		

Prerequisites for awarding credit points

Grade and calculation	The module is graded. The weighting of the module grade in the overall grade calculation can be found in the corresponding examination schedule.	
Assessment	M30 Oral examination of approx. 30 minutes' duration	
Assessment prerequisite	AR	Accepted seminar presentations
	Review by the tutors	

Classes and workload

I	GEO.21.032.10	Land Readjustment Lecture, 2 CH	32 h
II	GEO.21.032.20	Land Readjustment Seminar, 2 CH	32 h
III		Independent preparation and follow-up including exam preparation and seminar presentations	116 h
		Total:	180 h

Teaching staff	Professor of evaluation, land registry and planning
Teaching language	German
Contents	The classes cover: - international planning and land law in selected EU countries - discussion of proposed reforms.
Learning objectives/outcomes	After successfully completing the module, students will be familiar with the functioning of urban land markets in selected EU member states. They will be familiar with the points of reference of the current discussion: sustainability, suburbanisation, land usage, land tax reform.
Teaching and learning formats	Lecture on whiteboard and projector to present the module contents Tutorials and seminars on the subjects dealt with in the lecture The e-learning platform of the University will be used to provide supplementary information and tasks and for assessment of the practical papers.
Literature	BMBau (1993): Funktionsweise städtischer Bodenmärkte in Mitgliedsstaaten der EG. Bonn BBR (2001): Baulandbereitstellung nach dem niederländischen Modell. Bonn Uni Kassel (2003): Europäisches Planungsrecht. Current documentation for each of the programs used.
Further information	–

GEO.21.046	Unmanned Aerial Vehicles	
Module title (German)	Unbemannte Fluggeräte	
Responsibilities	Professor of measuring technology and informatics 6	
Credits		
Courses	GEO Master of Geomatics Compulsory elective module in semester 1	2021
Cycle and duration	Starts every summer semester over one semester	
Prerequisite	None	

Prerequisites for awarding credit points

Grade and calculation	The module is graded. The weighting of the module grade in the overall grade calculation can be found in the corresponding examination schedule.
Assessment	SCH120 Written examination of 120 minutes' duration
Assessment prerequisite	Successful completion of the tutorials and the project. Review by the tutors

Classes and workload

I	GEO.21.046.10	Unmanned Aerial Vehicles Lecture, 2 CH	32 h
II	GEO.21.046.20	Unmanned Aerial Vehicles Tutorial, 1 CH	16 h
III		Independent project work	22 h
IV		Independent preparation and follow-up including exam preparation	110 h
		Total:	180 h

Teaching staff	Professor of measuring technology and informatics, among others
Teaching language	English
Contents	The classes cover: - aviation law - aerodynamics - flight mechanics - electrical systems and sensors - remote control - photogrammetry - navigation - reliability evaluation of unmanned aerial vehicles (UAV) - major project.
Learning objectives/outcomes	After completing the module, students will be able to - assess opportunities for and limits of drone usage - comply with the legal rules for participating in air traffic - promptly identify hazards associated with drone usage and initiate mitigation measures - plan, execute and evaluate typical tasks for UAV-supported 3D data

	generation.
Teaching/learning formats*	Lecture on whiteboard and projector to present the contents Exercises using concrete examples for practical completion Major practical project for 3D recording of geometric data on construction sites and landscape objects
Literature*	
Further information*	[...]

GEO.21.047 Advanced Surveying 1

Module title (German)	Fortgeschrittene Aspekte der Ingenieurvermessung 1
Responsibilities	Professor of practical geodesy and engineering surveying
Credits	6
Courses	GEO Master of Geomatics 2021 Compulsory elective module in semester 1
Cycle and duration	Starts every summer semester over one semester
Prerequisite	Foundational knowledge of GNSS, terrestrial laser scanning, engineering surveying recommended

Prerequisites for awarding credit points

Grade and calculation	The module is graded. The weighting of the module grade in the overall grade calculation can be found in the corresponding examination schedule.
Assessment prerequisite	M30 Oral examination of approx. 30 minutes' duration
Assessment prerequisite	I TNW Evidence of attendance at seminars and II AHA Accepted project report with presentation. Review by the tutors. More detailed provisions are given in section 4 of the Departmental Examination Regulations.

Classes and workload

I	GEO.21.047.10	Advanced Surveying 1 Lecture, 2 CH	32 h
II	GEO.21.047.20	Advanced Surveying 1 Seminar, 2 CH	32 h
III		Independent preparation and follow-up including exam preparation and project realisation	116 h
		Total:	180 h

Teaching staff	Professor of practical geodesy and engineering surveying
Teaching language	English

Contents

- principles of inertial sensors (INS) regarding dynamic application for mobile mapping systems, including MEMS INS.
- special focus: possible errors, ZUPT/CUPT and calibration
- mobile mapping systems: concept and function
- practical component: realisation of a multi-sensor system based on INS and TLS.

Learning objectives/outcomes

- Students can critically assess the use of the latest multi-sensors based on inertial sensors and TLS.
- Students can evaluate these systems compared to conventional geodetic sensors to ensure cost-effective use.
- The increased error budget due to the inertial sensors and consideration of sensor fusion is known.
- Students can also assess the use of these systems for more complex measurement tasks.

Teaching and learning formats	Lecture on whiteboard and projector to present the contents Guided self-study for preparation and follow-up Completion of a project with specified questions Work in the laboratory Programming activities
Literature	Jan Wendel, Integrierte Navigation, 2011 MEMS-Based Integrated Navigation Priyanka Aggarwal et. al., 2010 Additional literature will be announced in the lecture (current research articles and conference proceedings).
Further information	–

GEO.21.048	**Advanced Surveying 2**
Module title (German)	Fortgeschrittene Aspekte der Ingenieurvermessung 2
Responsibilities	Professor of practical geodesy and engineering surveying
Credits	6
Courses	GEO Master of Geomatics 2021 Compulsory elective module in semester 2
Cycle and duration	Starts every winter semester over one semester
Prerequisite	Foundational knowledge of geodetic measuring technology: total stations, laser scanners, GNSS recommended

Prerequisites for awarding credit points

Grade and calculation	The module is graded. The weighting of the module grade in the overall grade calculation can be found in the corresponding examination schedule.
Assessment	M30 Oral examination of approx. 30 minutes' duration
Assessment prerequisite	I TNW Evidence of attendance at seminars and II AHA Accepted project report with presentation. Review by the tutors. More detailed provisions are given in section 4 of the Departmental Examination Regulations.

Classes and workload

I	GEO.21.048.10	Advanced Surveying 2 Lecture, 2 CH	32 h
II	GEO.21.048.20	Advanced Surveying 2 Seminar, 2 CH	32 h
III		Independent preparation and follow-up including exam preparation and project realisation	116 h
		Total:	180 h

Teaching staff	Professor of practical geodesy and engineering surveying
Teaching language	English
Contents	The classes cover: - principles of modern multi-sensor systems - influence of time on multi-sensor systems - calibration (lever arm) between the sensor coordination systems - use of a Monte Carlo simulation for precision estimation of multi-sensor systems - measurement exercises to determine time offset, triggering of sensors as well as lever arm determination of the HS multi-sensor system.
Learning objectives/outcomes	After completing the module, students will be able to - estimate the parameter time for dynamically operating multi-sensor systems - plan and evaluate the processing of major measurement tasks with multi-sensor systems - evaluate complex dynamic processes regarding their accuracy because

	the measurement system or the object can be a mobile component here. For this purpose, students can use the Monte Carlo simulation.
Teaching and learning formats	Lecture on whiteboard and projector to present the contents Guided self-study for preparation and follow-up Completion of a project with specified questions Work in the laboratory Programming activities
Literature	Theses of Dr Christian Hesse (Eng.): *Ein Beitrag zur hochauflösenden kinematischen Objekterfassung mit terrestrischen Laserscannern*, Dr Friedrich Keller (Eng.): *Entwicklung eines forschungsorientierten Multi-Sensor-Systems zum kinematischen Laserscanning innerhalb von Gebäuden* and Prof. Harald Sternberg (Eng.): *Zur Bestimmung der Trajektorie von Landfahrzeugen mit einem hybriden Meßsystem* MEMS-Based Integrated Navigation, Priyanka Aggarwal et. al., 2010 Sequential Monte Carlo Methods in Practice, Arnaud Doucet et. al., 2010
Further information	–

GEO.23.005	**Spatial Databases**
Module title (German)	Geodatenbanken
Responsibilities	Professor of photogrammetry, remote sensing, GIS and cartography
Credits	6
Courses	GEO Master of Geomatics 2021 Compulsory elective module in semester 2
Cycle and duration	Starts every winter semester over one semester
Prerequisite	None

Prerequisites for awarding credit points

Grade and calculation	The module is graded. The weighting of the module grade in the overall grade calculation can be found in the corresponding examination schedule.
Assessment	AR 15 Presentation of approx. 15 minutes' duration with written paper of approx. 15 pages
Assessment prerequisite	Successful participation in the tutorials, verified by submission of reports. Review by the tutors

Classes and workload

I	GEO.21.005.10	Spatial Databases Lecture, 2 CH	32 h
II	GEO.21.005.20	Spatial Databases Tutorial, 2 CH	32 h
III		Independent preparation/follow-up including exam preparation	116 h
		Total:	180 h

Teaching staff	Professor of photogrammetry, remote sensing, GIS and cartography
Teaching language	English
Contents	The lectures cover: - principles of relational and spatial database management systems (DBMS) - spatial data in DBMS - modelling of spatial data (development of specialist data models) - administration of geodata - model of spatial objects (ISO 19107 Spatial Schema, OGC Simple Feature model, SQL/MM Spatial) - requesting spatial data; methods of spatial data analysis (geometry and topology) - computerised methods for algorithmic geometry; indexing concepts. The tutorial covers: - development and implementation of students' own object-relational spatial database model, which will be used to implement solutions to real-world issues as part of hands-on projects - data entry, management and search - application of various methods of data analysis regarding real-world spatial issues.

As part of completing tutorials and projects, standards for scientific method and principles of presentation technology are taught and applied.

Learning objectives/outcomes

After completing the module, students will be able to

- summarise the principles of spatial database management systems and be aware of their advantages
- formulate problems, structure and model their own (spatial) data
- implement spatial and non-spatial data analyses at a database level.

The students will acquire an overview of spatial databases within GIS environments.

Teaching and learning formats

- lecture on whiteboard, projector, computer, work sheets
- completion of practical exercises and typical applications in projects
- use of open data and internal data, if necessary, data acquisition in the immediate surrounds of the University
- student's own practical projects that will be completed and presented before the participants
- self-study for preparation and follow-up; supervised individual investigations to expand and consolidate understanding.

The e-learning platform of the University will be used to provide supplementary information and tasks and for assessment of the practical papers.

Literature

- Obe, Regina O., Hsu, Leo (2014): PostGIS in Action. Manning Publications.
- Corti, Paolo, Kraft, Thomas J., Mather, Stephen V., Park, Bborie (2014): PostGIS Cookbook; Packt Publishing.
- Brinkmann, T. (2013): Geodatenbanksysteme in Theorie und Praxis.
- Wichmann.
- Rigaux, P., Scholl, M.O., Voisard, A. (2002): Spatial Databases with Applications to GIS. Morgan Kaufmann.

Additional literature will be announced in the lecture.

Further information –

GEO.21.008	Spatial Data Infrastructure		
Module title (German)	Geodateninfrastruktur		
Responsibilities	Prof. of photogrammetry, remote sensing, GIS, cartography		
Credits	6		
Courses	LGM	Master of Landscape Studies and Greenspace Management Compulsory elective module in semester 1	2020
	GEO	Master of Geomatics Compulsory elective module in semester 1	2021
Cycle and duration	Starts every summer semester over one semester		
Prerequisite	None		

Prerequisites for awarding credit points

Grade and calculation	The module is graded. The weighting of the module grade in the overall grade calculation can be found in the corresponding examination schedule.
Assessment	M30 Oral examination of 30 minutes' duration
Assessment prerequisite	AHA Accepted paper on the student's own project Review by the tutors

Classes and workload

I	GEO.21.008.10	Spatial Data Infrastructure Lecture, 2 CH		32 h
II	GEO.21.008.20	Spatial Data Infrastructure Tutorial, 2 CH		32 h
III		Independent project work		30 h
IV		Independent preparation/follow-up including exam preparation		86 h
			Total:	180 h

Teaching staff	N.N.
Teaching language	English
Contents	The lectures cover: - composition and structure - references and standards - networks - legal provisions - responsibilities - software solutions. The tutorials cover: - structure of a small system - recording of geometrical and factual data - client-server connection to databases - incorporation of WMS and WFS - design of the data portal.

Learning objectives/outcomes	After completing the module, students will be able to - explain the concept of geodata infrastructure (GDI) and its implementation at European, national, state and community levels - describe the references and standards applicable for GDI - differentiate the GDIs operated in Mecklenburg-Vorpommern - familiarise themselves with important software solutions for GDI - administer a community geodata portal, particularly to connect or disconnect technical data servers - program minor query functions and assign user rights.
Teaching and learning formats	The usual teaching aids, including the internet, will be used in the lectures. The practical sessions will be done on the computers and will merge several sources of data.
Literature	Zurbarán, Mayra, Kraft, Thomas, Mather, Stephen Vincent (2018): PostGIS Cookbook: Store, organize, manipulate, and analyze spatial data, Packt Publishing, UK Kresse, Wolfgang, Danko, David (2012): Handbook of Geographic Information, Springer Mitchell, Tyler, Emde, Astrid, Christl, Arnulf (2008): Web-Mapping mit Open Source-GIS-Tools. O'Reilly La Beaujardiere, Jeff de (2004): Web Map Service Implementation Specification (WMS), Open Geospatial Consortium document 04-024 Vretanos, Peter (2004): Web Map Feature Service Implementation Specification (WFS), Open Geospatial Consortium document 04-094 Additional literature will be announced in the lecture (current research articles, etc.).
Further information	–

GEO.21.013	Computer Graphics Project in Geoscience		
Module title (German)	Computer Grafik Projekt in Geowissenschaften		
Responsibilities	Professor of measuring technology and informatics		
Credits	6		
Courses	LGM	Master of Landscape Studies and Greenspace Management Compulsory elective module in semester 1 or 2	2020
	GEO	Master of Geomatics Compulsory elective module in semester 2	2021
Cycle and duration	Starts every winter semester for one semester		
Prerequisite	None		

Prerequisites for awarding credit points

Grade and calculation	The module is graded. The weighting of the module grade in the overall grade calculation can be found in the corresponding examination schedule.
Assessment	SCH120 Written examination of 120 minutes' duration
Assessment prerequisite	AHA Accepted paper on the student's own project Review by the tutors

Classes and workload

I	GEO.21.013.10	Computer Graphics Project in Geoscience Lecture, 2 CH	32 h
II	GEO.21.013.20	Computer Graphics Project in Geoscience Tutorial, 2 CH	32 h
III		Independent project work	30 h
IV		Independent preparation and follow-up including exam preparation	86 h
		Total:	180 h

Teaching staff	Professor of measuring technology and informatics
Teaching language	English
Contents	The lectures cover: - modern digital geometric object descriptions - georeferencing, geomesh tessellation and tiling - coordination transformations, point cloud import from laser scanning and photogrammetry - render pipelines - streaming multiprocessing - shader and nodes - ray tracing - compositing - interactive data visualisation - real-time requirements - strategies for managing and securing large data volumes. The tutorials cover: Completion of a semester project accompanying the lectures in geodata visualisation

Learning objectives/outcomes	After completing the module, students will be able to - describe current procedures and methods in digital geometric object descriptions and their 3D visualisation options - prepare specifications and implement solutions for practical visualisation tasks in the geo area - estimate the required hardware and software needs for specific accuracy requirements. Students will be familiar with procedures for handling locally incomplete information in geodata visualisation. Students will have experience in managing and securing large data volumes.
Teaching and learning formats	The usual teaching aids, including the internet, will be used in the lectures. The practical sessions are completed on the computer system of the University.
Literature	Literature will be announced in the lecture (data sheets, technical specifications, current research articles, etc.).
Further information	–

GEO.23.017 GI Technologies

Module title (German)	GI Technologien		
Responsibilities	Professor of photogrammetry, cartography, GIS and remote sensing		
Credits	6		
Courses	GEO	Master of Geomatics Compulsory elective module in semester 2	2021
	LGM	Master of Landscape Studies and Greenspace Management Compulsory elective module in semester 2	2020
Cycle and duration	Starts every winter semester over one semester		
Prerequisite	None		

Prerequisites for awarding credit points

Grade and calculation	The module is graded. The weighting of the module grade in the overall grade calculation can be found in the corresponding examination schedule.
Assessment	AR15 Presentation of approx. 15 minutes' duration with written paper of approx. 15 pages
Assessment prerequisite	AHA Successful completion of the seminar tasks Review by the tutors

Classes and workload

I	GEO.21.017.10	GI Technologies Tuition in seminars, 4 CH		64 h
II		Independent preparation and follow-up including exam preparation		116 h
			Total:	180 h

Teaching staff	Professor of photogrammetry, cartography, GIS and remote sensing
Teaching language	English
Contents	The classes take a highly practical approach. Students work through problems across a range of subjects. In theory, this includes an overview of current trends and developments in geoinformatics, particularly issues related to GIS and remote sensing (e.g. mobile and web-based GIS, OpenData, free and open-source software (FOSS), various sensor systems) with use of these technologies in various land management systems by way of example. The tutorials cover, among other elements, projects from land use management, risk management, agriculture, urban development, development collaboration, health management, tourism, resource planning and geology as well as archaeology and route research.

	As part of completing tutorials and projects, standards for scientific method and principles of presentation technology are taught and applied.
Learning objectives/outcomes	Students acquire an overview of the status of GIS and remote sensing. Depending on the selected themes (such as risk management, Web-GIS or OpenStreetMap), students will be familiar with the specific principles and techniques required.
Teaching and learning formats	Lecture or interactive handling of various key subjects on whiteboard, projector, computer and work sheets to introduce the contents; the specific theoretical principles underlying the use cases examined in the individual tutorials will be discussed in the lectures: - independently performed data acquisition (e.g. mapping) - guided self-study - completion and presentation of the student's own project. The e-learning platform of the University will be used to provide supplementary information and tasks and for assessment of the practical papers.
Literature	Various publications on the different topics in the class, e.g.: - Konecny, Milan (2010): Geographic information and cartography for risk and crisis management: towards better solutions. Springer-Verlag - Ramm F., Topf J. (2010): OpenStreetMap: Die freie Weltkarte nutzen und mitgestalten. Lehmans Media Verlag, 3rd edition. - Schweikart, Jürgen (2004): Geoinformationssysteme im Gesundheitswesen: Grundlagen und Anwendungen. Wichmann Verlag - Sherman, G.E. (2008): Desktop GIS – Mapping the Planet with Open Source Tools. O'Reilly; - Liu, Jian Guo (2016): Image processing and GIS for remote sensing – techniques and applications. Wiley-Blackwell. - Wegmann, M., Leutner B. & Dech, S. (2016). Remote sensing and GIS for ecologists – using open source software. Data in the wild, Pelagic Publishing. Additional literature will be announced in the lecture depending on the thematic focus.
Further information	

GEO. 21.040 Remote Sensing

Module title (German)	Fernerkundung		
Responsibilities	Professor of photogrammetry, remote sensing, GIS, cartography		
Credits	6		
Courses	GEO	Master of Geomatics Compulsory elective module in semester 2	2021
Cycle and duration	Starts every winter semester over one semester		
Prerequisite	None		

Prerequisites for awarding credit points

Grade and calculation	The module is graded. The weighting of the module grade in the overall grade calculation can be found in the corresponding examination schedule.
Assessment prerequisite	M30 Oral examination of approx. 30 minutes' duration
Assessment prerequisite	I TNW Evidence of participation in lab tasks and II AHA Accepted written reports and presentations of exercises Review by the tutors. More detailed provisions are given in section 4 of the Departmental Examination Regulations.

Classes and workload

I	GEO.21.040.10	Remote Sensing Lecture, 2 CH	32 h
II	GEO.21.040.20	Remote Sensing Tutorial, 2 CH	32 h
III		Independent preparation and follow-up including exam preparation	116 h
		Total:	180 h

Teaching staff	Professor of photogrammetry, remote sensing, GIS and cartography
Teaching language	English
Contents	Lectures: 1. Introduction to remote sensing 2. Interaction between electromagnetic radiation and materials 3. Data on the interaction between wave radiation and natural objects 4. Evidence of electromagnetic radiation 5. Processing remote sensing data 6. Image features 7. General methods for interpreting remote sensing images 8. Data analysis, including classification with modern methods 9. Interpretation of remote sensing data for feature mapping and land evaluations 10. Optoelectronic remote sensing 11. Heat-infrared remote sensing 12. Microwave remote sensing 13. Applications 14. In-situ calibration and validation (field exercises)

	Practical training: application of specific software packages and programming exercises related to the above topics
Learning objectives/outcomes	Design of a remote sensing process and/or a remote sensing processor as well as sustainable data retention that can be implemented in practice; various data collection methods and analytical methods can be adequately used. Participants acquire a critical methodological awareness for remote sensing and an advanced ability to solve problems as well as relevant advanced communication skills; students can evaluate and implement the necessary procedures needed to obtain information and they are familiar with the physical principles required for this.
Teaching and learning formats	Lecture on whiteboard, projector, computer, work sheets; if necessary, data acquisition as part of national and international field campaigns (e.g. TERENO, JECAM in the DEMMIN test site, MV) Work placement: Programming of new and application of prescribed software Self-study for preparation and follow-up The e-learning platform of the University will be used to provide supplementary information and tasks and for assessment of the practical papers.
Literature	Kramer, H. J. (1996): Observation of the Earth and its environment. Survey of missions and sensors, 580 pp, Springer-Verlag (Berlin, Heidelberg, etc.); ISBN: 3-540-57858-7 Kraus, K. & Schneider, W. (1988): Fernerkundung. Band 1: Physikalische Grundlagen und Aufnahmetechniken, 300 pp, Dümmler Verlag (Bonn); ISBN: 3-427-78661-7 Lillesand, T.M., R.W. Kiefer and J.W. Chipman (2003). Remote sensing and image interpretation, 5th edition, Wiley. ISBN 0-471-15227-7 Richards, J.A. and X. Jia (2006). Remote sensing digital image analysis: An introduction, 4th edition, Springer. ISBN 3-540-25128-6 Sabins, F. F. (1997): Remote sensing: Principles and interpretation, 3rd edition, 450 pp, Freeman Press (San Francisco) Schowengerdt, R.A. (1997): Remote sensing: Models and methods for image processing, 2nd edition, 525 pp, Academic Press Additional literature will be announced in the first lecture.
Further information	

GEO.23.050	GIS and Remote Sensing for Sustainable Land and Risk Management	
Module title (German)	GIS & Fernerkundung für Land- und Krisenmanagement	
Responsibilities	Professor of photogrammetry, cartography, GIS and remote sensing	
Credits	6	
Courses	GEO Master of Geomatics Compulsory elective module in semester 1	2021
Cycle and duration	Starts every summer semester for one semester	
Prerequisite	None	

Prerequisites for awarding credit points

Grade and calculation	The module is graded. The weighting of the module grade in the overall grade calculation can be found in the corresponding examination schedule.
Assessment	AR15 Presentation of approx. 15 minutes' duration with written paper of approx. 15 pages
Assessment prerequisite	I TNW Collaboration in the tutorials and II AHA Received written reports and presentations on individual tutorial tasks Review by the tutors

Classes and workload

I	GEO.21.050.10	GIS and Remote Sensing for Sustainable Land and Risk Management Lecture, 1 CH	16 h
II	GEO.21.050.20	GIS and Remote Sensing for Sustainable Land and Risk Management Tuition in seminars, 2 CH	32 h
III	GEO.21.050.30	GIS and Remote Sensing for Sustainable Land and Risk Management Tutorial, 1 CH	16 h
IV		Independent preparation and follow-up including exam preparation	116 h
		Total:	180 h

Teaching staff	Professor of photogrammetry, cartography, GIS and remote sensing
Teaching language	English
Contents	The lectures cover: - general principles of the concepts behind land and crisis management systems - investigations of issues relating to natural and anthropogenic risks - theoretical consideration of various natural hazards - theory of hazards, vulnerabilities and risk - analytical methods: imprecise quantities and weighting (vulnerability analysis) and statistical analyses (hazard analysis) - consideration of existing systems and international organisations as well as presentation of several practical national and international examples. The tuition in seminars includes detailed theoretical consideration of different natural hazards (e.g. flooding, flash floods, epidemics, earthquakes, volcanos,

wildfires, mass migrations) and calculation of the specific relevant parameters.

The tutorials cover:

- application of the theoretical principles, particularly the vulnerability analysis and hazard analysis; the risk assessment is generated from these two parts
- search and use of free data
- analysis, particularly of remote sensing data
- construction of GIS on practical real and current examples with free and open-source software (FOSS).

When working through the projects and presentations, students are taught and apply standards for scientific method and principles of presentation technology.

Learning objectives/outcomes

After completing the module, students can differentiate between hazards, vulnerabilities and risks and identify important relevant local, national and international platforms and data sources. They will master qualitative raster-based analytical methods and the concept of fuzzy quantities. They can independently develop concepts for risk assessments of natural and anthropogenic hazards and perform fundamental analyses.

Teaching and learning formats

- lecture on whiteboard, projector, computer and work sheets
- carrying out practical exercises for the individual analytical methods in projects; use of open data, particularly satellite data, and free software products (FOSS)
- tuition in seminars with presentations by students on the various natural hazards; presentation of the results from tutorials and the student's own project
- supervised individual investigations to expand and consolidate understanding
- completion of an independent project on a concrete natural or anthropogenic hazard in a defined region
- if possible, field trip(s) to various organisations, institutions or companies such as GFZ Potsdam (early warning systems), the German tourism association DTV (risk monitoring in the industry), Munich Re, A3M Global Monitoring.

The e-learning platform of the University will be used to provide supplementary information and tasks and for assessment of the practical papers.

Literature

Various publications on the different topics in the class, e.g.:

- Konecny, Milan (2010): Geographic information and cartography for risk and crisis management: towards better solutions. Springer-Verlag
- Ramm F., Topf J. (2010): OpenStreetMap: Die freie Weltkarte nutzen und mitgestalten. Lehmans Media Verlag, 3rd edition
- Schweikart, Jürgen (2004): Geoinformationssysteme im Gesundheitswesen: Grundlagen und Anwendungen. Wichmann Verlag
- Wegmann, M., Leutner B. & Dech, S. (2016). Remote sensing and GIS for ecologists – using open source software. Data in the wild, Pelagic Publishing

Articles:

- Eastman (1999): Multi-criteria evaluation and GIS. Geographical information systems, 1(1), 493–502.
- Greene, R., Devillers, R., Luther, J. E., & Eddy, B. G. (2011). GIS-based multiple-criteria decision analysis. Geography compass, 5(6), 412–432.
- Malczewski, J., & Rinner, C. (2015). Introduction to GIS-MCDA. in Multicriteria Decision Analysis in Geographic Information Science (pp 23–54). Springer, Berlin, Heidelberg.

Additional literature will be announced in the lecture.

Further information

GEO.23.053	**Earth Observation and Space Weather Impact**	
Module title (German)	Erdbeobachtung und Weltraumwetter	
Responsibilities	Professor of applied and practical informatics	
Credits	6	
Courses	GEO Master of Geomatics Compulsory elective module in semester 1	2021
Cycle and duration	Starts every summer semester over one semester	
Prerequisite	Good knowledge of physics and mathematics is recommended	

Prerequisites for awarding credit points

Grade and calculation	The module is graded. The weighting of the module grade in the overall grade calculation can be found in the corresponding examination schedule.
Assessment	AR30 Presentation of approx. 30 minutes' duration with written paper of approx. 10 pages
Assessment prerequisite	I TNW Evidence of participation in tuition in seminars. II AHA Successful completion of the tutorial tasks and delivery of interim presentations Review by the tutors. Section 4 of the Departmental Examination Regulations applies.

Classes and workload

I	GEO.21.053.10	Earth Observation and Space Weather Impact Tuition in seminars, 2 CH	32 h
II		Scientific treatment of relevant issues related to the specified contents with interim presentations	64 h
III		Independent analysis, research and treatment of an individual scientific topic related to earth observation or space weather	64 h
IV		Independent preparation/follow-up including exam preparation	20 h
		Total:	180 h

Teaching staff	Scientists from the German Aerospace Center (DLR) in Neustrelitz
Teaching language	Primary teaching language English
Contents	The classes cover: - the earth–sun system - sporadic and massive eruptions of very high energy material and solar radiation - modelling of processes within and between the thermosphere, ionosphere and magnetosphere - impacts of these processes on technical systems and life on earth - sensors, methods and applications - current earth observation systems and missions - space-weather–related ground- and space-supported observations

	- techniques and challenges associated with accessing, collecting, processing and presenting data - methods for measuring, evaluating and predicting impacts - current and future issues and needs relating to earth observation and space weather - existing and upcoming earth observation and space weather services.
Learning objectives/outcomes	Students will be familiar with and understand important processes in the earth–sun system as well as current and future challenges in earth observation and space weather. They can apply and interpret physically based methods for modelling the earth–sun system. They are familiar with and understand important measuring methods and can evaluate and process data obtained from the systems.
Teaching/learning formats*	- tuition in seminars to introduce and explain the most important material using presentations and current scientific results using projector and whiteboard - independent treatment of scientific issues based on given approaches and presentation of the findings - supervised preparation of an academic article on a current topic. The e-learning platform of the University will be used to provide supplementary information and tasks and for assessment of the practical papers.
Literature*	- current academic literature and articles
Further information*	

GEO.21.022	**Data Mining**
Module title (German)	Datenanalyse / Wissensverarbeitung
Responsibilities	Professor of mathematics, geometry and applied informatics
Credits	6
Courses	GEO Master of Geomatics 2021 Compulsory elective module in semester 1
Cycle and duration	Starts every summer semester over one semester
Prerequisite	Mathematics at the level obtained in the Bachelor courses Geoinformatics as well as Geodesy and Measuring Technology is recommended.

Prerequisites for awarding credit points

Grade and calculation	The module is graded. The weighting of the module grade in the overall grade calculation can be found in the corresponding examination schedule.
Assessment prerequisite	AHA8 Research project of at least 8 pages
Assessment prerequisite	I TNW Evidence of participation in tutorials and II AHA Preparation of reports Review by the tutors. Section 4 of the Departmental Examination Regulations applies.

Classes and workload

I	GEO.21.022.10	Data Mining Lecture, 2 CH	32 h
II	GEO.21.022.20	Data Mining Tutorial, 2 CH	32 h
III		Independent preparation and follow-up	116 h
		Total:	180 h

Teaching staff	Prof. of mathematics, geometry and applied informatics
Teaching language	Primary teaching language English
Contents	The classes cover: - geometric characterisation of data - classification methods - pattern recognition - machine learning.
Learning objectives/outcomes	After completing the module, students will be able to - handle and apply formulas and algorithms for classification and pattern recognition incorporating computer systems - understand the theoretical principles required for this.
Teaching and learning formats	The module contents are taught in the lectures using whiteboard, PC and projector. In the tutorials, joint examples and tasks based on the lecture material are formulated and solved individually or in groups.

	Guided self-study for preparation and follow-up.
Literature	Bishop, C. M.: Pattern recognition and machine learning, Springer 2006 Additional literature will be announced in the lecture.
Further information	–

GEO.21.026	Multimedia		
Module title (German)	Multimedia		
Responsibilities	Professor of practical geodesy, data processing and cartography		
Credits	6		
Courses	GEO	Master of Geomatics Compulsory elective module in semester 1	2021
Cycle and duration	Starts every summer semester over one semester		
Prerequisite	Comprehensive knowledge of object-oriented programming recommended		

Prerequisites for awarding credit points

Grade and calculation	The module is graded. The weighting of the module grade in the overall grade calculation can be found in the corresponding examination schedule.
Assessment	AP Writing and documentation of software
Assessment prerequisite	None

Classes and workload

I	GEO.21.026.10	Multimedia Lecture, 2 CH	32 h
II	GEO.21.026.20	Multimedia Tutorial, 2 CH	32 h
III		Independent preparation and follow-up including exam preparation	116 h
		Total:	180 h

Teaching staff	Professor of practical geodesy, data processing and cartography
Teaching language	English
Contents	The classes cover: - media and data law - data formats in the media sector - basic graphic algorithms - mobile computing - security aspects - storage networks - web technologies for real and virtual worlds - 3D animation with a game engine.
Learning objectives/outcomes	After completing the module, students will be able to - demonstrate more in-depth knowledge of media and data law - program interactive multimedia processes on websites or mobile devices - program virtual worlds in a game engine.
Teaching and learning formats	Lecture on whiteboard, projector and computer lab to present the seminar material based on concrete tasks from nature, technology and the environment
Literature	Additional literature will be announced in the first lecture.
Further information	–

GEO.21.026	**Software Project**
Module title (German)	Software-Projekt
Responsibilities	Professor of applied and practical informatics
Credits	6
Courses	GEO Master of Geomatics 2021 Compulsory elective module in semester 2
Cycle and duration	Starts every winter semester over one semester
Prerequisite	Basic programming knowledge required

Prerequisites for awarding credit points

Grade and calculation	The module is graded. The weighting of the module grade in the overall grade calculation can be found in the corresponding examination schedule.
Assessment	AR30 Presentation of approx. 30 minutes' duration with written paper of approx. 10 pages The topic for each student's project will be specified at the start of the module. The lecturer assesses the results of the project and the written report.
Assessment prerequisite	I TNW Collaboration in the tutorials and II AHA Recognised solutions for the assignments and interim presentations for the project Review by the tutors

Classes and workload

I	GEO.21.033.10	Software Project Seminar, 1 CH	16 h
II		Independent project work	114 h
		Preparation of the documentation and the presentations	28 h
III		Preparation and follow-up including exam preparation	20 h
		Total:	180 h

Teaching staff	Professor of applied and practical informatics
Teaching language	English
Contents	- analysis, planning and implementation of an application-oriented software project - project management and work - application of the course materials to discipline-specific problems from science and practice - development of project-dependent specialist knowledge - project management - independent development of projects.
Learning objectives/outcomes	Students will have consolidated experience in the analysis, planning, development, implementation and presentation of complex application-related software in geoinformatics and/or applied informatics. They will independently solve challenging tasks and apply modern software technologies.

Teaching and learning formats

- tuition in seminars and interim presentations
- project discussions and consultations
- independent completion of a project in laboratories or with project partners
- independent research, design and execution
- supervised treatment of an individual problem.

The e-learning platform of the University will be used to provide supplementary information and tasks and for assessment of the practical papers.

Literature

- online documentation of algorithms and sample solutions
- in-house scripts
- relevant current publications or documentation.

Further information

GEO.23.034	**Practical Computer Science**		
Module title (German)	Praktische Informatik		
Responsibilities	Professor of applied and practical informatics		
Credits	6		
Courses	GEO	Master of Geomatics Compulsory elective module in semester 2	2023
Cycle and duration	Starts every winter semester over one semester		
Prerequisite	Solid programming knowledge, principles of shell programming recommended		

Prerequisites for awarding credit points

Grade and calculation	The module is graded. The weighting of the module grade in the overall grade calculation can be found in the corresponding examination schedule.
Assessment	I AP6 Independent design and implementation of a selected project/algorithm and documentation Scope of approx. 6 pages (weighting 75%) and AP15 Presentation of the results of 15 minutes' duration (weighting 25%) For these parts of the assessment, registration only is required. The topic for each student's report will be specified during the module. The presentation addresses the topic of the written report.
Assessment prerequisite	I TNW Collaboration in the tutorials and II AHA Recognised solutions to the exercises and interim presentations on the individually completed topics The review will be conducted by the tutors.

Classes and workload

I	GEO.23.034.10	Practical Computer Science Tuition in seminars, 2 CH	32 h
II	GEO.23.034.20	Practical Computer Science Tutorial, 2 CH	32 h
III		Independent completion and implementation of a project	82 h
IV		Independent preparation and follow-up incl. examination preparation	34 h
		Total:	180 h

Teaching staff	Professor of applied and practical informatics
Teaching language	English
Contents	Part 1: Seminar The seminars cover current technologies in practical and applied informatics. At the start of the semester, topics and issues from the perspective of

	informatics with a focus on processing data will be collated from geoinformatics, big data and related areas and then discussed and worked through during the semester. The focus will be on algorithmic approaches, software engineering methods, optimisation approaches and implementation in software. Part 2: Tutorial Solutions and applications for concrete tasks will be discussed and applied practically in the tutorials. Part 3: Project Students select a project from a list of predetermined problems that are worked through and solved independently or in small groups.
Learning objectives/outcomes	Students are familiar with fundamental approaches and procedures to methodically apply programming to solve practical problems with the help of informatics. They can analyse complex tasks, define requirements, select suitable algorithms, and develop and implement software solutions.
Teaching and learning formats	- seminar to present and explain important material using presentations and programming examples using projector and whiteboard - completion of practical exercises by jointly working through sample solutions on the PC in a project lab - independent completion of tasks using predefined example solutions - supervised treatment of an individual problem with interim presentations to expand and consolidate understanding. The e-learning platform of the University will also be used Information and tasks as well as assessment of the practical work.
Literature	- online documentation of algorithms and sample solutions - in-house scripts - current documents from programming languages and libraries used. Additional suitable literature will be researched jointly based on the task or will be provided by the tutors.
Further information	

GEO.21.001	**Higher Mathematics**
Module title (German)	Höhere Mathematik
Responsibilities	Professor of mathematics, geometry and applied informatics
Credits	6
Courses	GEO Master of Geomatics 2021 Compulsory elective module in semester 1
Cycle and duration	Starts every summer semester over one semester
Prerequisite	Mathematics and geometry at the level obtained in the Bachelor courses Geoinformatics as well as Geodesy and Measuring Technology are recommended.

Prerequisites for awarding credit points

Grade and calculation	The module is graded. The weighting of the module grade in the overall grade calculation can be found in the corresponding examination schedule.
Assessment	SCH120 Written examination of 120 minutes' duration
Assessment prerequisite	None

Classes and workload

I	GEO.21.001.10	Higher Mathematics Lecture, 2 CH	32 h
II	GEO.21.001.20	Higher Mathematics Tutorial, 2 CH	32 h
III		Independent preparation and follow-up including exam preparation	116 h
		Total:	180 h

Teaching staff	Prof. of mathematics, geometry and applied informatics
Teaching language	Primary teaching language English
Contents	The classes cover: - solution behaviour for linear equation systems - intrinsic values and vectors - differential and integral calculus of several varying fields and tensors - conventional differential equations - implementation of these topics with mathematical software.
Learning objectives/outcomes	After completing the module, students will be able to - demonstrate skills in and knowledge of the handling of formulas and algorithms incorporating computer systems - understand the theoretical principles required for this.
Teaching and learning formats	The module contents are taught in the lectures using whiteboard, PC and projector. In the tutorials, joint examples and tasks relating to the module material are formulated and solved individually or in groups. Guided self-study for preparation and follow-up.
Literature	Additional literature will be announced in the lecture.

Further information	–

GEO.21.025	Geostatistics		
Module title (German)	Geostatistik		
Responsibilities	Professor of practical geodesy, data processing and cartography		
Credits	6		
Courses	GEO	Master of Geomatics Compulsory elective module in semester 1	2021
Cycle and duration	Starts every summer semester over one semester		
Prerequisite	Passed examination of a module in spatial statistics (Bachelor) is required.		

Prerequisites for awarding credit points

Grade and calculation	The module is graded. The weighting of the module grade in the overall grade calculation can be found in the corresponding examination schedule.
Assessment	AHA15 Assignment of 15 pages
Assessment prerequisite	None

Classes and workload

I	GEO.21.025.10	Geostatistics Lecture, 2 CH	32 h
II	GEO.21.025.20	Geostatistics Seminar, 2 CH	32 h
III		Independent preparation and follow-up including exam preparation	116 h
		Total:	180 h

Teaching staff	Professor of practical geodesy, data processing and cartography
Teaching language	English
Contents	The classes cover: - multivariate geostatistics - optimal test network planning - methods for geostatistical prediction and geostatistical simulation - models and algorithms for data processing - Bayesian statistics.
Learning objectives/outcomes	After completing the module, students will be able to - analyse and evaluate n-dimensional data - select the optimal estimation method based on different parameters - estimate parameters for spatial dependencies - make statements about extreme values based on conditional geostatistical simulations - consider fuzzy data quantities in the forecast - answer various technical spatially related questions.
Teaching and learning formats	Lecture on whiteboard, projector and computer lab to present the seminar material based on concrete tasks from nature, technology and the environment
Literature	Additional literature will be announced in the lecture.
Further information	–

GEO.21.025	**Differential Geometry**
Module title (German)	Differenzialgeometrie
Responsibilities	Professor of mathematics, geometry and applied informatics
Credits	6
Courses	GEO Master of Geomatics 2021 Compulsory elective module in semester 2
Cycle and duration	Starts every winter semester over one semester
Prerequisite	Mathematics 1 and 2 from the Bachelor courses Geoinformatics and Geodesy and Measuring Technology, including solving of equations, matrices, vectors, differential and integral calculus of a variable, are recommended.

Prerequisites for awarding credit points

Grade and calculation	The module is graded. The weighting of the module grade in the overall grade calculation can be found in the corresponding examination schedule.
Assessment	SCH120 Written examination of 120 minutes' duration
Assessment prerequisite	None

Classes and workload

I	GEO.21.028.10	Differential Geometry Lecture, 2 CH	32 h
II	GEO.21.028.20	Differential Geometry Seminar, 2 CH	32 h
III		Independent preparation and follow-up including exam preparation	116 h
		Total:	180 h

Teaching staff	Professor of mathematics, geometry and applied informatics
Teaching language	Primary teaching language English
Contents	The classes cover: - curve theory (particularly surface curves) - geodetic lines - surface metrics - surface curvature - application in geodesy - software implementation of these topics.
Learning objectives/outcomes	After completing the module, students will be able to - handle formulas and algorithms considering the programming environment - understand the theoretical principles required for this.
Teaching and learning formats	The module contents are taught in the lectures using whiteboard, computer and projector. In the tutorials, examples and tasks related to the lecture material are formulated jointly and solved individually or in groups. The tutorials are completed in computer laboratories.

Literature	Gray (various editions): Modern Differential Geometry of Curves and Surfaces, CRC Press Inc. Heitz (1988): Coordinates in Geodesy. Springer.

	Lipschutz (various editions): Theory and problems of differential geometry. Schaum's Outline.
	Additional literature will be announced in the lecture.
Further information	–

GEO.23.014	**Marines GIS**
Module title (English)	Marine GIS
Responsibilities	Professor of photogrammetry, remote sensing, GIS and cartography
Credits	6
Courses	GEO Master of Geomatics 2021 Compulsory elective module in semester 1
Cycle and duration	Starts every winter semester over one semester
Prerequisite	None

Prerequisites for awarding credit points

Grade and calculation	The module is graded. The weighting of the module grade in the overall grade calculation can be found in the corresponding examination schedule.
Assessment	AR 15 Presentation of approx. 15 minutes' duration with written paper of approx. 15 pages The topic for each student's report will be specified during the module. The presentation addresses the topic of the written report.
Assessment prerequisite	I TNW Collaboration in the tutorials and II AHA Recognised written reports and III AP Presentations on individual tutorial tasks. The review will be conducted by the students.

Classes and workload

I	GEO.23.014.10	Marine GIS Lecture, 2 CH	32 h
II	GEO.23.014.20	Marine GIS Tutorial, 2 CH	32 h
III		Independent preparation and follow-up	116 h
		Total:	180 h

Teaching staff	Professor of photogrammetry, remote sensing, GIS and cartography
Teaching language	Primary teaching language English
Contents	- marine science, nautical hydrography, marine environmental planning - coastal zones: problems and risks, planning and integrated coastal zone management (ICZM), coastal protection in MV - marine data models (S57, S100, ESRI), Electronical Nautical Chart (ENC), Hydrographic Production Database (HPD), marine databases (MarGIS, Pangaea, Helcom) - importance of coasts and oceans for the climate, integrated maritime policy in the EU; importance of the Arctic regions.
Learning objectives/outcomes	Students will be familiar with the special features of marine geoinformation systems and know the essential features of marine informatics; they will be aware of the characteristics of coastal and marine regions, including in the context of the impacts of climate change.
Teaching and learning formats	Lecture on whiteboard, projector, computer, work sheets; in the lectures the

	specific theoretical principles that are implemented in the tutorials will be discussed; where applicable, field trips to the Baltic Sea coast and coastal management services
	Self-study for preparation and follow-up; supervised individual investigations to expand and consolidate understanding
	The e-learning platform of the University will be used to provide supplementary information and tasks and for assessment of the practical papers.
Literature	Additional literature will be announced in the first lecture.
Further information	

GEO.21.052 Numerical Analysis

Module title (German)	Numerische Mathematik
Responsibilities	Professor of mathematics, geometry and applied informatics
Credits	6
Courses	GEO Master of Geomatics 2021 Compulsory elective module in semester 1
Cycle and duration	Starts every summer semester over one semester
Prerequisite	Mathematics and geometry at the level obtained in the Bachelor courses Geoinformatics as well as Geodesy and Measuring Technology are recommended.

Prerequisites for awarding credit points

Grade and calculation	The module is graded. The weighting of the module grade in the overall grade calculation can be found in the corresponding examination schedule.
Assessments	I AP6 Independent design and implementation of a numerical algorithm as a solution to a specified problem including documentation of at least 6 pages (weighting: 75%) and II AP15 Presentation of the results of 15 minutes' duration (weighting: 25%) For these parts of the assessment, registration only is required. The tasks are issued by the tutors. The presentation includes the results of the numerical program and the submitted report.
Assessment prerequisites	TNW Successful participation in the tutorials. Review by the tutors. Section 4 of the Departmental Examination Regulations applies.

Classes and workload

I	GEO.21.052.10	Numerical Analysis Lecture, 2 CH	32 h
II	GEO.21.052.20	Numerical Analysis Tutorial, 2 CH	32 h
III		Independent preparation and follow-up including exam preparation	116 h
		Total:	180 h

Teaching staff	Prof. of mathematics, geometry and applied informatics
Teaching language	Primary teaching language English
Contents	- essential concepts in numerical mathematics (computer arithmetic, condition, stability, error propagation) - methods to solve linear equation systems and non-linear equations - interpolation - numerical solving of differential equations - numerical integration.
Learning objectives/outcomes	After completing the module, students will be familiar with the special features

	that must be considered when applying numerical methods to solve mathematical tasks and can thus estimate the quality of numerical results.
Teaching/learning formats*	Lecture: The module contents are taught in the lectures using whiteboard, PC and projector. Tutorials: In the tutorials, examples and tasks related to the lecture material are formulated jointly and solved individually or in groups. Self-study for preparation and follow-up
Literature*	M. Knorrenschild: Numerische Mathematik. Eine beispielorientierte Einführung, Fachbuchverlag Leipzig G. Engeln-Müllges, K. Niederdrenk, R. Wodicka: Numerik-Algorithmen, Verfahren, Beispiele, Anwendungen, Springer-Verlag Heidelberg/Berlin Introduction to Numerical Analysis, Springer, 1980
Further information*	–

GEO.23.035	Geoinformatik-Exkursion	
Module title (English)	Geoinformatics Field Trip	
Responsibilities	Professor of photogrammetry, remote sensing, GIS and cartography	
Credits	6	
Courses	GEO Master of Geomatics Compulsory elective module in semester 2	2023
Cycle and duration	Starts every winter semester over one semester	
Prerequisite	None	

Prerequisites for awarding credit points

Grade and calculation	The module is graded. The weighting of the module grade in the overall grade calculation can be found in the corresponding examination schedule.
Assessment	AHA Assignment (field trip report) of 15 pages
Assessment prerequisite	None

Classes and workload

I	GEO.23.035.10	Geoinformatics Excursion Field trip, 5 CH	80 h
II	GEO.23.035.20	Field trip preparation and follow-up Tuition in seminars, 1 CH	16 h
III		Independent preparation and follow-up including exam preparation	84 h
		Total:	180 h

Teaching staff	Professor of photogrammetry, remote sensing, GIS and cartography
Teaching language	Primary teaching language English
Contents	The module includes more extensive field work with the nature of a field trip. Under an environmentally relevant topic, various issues will be discussed and analysed as part of the field work, either individually or in groups. The major field trip may also be supplemented by practical components (such as mapping).
Learning objectives/outcomes	Students gain experience in field work and develop a deeper understanding of the topic covered and the selected region while also gaining practical experience in various geoscientific, geographical or cultural geographical areas; they develop an awareness and an environmentally relevant, scientifically based appreciation of the problems to identify and evaluate natural and anthropogenically induced phenomena.
Teaching and learning formats	Field trip, supported by various materials such a field trip guide, maps, tables. The e-learning platform of the University will be used to provide supplementary information and for assessment of the submitted assignments. Self-study for preparation and follow-up
Literature	Additional literature will be announced in the first lecture.
Further information	–

GEO.21.002	Management in Business and Authorities		
Module title (German)	Management in Unternehmen und Behörden		
Responsibilities	Professor of measuring technology and informatics		
Credits	6		
Courses	LGM	Master of Landscape Studies and Greenspace Management Compulsory elective module in semester 2 (conversion)	2020
	GEO	Master of Geomatics Compulsory elective module in semester 2	2021
Cycle and duration	Starts every winter semester for one semester		
Prerequisite	None		

Prerequisites for awarding credit points

Grade and calculation	The module is graded. The weighting of the module grade in the overall grade calculation can be found in the corresponding examination schedule.
Assessment	SCH120 Written examination of 120 minutes' duration
Assessment prerequisite	None

Classes and workload

I	GEO.21.002.10	Management in Business and Authorities Lecture, 2 CH	32 h
II	GEO.21.002.20	Management in Business and Authorities Tutorial, 2 CH	32 h
III		Independent project work	20 h
IV		Independent preparation/follow-up incl. exam preparation	96 h
		Total:	180 h

Teaching staff	Professor of measuring technology and informatics
Teaching language	English
Contents	The classes cover: - operations of businesses and authorities in society - legal environment - range of services - service provision - product life cycle management - mission, vision, strategy, tactics - operational business, controlling - quality management, risk management - certification, validation, verification, accreditation - liability issues, data privacy - personnel management, international management - planned responses to major disruptions.
Learning objectives/outcomes	Students will obtain the foundational knowledge and skills required for subsequently taking on managerial responsibility. They will be confronted with the typical complexity of decisions in business or authorities. Carrying out independent project work will promote personal initiative and teamwork.

	Instead of teaching preprepared standard solutions, students will instead participate in researching and developing modern management methods. After completing the module, the students will be able to: - develop options for strategic and operative decisions regarding company and regulatory policy - critically assess risks and suggest mitigation procedures - exploit scope for action even with major disruptions and incomplete information.
Teaching and learning formats	Lecture on whiteboard and projector to present the contents Tutorials using concrete examples for practical execution Guided self-study for preparation and follow-up Completion and presentation of the student's own project
Literature	Directives of the European Union, according to subject ISO 9001, various certification standards, current edition General Data Protection Regulation EU, current edition ISO 31000, current version Additional literature will be announced in the lecture (current research articles, etc.).
Further information	–

Compulsory modules

GEO.23.007	**Application Project**		
Module title (German)	Anwenderprojekt		
Responsibilities	Professor of photogrammetry, cartography, GIS and remote sensing		
Credits	6		
Courses	GEO	Master of Geomatics Compulsory elective module in semesters 1 and 2	2021
Cycle and duration	Starts every summer semester for two semesters		
Prerequisite	None		

Prerequisites for awarding credit points

Grade and calculation	The module is graded. The weighting of the module grade in the overall grade calculation can be found in the corresponding examination schedule.
Assessment	AP Independent completion of a specified practical or scientific issue. Research, design and implementation of a solution (weighting: 75%) and AHA15 Assignment of approx. 15 pages (weighting 25%) For these parts of the assessment, registration only is required. The presentation covers the results of the project and describes the essential contents of the written report. The individual topic will be selected from a list of current topics and defined at the start of the module. A project can be completed individually or in small groups depending on its size and complexity.
Assessment prerequisite	TNW Evidence of participation in the seminars for the interim presentations about the projects. Review by the tutors. More detailed provisions are given in section 4 of the Departmental Examination Regulations.

Classes and workload

I	GEO.23.007.10	Application Project Seminar, 1 CH	16 h
II		Independent project work	118 h
III		Independent preparation/follow-up incl. exam preparation	48 h
		Total:	180 h

Teaching staff	Professors in the course
Teaching language	English
Contents	The classes cover: - application of the course materials to discipline-specific problems from science and practice - development of project-dependent specialist knowledge - project management - preparation of the Master's thesis.
Learning objectives/outcomes	After completing the module, students will be able to - apply experience in the planning and execution of challenging projects to

solve complex tasks in geodesy or geoinformatics
- independently solve sub-tasks and
- coordinate sub-tasks in teams.

Teaching and learning formats

- tuition in seminars and interim presentations
- project discussions and consultations
- independent completion of a project in laboratories or with project partners
- independent research, design and execution
- supervised treatment of an individual problem.

The e-learning platform of the University will be used to provide supplementary information and for assessment of the submitted assignments.

Literature

- online documentation of algorithms and sample solutions
- in-house scripts
- relevant current publications or documentation.

Further information

GEO.23.009	Master's thesis with Master's colloquium	
Module title (German)	Master-Arbeit mit Master-Kolloquium	
Responsibilities	Dean of Studies	
Credits	6	
Courses	GEO Master of Geomatics Compulsory elective module in semester 3	2021
Cycle and duration	Starts every summer semester for one semester	
Prerequisite	Evidence of at least 42 credits (as per section 8 of the Departmental Examination Regulations)	

Prerequisites for awarding credit points

Grade and calculation	The module is graded. The weighting of the module grade in the overall grade calculation can be found in the corresponding examination schedule.
Assessment	MA60 Master's thesis of approx. 60 pages (weighting: 23 ECTS credits) and AKQ45 Master's colloquium of 45 minutes' duration (weighting: 7 ECTS credits)
Assessment prerequisite	Where applicable, requirements defined in section 3 of the Departmental Examination Regulations are met in full.

Classes and workload

I	Master's thesis	690 h
II	Master's colloquium	210 h
	Total:	900 h

Teaching staff	Professors in the course
Teaching language	Primary teaching language English or German as per note in section 7(3) of the Departmental Examination Regulations.
Contents	Independent completion of a scientific or engineering task or problem at the level of a Master's degree.
Learning objectives/outcomes	Students will be able to structure and independently solve a scientific or engineering task in geoinformatics or geodesy and appropriately describe the solution in a written format and present the solution orally. Based on the knowledge acquired in the course, students will be able to analyse problems, relate the problems to the current international body of knowledge based on the literature and internet, and implement a well-founded solution.
Teaching and learning formats	- academic supervision of the subject in the form of consultations by supervisors.
Literature	Current literature related to the topic
Further information	