HafenCity Universität Hamburg

Module Guide

Master of Science

Geodesy and Geoinformatics

BSPO-MSc-Geo-23

Winter Semester

2023/2024

Geodäsie und Geoinformatik (M.Sc.) Vertiefung Geodäsie

BSPO-Msc-Geo-2023

HafenCity Universität Hamburg

Lehrbereiche	Semester 1	CP	Semester 2	CP	Semester 3	CP	Semester 4	CP
MINT	**Geo-M-Mod-101** Geodetic Mathematics	2,5						
	Geo-M-Mod-103 Software and Interface Technology	5						
Geodäsie	**Geo-M-Mod-104** Nachbereichsphotogrammetrie	5	**Geo-M-Mod-203 Terrestrisches Laserscanning** Terrestrisches Laserscanning 1 Terrestrisches Laserscanning 2	7,5	**Geo-M-Mod-311** Geodetic Earth Observation	5		
	Geo-M-Mod-110 Industrielle Messtechnik	5	**Geo-M-Mod-211** Location Based Services	5	**Geo-M-Mod-312** 3D-Visualisierung	7,5		
			Geo-M-Mod-204 Integrated Navigation	5	**Geo-M-Mod-301** Dynamische Messtechnik	5		
			Geo-M-Mod-205 Physical Geodesy	5				
Geoinformatik			**Geo-M-Mod-207** Geodaten-Modellierung	5	**Geo-M-Mod-303** GIS-Programmierung	5		
			Geo-M-Mod-208 WebGIS	7,5	**Geo-M-Mod-313** Geovisualisierung	5		
			Geo-M-Mod-209 Spatial Data Analysis	5	**Geo-M-Mod-314** Big Data Analytics	5		
Hydrographie	**Geo-M-Mod-107 Basics of Hydrography** Determ. of Positions and Water Depths Practical Course 1	2,5			**Geo-M-Mod-305** Nautical Charting	2,5		
	Geo-M-Mod-306 Navigation in Hydrography Nautical Science Electronic Chart Display and Information System	2,5			**Geo-M-Mod-310** LiDAR and Remote Sensing	2,5		
	Geo-M-Mod-109 Marine Environment Marine Metereology Legal Aspects	5						
Fachübergreifende Studienangebote	**BS-M-MOD-001 Project Management** Lecture		Seminar	5	**Q-M-MOD-001 [Q] Studies** [Q] Studies I [Q] Studies II	5		
Thesis							**Geo-M-Mod-401** Master-Thesis	30
120 CP		30		30		30		30

Wahlpflicht es sind 12,5 CP aus dem WPF-Bereich zu wählen

Geodäsie und Geoinformatik (M.Sc.) Vertiefung Geoinformatik

BSPO-Msc-Geo-2023

HafenCity Universität Hamburg

Lehrbereiche	Semester 1	CP	Semester 2	CP	Semester 3	CP	Semester 4	CP
MINT	**Geo-M-Mod-101** Geodetic Mathematics	2,5						
	Geo-M-Mod-103 Software and Interface Technology	5						
Geodäsie	**Geo-M-Mod-104** Nachbereichsphotogrammetrie	5	**Geo-M-Mod-203 Terrestrisches Laserscanning** Terrestrisches Laserscanning 1 Terrestrisches Laserscanning 2	7,5	**Geo-M-Mod-311** Geodetic Earth Observation	5		
	Geo-M-Mod-110 Industrielle Messtechnik	5	**Geo-M-Mod-211** Location Based Services	5	**Geo-M-Mod-312** 3D-Visualisierung	7,5		
			Geo-M-Mod-204 Integrated Navigation	5				
			Geo-M-Mod-205 Physical Geodesy	5				
Geoinformatik	**Geo-M-Mod-106** Projekt Geoinformatik	10	**Geo-M-Mod-207** Geodaten-Modellierung	5	**Geo-M-Mod-303** GIS-Programmierung	5		
			Geo-M-Mod-208 WebGIS	7,5	**Geo-M-Mod-313** Geovisualisierung	5		
			Geo-M-Mod-209 Spatial Data Analysis	5	**Geo-M-Mod-314** Big Data Analytics	5		
Hydrographie	**Geo-M-Mod-107 Basics of Hydrography** Determ. of Positions and Water Depths Practical Course 1	2,5			**Geo-M-Mod-305** Nautical Charting	2,5		
	Geo-M-Mod-306 Navigation in Hydrography Nautical Science Electronic Chart Display and Information System	2,5			**Geo-M-Mod-310** LiDAR and Remote Sensing	2,5		
	Geo-M-Mod-109 Marine Environment Marine Metereology Legal Aspects	5						
Fachübergreifende Studienangebote	**BS-M-MOD-001 Project Management** Lecture		Seminar	5	**Q-M-MOD-001 [Q] Studies** [Q] Studies I [Q] Studies II	5		
Thesis							**Geo-M-Mod-401** Master-Thesis	30
120 CP		30		30		30		30

Wahlpflicht es sind 25 CP aus dem WPF-Bereich zu wählen

Geodäsie und Geoinformatik (M.Sc.) Specialization Hydrography

BSPO-Msc-Geo-2023

HafenCity Universität Hamburg

Lehrbereiche	Semester 1	CP	Semester 2	CP	Semester 3	CP	Semester 4	CP
MINT	**Geo-M-Mod-101** Geodetic Mathematics	2,5						
	Geo-M-Mod-103 Software and Interface Technology	5						
Geodäsie	**Geo-M-Mod-104** Nachbereichsphotogrammetrie	5	**Geo-M-Mod-211** Location Based Services	5	**Geo-M-Mod-311** Geodetic Earth Observation	5		
	Geo-M-Mod-110 Industrielle Messtechnik	5	**Geo-M-Mod-204** Integrated Navigation	5	**Geo-M-Mod-312** 3D-Visualisierung	7,5		
			Geo-M-Mod-205 Physical Geodesy	5				
Geoinformatik			**Geo-M-Mod-207** Geodaten-Modellierung	5	**Geo-M-Mod-303** GIS-Programmierung	5		
			Geo-M-Mod-208 WebGIS	7,5	**Geo-M-Mod-313** Geovisualisierung	5		
			Geo-M-Mod-209 Spatial Data Analysis	5	**Geo-M-Mod-314** Big Data Analytics	5		
Hydrographie	**Geo-M-Mod-107 Basics of Hydrography** Determ. of Positions and Water Depths Practical Course 1	2,5	**Geo-M-Mod-212 Advanced Hydrography** Advanced Hydrography Practical Course 3 Terrestrial Laser Scanning 1	7,5	**Geo-M-Mod-305** Nautical Charting	2,5		
	Geo-M-Mod-108 Hydrographic Data Acquisition and Processing Underwater Acoustics Hydrographic Data Processing Practical Course 2	7,5			**Geo-M-Mod-310** LiDAR and Remote Sensing	2,5		
	Geo-M-Mod-109 Marine Environment Marine Metereology Legal Aspects	5			**Geo-M-Mod-306 Navigation in Hydrography** Nautical Science Electronic Chart Display and Information System	2,5		
					Geo-M-Mod-307 Oceanography Physical Oceanography and Tides Oceanographic Data Processing	5		
					Geo-M-Mod-308 Marine Geology/Geophysics Geology/Geomorphology Seismics Magnetics and Gravimetry	5		
					Geo-M-Mod-309 Hydrographic Practice Supplementary Field Training/ Practical Course Quality Management	7,5		
Fachübergreifende Studienangebote	**BS-M-MOD-001 Project Management** Lecture		Seminar	5				
			Q-M-MOD-001 [Q] Studies [Q] Studies I [Q] Studies II	5				
Thesis							**Geo-M-Mod-401** Master-Thesis	30
120 CP		30		30		30		30

Electives	Please select 10 CP of Electives

Geodetic Mathematics

Geodesy and Geoinformatics (M.Sc.)

HCU Hamburg

Module number	Type of module (C/CE/E)	SWS	Student workload	CP (according to ECTS)	Semester (proposed)	Duration
Geo-M-Mod-101	C/C/C GD/GI/HY	2	75	2,5	1	1

Subject Area	Module Coordinators
MINT	Prof. Dr.-Ing. Youness Dehbi Computational Methods

Courses

Title	Course type	SWS (Contact Hours/Week)	Ø Group size
1. Geodetic mathematics	Lecture & exercices	2 SWS (21 h)	

Teaching and learning activities

Title	face-to-face teaching	Project work	examination preparation	Self study	Total student workload
1. Geodetic mathematics	21 h		Included in self study	54 h	75 h

Objectives and contents

Objectives of qualifications (Competencies)
In this module students will gain the competencies to • understand advanced mathematical concepts related to geodetic problems • derive and apply equations of three-dimensional geodesy as well as two-dimensional geodesy on the sphere and on the rotational ellipsoid • make computations based on different 2D and 3D coordinate systems and perform coordinate transformations between them • Independently implement programmes to solve problems of 3D surveying
Contents of the module
• Geocentric and local cartesian coordinate systems, ellipsoidal coordinates, coordinate transformations, geodetic datums and transformation • Elements of spherical trigonometry (great circles, spherical triangles), geodesic lines • Differential geometry: parametric equations of curves and surfaces • Differential equations as relevant for geodesy • Geodesic lines and normal section curves on the ellipsoid • Surface coordinates on the sphere and the rotational ellipsoid: geodetic polar and parallel coordinates, isothermal coordinates, transformation of surface coordinates, applications in land surveying (e.g. UTM- und Gauß-Krüger coordinates) • Series, Taylor expansions
Recommended literature
• Torge, W. & Müller, J. (2012) Geodesy, Walter de Gruyter, ISBN 978-3-11-025000-8 • Harris, J. W. & Stöcker, H. (1998). Handbook of Mathematics and Computational Science. Springer, ISBN 0-387-94746-9
Forms of teaching and learning
Lecture and Exercises

Assessment and ECTS awarding criteria

Precondition of examination (Pre-requisite for examination, attendance)
Successful completion of homework exercises and of tutorial “Adjustment Theory” (variance propagation & least squares adjustment)
Assessment methods and criteria (type, duration & scope)
written examination (120 min) or oral examination (25 min), respectively (graded)
ECTS awarding criteria
successful completion of the module examination
Calculation of the module grade
Grade for oral/written exam (100%)
Weighting of the module grade

Module grade represents 2,08 % of the final grade.

Additional Information

Previous knowledge / Requirements for participation (in form and content) in accordance with examination regulations
Mathematical basics: functions, vectors, matrices, etc.
Applicability of Module
The module can only be used within the study program Geodesy and Geoinformatics (M.Sc.)
Special requirements for workplaces (room type / extent of use presence / extent of use project work and/or model construction in self-study)
Lecture hall
Frequency of Offering
Every winter term
Course Language
Englisch

Valid from	Valid until	Version	last updated	Adopted on
WiSe 22/23 / SoSe 24		V.1 01	03.07.2023	

Software and Interface Technology

Geodesy and Geoinformatics (M.Sc.)

HCU Hamburg

Module number	Type of module (C/CE/E)	SWS	Student workload	CP (according to ECTS)	Semester (proposed)	Duration
Geo-M-Mod-103	GD / GI / HY C / C/ C	3 SWS	150 Std.	5	1	1 Semester
Subject Area				Module Coordinators		
MINT				Prof. Dr. Youness Dehbi Computational Methods		

Courses

Title	Course type	SWS (Contact Hours/Week)	Ø Group size
1. Software and Interface Technology – Lecture 1.1 Software and Interface Technology- Exercise	VL UE	2 SWS (21 h) 1 SWS (10,5 h)	

Teaching and learning activities

Title	face-to-face teaching	Project work	examination preparation	Self study	Total student workload
Software and Interface Technology	31,5	31,5	included in self study	87 h	150 h

Objectives and contents

Objectives of qualifications (Competencies)

- Students shall gain the ability to solve complex problems by utilizing modern general purpose programming languages. Examples include (geo)data processing and creating small applications.
- Students acquire deeper data processing knowledge in the area of hard- and software.
- They are able to solveinterfacing problems between data processing equipment and geodetic instruments

Contents of the module

- Software development
- general purpose programming languages
- procedural and object-oriented programming
- methods of software development
- error handling
- testing
- concepts about complexity and development processes;
- Programming using integrated development environments (IDE)
- Interfacing techniques (RS-232/422/485, Ethernet)
- Mechanical, functional, electrical properties
- Handshaking
- Connectingsensors to a computer
- Network topologies
- Architecture models
- IP addresses and ports
- Service
- Programming with application layer protocols
- Socket Programming

Recommended literature

- Python Software Foundation: Python documentation (https://docs.python.org/)
- Sweigart: Automate the Boring Stuff with Python (https://automatetheboringstuff.com)
- Axelson, J.: Serial Port Complete, Second Edition
- Faruque Sarker, M.O. and Washington, S.: Learning Python Network Programming
- Rhodes, B. and Goerzen, J.: Foundations of Python Network Programming

Forms of teaching and learning

VL / UE

Assessment and ECTS awarding criteria

Precondition of examination (Pre-requisite for examination, attendance)

successful exercises (not graded) successful completion of tutorial “Programming”
Assessment methods and criteria (type, duration & scope)
K (or M)
ECTS awarding criteria
Successful completion of graded examination
Calculation of the module grade
100 % K (or M)
Weighting of the module grade
4,17 %

Additional Information

Previous knowledge / Requirements for participation (in form and content) in accordance with examination regulations
Applicability of Module
The module can only be used within the study program Geodesy and Geoinformatics
Special requirements for workplaces (room type / extent of use presence / extent of use project work and/or model construction in self-study)
Completion of exercises requires special software (available in Helava room) and student working places
Frequency of Offering
Every WiSe
Course Language
English

Valid from	Valid until	Version	last updated	Adopted on
WiSe 23/24		V.1 01	14.08.2023	

Nahbereichsphotogrammetrie

Geodäsie und Geoinformatik (M.Sc.).
HCU Hamburg

Modulnummer	Modultyp (PF/WP/W)	SWS	Arbeitsaufwand (Workload)	CP (nach ECTS)	Studiensemester gem. Studienplan	Moduldauer
Geo-M-Mod-104	P/WP/WP GD/GI/HY	3 SWS	150 Std.	5	1	1 Semester

Lehr- und Lernbereich	Modulverantwortliche Person
Geodäsie	Prof. Dr.-Ing. Thomas Kersten Photogrammetrie und Laserscanning

Lehrveranstaltungen

Titel	Lehrveranstaltungsform	SWS (Kontaktzeit)	Ø Gruppengröße
1. Nahbereichsphotogrammetrie - Vorlesung		1 SWS (10,5 Std.)	30
1.1 Nahbereichsphotogrammetrie - Übung		2 SWS (21 Std.)	30

Studentischer Arbeitsaufwand

Titel	Kontaktzeit	Projekt-bearbeitung	Prüfungs-vorbereitung	Selbststudium	Gesamt
1. Nahbereichsphotogrammetrie - Vorlesung	10,5 Std.	XX Std.	XX Std.	XX Std.	150 Std.
1.1 Nahbereichsphotogrammetrie - Übung	21 Std.	XX Std.	XX Std.	XX Std.	

Ziele und Inhalte

Qualifikationsziel des Moduls (Angestrebte Kompetenzen)

Die Studierenden bearbeiten mehrere Aufgaben im Bereich industrieller optischer 3D-Messtechnik und sammeln Erfahrungen in verschiedenen Übungen. Sie lernen Aufnahmeverfahren (Offline und Online) und Aufnahmekonfigurationen (im Testfeld oder am Objekt) sowie verschiedene Aufnahmesysteme und deren Möglichkeiten zur Kalibrierung kennen. Durch die Auswertung der aufgenommenen Daten lernen die Studierenden die Fehleranalyse und die Bewertung der Ergebnisse durchzuführen und das Automations- und das Genauigkeitspotential der verschiedenen Systeme einzuschätzen.

Inhalte des Moduls

Die Studierenden bearbeiten mehrere Aufgaben im Bereich industrieller optischer 3D-Messtechnik und sammeln Erfahrungen in verschiedenen Übungen. Sie lernen Aufnahmeverfahren (Offline und Online) und Aufnahmekonfigurationen (im Testfeld oder am Objekt) sowie verschiedene Aufnahmesysteme und deren Möglichkeiten zur Kalibrierung kennen. Durch die Auswertung der aufgenommenen Daten lernen die Studierenden die Fehleranalyse und die Bewertung der Ergebnisse durchzuführen und das Automations- und das Genauigkeitspotential der verschiedenen Systeme einzuschätzen.

Inhalte des Moduls

Einführung in photogrammetrische Messsysteme (analoge und digitale Aufnahmekameras, Panoramakameras, Streifen-projektionssysteme), photogrammetrische Aufnahmeverfahren - Aufnahmetechnik und Aufnahmesysteme (Einbildverfahren, Zweibildverfahren, Mehrbildtriangulation, Streifenprojektion), Projekt- und Aufnahmeplanung (Parameter und Anforderungen), Passpunktsignalisierung (kodierte Messmarken und Maßstäbe) und Passpunktbestimmung, verschiedene Verfahren zur Kamerakalibrierung (Testfeld), Bildorientierung und Bündelblockausgleichung inkl. Fehler- und Genauigkeitsanalyse sowie Bewertung der Ergebnisse, Online-Photogrammetrie, Kodierte Messmarken, Photogrammetrische Industriemesssysteme (Anwendungen industrieller Messtechnik), automatische Messverfahren durch pixel-basierte Matching- Verfahren, low-cost Systeme, Einführung in die Streifenprojektion, Distanz-basierte Kameras (TOF-Kamera), 3D-Handscanner

Empfohlene Literatur

- Luhmann, T. (2018). Nahbereichsphotogrammetrie – Grundlagen, Methoden und Anwendungen. 4. Auflage, Wichmann VDE-Verlag, 792 S.
- Kraus, K. (2007). Photogrammetry - Geometry from Images and Laser Scans. 2nd Edition, De Gruyter
- Wiggenhagen, M. & Steensen, T (2021). Taschenbuch zur Photogrammetrie und Fernerkundung. 6., neu bearbeitete und erweiterte Auflage, Wichmann VDE-Verlag, ca. 360 S.
- Luhmann, T., Robson, S., Kyle, S., Boehm, J. (2013). Close-Range Photogrammetry and 3D Imaging. de Gruyter
- Szeliski, R. (2011). Computer Vision - Algorithms and Applications. Springer

Lehr- und Lernform

Vorlesung und Übung, Plenum

Prüfungsleistungen und Voraussetzung(en) für die Vergabe von CP

Voraussetzung(en) zur Prüfungsteilnahme (Prüfungsvorleistung, Anwesenheit)

Erfolgreicher Abschluss der Übungsaufgaben (Semesterarbeit; unbenotet)

Prüfungsleistung(en) (Art, Dauer, Umfang)

Klausur bzw. mündliche Prüfung (benotet) 90 min/ mündl. Prüfung 20 min
Voraussetzung(en) für die Vergabe von CP
Erfolgreicher Abschluss der Prüfungsleistung
Berechnung der Modulnote
100% Note der Klausur oder mündlichen Prüfung
Gewichtung der Modulnote
4,17 %

Ergänzende Informationen

Vorkenntnisse/ Voraussetzungen für die Teilnahme am Modul (formal und inhaltlich)
Verwendbarkeit des Moduls/ Zugangsvoraussetzung für künftige Module (verbindlich oder empfohlen)
Modul ist verwendbar in Geodäsie und Geoinformatik (M.Sc.)
Besonderer Bedarf an Arbeitsplätzen (Raumtyp / Nutzungsumfang Präsenz / Nutzungsumfang Projektbearbeitung und/oder Modellbau im Selbststudium)
Häufigkeit des Angebots
Jedes Wintersemester
Unterrichtssprache
deutsch

Gültig ab	Gültig bis	Version	zuletzt aktualisiert	Beschlossen am
WiSe 23/24		V.1 01	04.08.2023	

Industrial Measurement Technology

Geodesy and Geoinformatics (M.Sc.)
HCU Hamburg

Module number	Type of module (C/CE/E)	SWS	Student workload	CP (according to ECTS)	Semester (proposed)	Duration
Geo-M-Mod-110	C in GD CE in GI CE in HY	3 SWS	150 h	5	1	1 Semester

Subject Area	Module Coordinators
Geodesy	Prof. Dr.-Ing. Harald Sternberg Hydrographie und Geodäsie

Courses

Title	Course type	SWS (Contact Hours/Week)	Ø Group size
1. Industrial Measurement Technology	Lecture	2 SWS (21 h)	10
1.1 Practical of Industrial Measurement Technology	Practical exercises	1 SWS (10,5 h)	10

Teaching and learning activities

Title	face-to-face teaching	Project work	examination preparation	Self study	Total student workload
1. Industrial Measurement Technology	21 h	0 h	27 h	27 h	75 h
1.1 Practical of Industrial Measurement Technology	10,5 h	64,5 h	0 h	0 h	75 h

Objectives and contents

Objectives of qualifications (Competencies)

The students know the procedures, the instruments and the sensors of industrial measurement technology and can use them for corresponding measurements. Collected measurement results can be evaluated. The students can deal with measurement uncertainty in an indicative context and evaluate it safely.

Contents of the module

Terms and basics: Sets of rules and overview of methods, measurement accuracy, measurement uncertainty, tolerances, tolerance chains, qualitative and quantitative accuracies, and technical terms from plant engineering.

Industrial measurement technology in civil engineering, mechanical engineering and plant construction: Methods of measurement and automation technology, sensor technology, digital and analog measuring equipment, interferometric and laser-based acquisition methods (e.g. laser trackers and line laser scanners), 3D theodolite measuring systems, 3D coordinate measuring machines, sensors of modern total stations, area-based measuring systems, autocollimation, inclinometers, flatness and alignment measurements, calibration and testing of sensors.

Integration of different measuring sensors to solve a measuring task

Special geodetic evaluation procedures: Evaluation of measurement results using descriptive and databased methods.

Measurement plan based work and evaluation: global and local coordinates and reference systems, alignment strategies and point definitions, area and geometry traceability.

Recommended literature

Möser, Müller, Schlemmer, Werner (Hrsg.): Handbuch Ingenieurgeodäsie, Grundlagen (Wichmann Verlag)
Möser, Müller, Schlemmer, Werner (Hrsg.): Handbuch Ingenieurgeodäsie, Maschinen- und Anlagenbau (Wichmann Verlag) Schlemmer, H.: Grundlagen der Sensorik. Eine Instrumentenkunde für Vermessungsingenieure (Wichmann Verlag)
Pfeifer, T., Schmitt, R.: Fertigungsmesstechnik (Oldenbourg Wissenschaftsverlag) Keferstein, Claus P.: Fertigungsmesstechnik (Vieweg + Teubner Verlag)
Joseph, Lentin: ROS robotics projects (Packt Publishing Limited)

Forms of teaching and learning

Regular Lecture and exercises in sub-groups

Assessment and ECTS awarding criteria

Precondition of examination (Pre-requisite for examination, attendance)

Successfully completed exercises (ungraded)

Assessment methods and criteria (type, duration & scope)

Written (120 min.) or oral exam (20 min.)

ECTS awarding criteria

Regular active participation and successful completion of the module examination / examination achievements

Calculation of the module grade
Grade of the written or oral exam (100%)
Weighting of the module grade
Module grade is 4.17% of the final grade

Additional Information

Previous knowledge / Requirements for participation (in form and content) in accordance with examination regulations
Recommended Prerequisites: Knowledge from the bachelor's degree program in Geodesy and Geoinformatics can be used.
Applicability of Module
The module can only be used within the study program Geodesy and Geoinformatics
Special requirements for workplaces (room type / extent of use presence / extent of use project work and/or model construction in self-study)
Lecture: Lecture hall Practical exercises: Geodetic Laboratory, Physical presence is required.
Frequency of Offering
Every second year in the winter semester
Course Language
German

Valid from	Valid until	Version	last updated	Adopted on
WiSe 23/24		V.1 01	25.5.2023	

Terrestrisches Laserscanning

Geodäsie und Geoinformatik (M.Sc.).

HCU Hamburg

Modulnummer	Modultyp (PF/WP/W)	SWS	Arbeitsaufwand (Workload)	CP (nach ECTS)	Studiensemester gem. Studienplan	Moduldauer
Geo-M-Mod-203	P/WP/- GD/GI/HY	4 SWS	225 Std.	7,5	2	1 Semester

Lehr- und Lernbereich	Modulverantwortliche Person
Geodäsie	Prof. Dr.-Ing.Thomas Kersten Photogrammetrie und Laserscanning

Lehrveranstaltungen

Titel	Lehrveranstaltungsform	SWS (Kontaktzeit)	Ø Gruppengröße
1. Terrestrisches Laserscanning 1 - Vorlesung	Vorlesung	1 SWS (10,5 Std.)	30
1.1 Terrestrisches Laserscanning 1 -Übung	Übung	1 SWS (10,5 Std.)	30
2. Terrestrisches Laserscanning 2- Vorlesung	Vorlesung	1 SWS (10,5 Std.)	30
2.1 Terrestrisches Laserscanning -Übung	Übung	1 SWS (10,5 Std.)	30

Studentischer Arbeitsaufwand

Titel	Kontaktzeit	Projekt-bearbeitung	Prüfungs-vorbereitung	Selbststudium	Gesamt
1. Terrestrisches Laserscanning 1 - Vorlesung	1 SWS (10,5 Std.)	XX Std.	XX Std.	XX Std.	
1.1 Terrestrisches Laserscanning 1 -Übung	1 SWS (10,5 Std.)	XX Std.	XX Std.	XX Std.	225 Std.
2. Terrestrisches Laserscanning 2- Vorlesung	1 SWS (10,5 Std.)	XX Std.	XX Std.	XX Std.	
2.1 Terrestrisches Laserscanning -Übung	1 SWS (10,5 Std.)	XX Std.	XX Std.	XX Std.	

Ziele und Inhalte

Qualifikationsziel des Moduls (Angestrebte Kompetenzen)

Die Studierenden führen im Rahmen von praktischen Übungen kleine Projekte im Bereich terrestrisches Laserscanning durch und sammeln Erfahrungen in der Projekt- und Aufnahmeplanung. Sie lernen verschiedene Laserscanningsysteme hinsichtlich Messverfahren und Funktionsprinzip und deren damit verbundenen verschiedenen Einsatzmöglichkeiten in den Bereichen Architektur, Topographie und Industrie kennen. Sie führen Objektaufnahmen praktisch durch und werten die erfassten Daten selbständig aus. Durch die Auswertung der aufgenommenen Daten lernen die Studierenden die Fehleranalyse und die Bewertung der Ergebnisse durchzuführen und das Genauigkeitspotential des Systems einzuschätzen. TLS 2 ist eine ergänzende praxisbezogene Veranstaltung zum Modul Terrestrial Laser Scanning 1

Inhalte des Moduls

Terrestrial Laser Scanning 1 (englisch):

Introduction into terrestrial laser scanning (TLS), measuring procedures, system criteria of laser scanning systems, data acquisition (scanning), sensor integration & data fusion (digital camera & scanner), registration & geo-referencing of scans, segmentation & filtering, geometric investigations in the precision/accuracy of terrestrial laser scanning systems, modelling & object reconstruction (3D triangulation/meshing and CAD modelling using point clouds) & visualization, applications, kinematic (mobile) TLS 1 Exercise: Scanning and registration of laser scans,

Terrestriscches Laserscanning 2 (deutsch)

a) topographische Aufnahme (z.B. für die Archäologie), b) Genauigkeitsuntersuchungen im Labor und im Feld, und c) 3D-Aufnahme eines Architekturobjektes und dessen Modellierung mit Punktwolken) als praktische Ergänzung zum Modul Terrestrial Laser Scanning 1

Empfohlene Literatur

-Vosselman, G., & Maas, H. G. (Eds.). (2010). Airborne and terrestrial laser scanning. Whittles Publishing.

-Shan, J., & Toth, C. K. (Eds.). (2018). Topographic laser ranging and scanning: principles and processing. Second Edition, CRC press.

-Luhmann, T., Robson, S., Kyle, S., & Boehm, J. (2014). Close-range photogrammetry and 3D imaging. Walter de Gruyter.

-Kraus, K. (2007). Photogrammetry: geometry from images and laser scans. 2nd Edition, De Gruyter.

-Diverse Fachartikel aus Fachzeitschriften und Tagungsbänden

Lehr- und Lernform

Vorlesung und Übung:
TLS1: 2,5 CP (2 SWS),
TLS 2: 5 CP (2 SWS)

Prüfungsleistungen und Voraussetzung(en) für die Vergabe von CP

Voraussetzung(en) zur Prüfungsteilnahme (Prüfungsvorleistung, Anwesenheit)

Erfolgreicher Abschluss der Übungsaufgaben (Semesterarbeit; unbenotet)

Prüfungsleistung(en) (Art, Dauer, Umfang)
Klausur oder mündliche Prüfung (benotet)
Voraussetzung(en) für die Vergabe von CP
Erfolgreicher Abschluss der Prüfungsleistung
Berechnung der Modulnote
100% Note der Klausur oder mündlichen Prüfung
Gewichtung der Modulnote
4,17 %

Ergänzende Informationen

Vorkenntnisse/ Voraussetzungen für die Teilnahme am Modul (formal und inhaltlich)
Verwendbarkeit des Moduls/ Zugangsvoraussetzung für künftige Module (verbindlich oder empfohlen)
Modul ist verwendbar in Geodäsie und Geoinformatik (M.Sc.)
Besonderer Bedarf an Arbeitsplätzen (Raumtyp / Nutzungsumfang Präsenz / Nutzungsumfang Projektbearbeitung und/oder Modellbau im Selbststudium)
Häufigkeit des Angebots
Jedes Sommersemester
Unterrichtssprache
TLS 1: Englisch, TLS 2: Deutsch

Gültig ab	Gültig bis	Version	zuletzt aktualisiert	Beschlossen am
WiSe 23/24		V.1 01	04.08.2023	

Location Based Services

M.Sc. Geodesy and Geoinformatics

HCU Hamburg

Module number	Type of module (C/CE/E)	SWS	Student workload	CP (according to ECTS)	Semester (proposed)	Duration
Geo-M-Mod-211	C in GD CE in GI CE in HYD	3 SWS	150 h	5	2	1 Semester

Subject Area	Module Coordinators
Geodesy	Prof. Dr.-Ing. Harald Sternberg Hydrographie und Geodäsie

Courses

Title	Course type	SWS (Contact Hours/Week)	Ø Group size
1. Location Based Services	Lecture	1 SWS (10,5 h)	20
1.1 LBS Project	Project	2 SWS (21 h)	20

Teaching and learning activities

Title	face-to-face teaching	Project work	examination preparation	Self study	Total student workload
1. Location Based Services	10,5 h	0 h	0 h	9,5 h	20 h
1.1 LBS Project	21 h	109 h	0 h	0 h	130h

Objectives and contents

Objectives of qualifications (Competencies)

Students will be familiarized with current methods and technologies for determining positions using local and global radio networks and will be able to evaluate and independently apply them. They can independently collect position data; fuse data sets and process them for visualization or in navigation.
Project management skills are developed through a practical application in the mini-research project.

Contents of the module

- Basics of location-based systems and position determination: Data collection options for geospatial and subject data (analog/digital or primary/secondary data) and position determination in motion inside and outside buildings, prepare data for integration into a mobile geospatial information system or app.
- Mobile computing terms and applications: characteristics of mobile applications and services,
- Location Based Services: Definition of terms, classification, players
- Mobile Geoinformation Systems: Areas of application, Mobile location-based applications and services.
- Mobile location-based applications technology: Wireless communication technology Cell-based radio systems, Fundamentals of data networks, Wireless communication networks, Mobile information technology, Mobile terminals, Mobile operating systems, Data storage on mobile terminals, Mobile clients, USBL.
- Positioning methods for LBS and mobile GIS: alternative methods of position determination, basics of automated position determination, application of network-based position determination, indoor position determination, satellite-based positioning, A-GPS assisted, logical and topological position determination, particle filters.
- Mini research project: data collection or fusion of data, positioning, data integration, and visualization in a mobile application.

Recommended literature

Blankenbach, Jörg: Handbuch der mobilen Geoinformation (Wichmann Verlag)
Lawhead, Joel: Learning geospatial analysis with Python : understand GIS fundamentals and perform remote sensing data analysis using Python 3.7 (Packt Publishing)
Gartner, Georg et al.: Location Based Services and TeleCartography (Springer)

Forms of teaching and learning

Lecture, Project, Lab and term paper

Assessment and ECTS awarding criteria

Precondition of examination (Pre-requisite for examination, attendance)

None

Assessment methods and criteria (type, duration & scope)

Semester paper and presentation

ECTS awarding criteria

Regular active participation and successful completion of the module examination / examination achievements
Calculation of the module grade
Grade of presentation and semester paper (100%)
Weighting of the module grade
Module grade is 4.17% of the final grade

Additional Information

Previous knowledge / Requirements for participation (in form and content) in accordance with examination regulations
Recommended Prerequisites: Knowledge from the master program in Geodesy and Geoinformatics can be used.
Applicability of Module
The module can only be used within the study program Geodesy and Geoinformatics
Special requirements for workplaces (room type / extent of use presence / extent of use project work and/or model construction in self-study)
Lecture: Lecture hall Project: Geodetic Laboratory, Seminar rooms and PC-Pool. Physical presence is required.
Frequency of Offering
Each summer semester
Course Language
German

Valid from	Valid until	Version	last updated	Adopted on
WiSe 23/24		V.1 01	24.05.2023	

Integrated Navigation

Geodesy and Geoinformatics (M.Sc.)

HCU Hamburg

Module number	Type of module (C/CE/E)	SWS	Student workload	CP (according to ECTS)	Semester (proposed)	Duration
Geo-M-Mod-204	C in GD CE in GI C in HYD	3 SWS	150 Std.	5	2	1 Semester

Subject Area	Module Coordinators
Geodesy	Prof. Dr.-Ing. Harald Sternberg Hydrographie und Geodäsie

Courses

Title	Course type	SWS (Contact Hours/Week)	Ø Group size
1. Integrated Navigation	Lecture	2 SWS (21 h)	50
1.1 Exercises of Integrated Navigation	Practical exercises	1 SWS (10,5 h)	50

Teaching and learning activities

Title	face-to-face teaching	Project work	examination preparation	Self study	Total student workload
1. Integrated Navigation	21 h	0 h	19 h	35 h	75 h
1.1 Exercises of Integrated Navigation	10,5 h	64,5 h	0 h	0 h	75 h

Objectives and contents

Objectives of qualifications (Competencies)

The students can evaluate applications, sensors and systems of navigation as well as their respective potential. They can apply the required hardware and software foundations for the integration of data. The students can analyse different hybrid measurement systems and procedures for three-dimensional position determination. They can evaluate the utilization of complementary designs. Students are able to apply, develop and evaluate simple filters and fusion methods. A comprehensive understanding of the functionality and implementation of high-end and low-cost sensors for navigation is gained.

Contents of the module

- Introduction: Terminology, multi-sensor-systems, kinematic positioning methods and their applications.
- GNSS: Kinematic GNSS positioning, accuracies, comparison of different static and kinematic data GNSS processing methods.
- Inertial sensors: Principle of inertial sensors, Measurement uncertainties, MEMS inertial measurement unit.
- Low-cost multi-sensor: Development and investigation of -systems.
- Aiding sensors and real-time systems: Odometer, barometer, real-time systems, multi-tasking systems and requirements for real-time systems.
- Sensor fusion and filtering: Adjustment, principles of Kalman Filter

Recommended literature

Hofmann-Wellenhof, B.; Lichtenegger, H.; Collins, J.: GPS – Theory and Practice, 5th edition, Springer, New York, 2001. Linkwitz, K.; Hangleiter, U.: High Precision Navigation 91, Dümmler Verlag, Bonn, 1991.

Grewal, M. S.; Andrews, A. P.: Kalman Filtering Theory and Practice using MATLAB, Second edition, Wiley, 2001.

Grewal, M. S.; Weill, L. R.; Andrews, A. P.: Global Positioning Systems, Inertial Navigation and Integration, Second edition, Wiley, 2007.

De Jong, C. D.; Lachapelle, G.; Skone, S.; Elema, I. A.: Hydrography, First edition, VSSD, 2001. Lawrence, A.: Modern Inertial Technology – Navigation, Guidance and Control, Springer, 1993.

Bose, A.; Puri, S.; Banerjee, P.: Modern Inertial Sensors and Systems, Second edition, Phi Learning, 2008.

Wendel, J.: Integrierte Navigationssysteme : Sensordatenfusion, GPS und inertiale Navigation, Oldenbourg-link.com, 2011

Forms of teaching and learning

Flipped class room lecture and exercises in sub-groups

Assessment and ECTS awarding criteria

Precondition of examination (Pre-requisite for examination, attendance)

Successfully accomplished exercises (not graded)

Assessment methods and criteria (type, duration & scope)

written (120 min.) or oral examination (40 min., group of three students)

ECTS awarding criteria

Regular active participation in the practical exercise and successful completion of the module examination / examination achievements

Calculation of the module grade
Grade for oral or written exam (100%)
Weighting of the module grade
Module grade is 4.17% of the final grade.

Additional Information

Previous knowledge / Requirements for participation (in form and content) in accordance with examination regulations
Recommended Prerequisites: Basic Knowledge about sensor function, mathematic filters and programming in python are necessary.
Applicability of Module
The module can only be used within the study program Geodesy and Geoinformatics
Special requirements for workplaces (room type / extent of use presence / extent of use project work and/or model construction in self-study)
Lecture: Lecture hall Practical exercises: Geodetic Laboratory, Physical presence is required.
Frequency of Offering
Each summer semester
Course Language
English

Valid from	Valid until	Version	last updated	Adopted on
WiSe 23/24		V.1 01	24.05.2023	

Physical Geodesy

Geodesy and Geoinformatics (M.Sc.).

HCU Hamburg

Module number	Type of module (C/CE/E)	SWS	Student workload	CP (according to ECTS)	Semester (proposed)	Duration
Geo-M-Mod-205	**C/CE/C** (GD/GI/HY)	4 SWS	150 h	5	2	1 Semester
Subject Area				Module Coordinators		
Geodesy				Prof. Dr.-Ing. Annette Eicker Geodesy and Adjustment Theory		

Courses

Title	Course type	SWS (Contact Hours/Week)	Ø Group size
1. Physical Geodesy	VL	2 SWS (21 h)	40
1.1 Physical Geodesy (Exercise)	UE	2 SWS (21 h)	40

Teaching and learning activities

Title	face-to-face teaching	Project work	examination preparation	Self study	Total student workload
1. Physical Geodesy	21 h		Incldued in self study	108 h	129 h
1.1 Physical Geodesy (Exercise)	21 h			0 h	21 h

Objectives and contents

Objectives of qualifications (Competencies)

In this course students shall gain the competence to

- understand the concepts of physical geodesy including their mathematical derivations,
- to apply the derived equations to new problems,
- to independently compute and interpret gravity field functionals from a given data set.

Contents of the module

- gravity and gravity potential,
- energy conservation, conservative force fields,
- parameters of the normal gravity field, computation of normal gravity,
- disturbing quantities in the earth's gravity field and their observation: gravity disturbance, gravity anomaly, deflection of the vertical,
- boundary value problems of physical geodesy,
- spherical harmonics,
- Earth models, high resolution gravity field representation,
- height systems (ellipsoidal, dynamic, orthometric, normal), vertical datum.

Recommended literature

- Hofmann-Wellenhof, B. & Moritz, H. (2006) Physical Geodesy, Springer, ISBN 978-3-211-33545-1
- Torge, W. & Müller, J. (2012) Geodesy, Walter de Gruyter, ISBN 978-3-11-025000-8

Forms of teaching and learning

Lecture and computation exercises

Assessment and ECTS awarding criteria

Precondition of examination (Pre-requisite for examination, attendance)

Assessment methods and criteria (type, duration & scope)

written examination or oral examination, respectively (graded), written: 120 min, oral: 25 min.

ECTS awarding criteria

successful completion of the module examination

Calculation of the module grade

100% grade for oral/written exam

Weighting of the module grade

4,17% of final grade

Additional Information

Previous knowledge / Requirements for participation (in form and content) in accordance with examination regulations
Content: Satellitengeodäsie (B.Sc.), Mathematische Geodäsie (B.Sc.), Geodetic Mathematics
Applicability of Module
Geodetic Earth Observation The module can be used within the study program Geodesy and Geoinformatics
Special requirements for workplaces (room type / extent of use presence / extent of use project work and/or model construction in self-study)
Frequency of Offering
Every summer term
Course Language
English

Valid from	Valid until	Version	last updated	Adopted on
WiSe 23/24 / SoSe 24		V.1 01	05.07.2023	

Geodetic Earth Observation

Geodesy and Geoinformatics (M.Sc.).
HCU Hamburg

Module number	Type of module (C/CE/E)	SWS	Student workload	CP (according to ECTS)	Semester (proposed)	Duration
Geo-M-Mod-311	C/CE/CE (GD/GI/HY)	2 SWS	150 h	5	3	1 Semester
Subject Area				Module Coordinators		
Geodesy				Prof. Dr.-Ing. Annette Eicker Geodesy and Adjustment Theory		

Courses

Title	Course type	SWS (Contact Hours/Week)	Ø Group size
1. Geodetic Earth Observation - lecture 1.1 Geodetic Earth Observation -excercise	Lecture exercise	2 SWS (21 h)	20

Teaching and learning activities

Title	face-to-face teaching	Project work	examination preparation	Self study	Total student workload
1. Geodetic Earth Observation	21 h	40 h	included in self study	89 h	150 h

Objectives and contents

Objectives of qualifications (Competencies)
In this course students shall gain the competence to • understand geodetic satellite observation techniques such as satellite gravimetry and satellite altimetry including their error sources and necessary post-processing steps • evaluate and interpret data products derived from geodetic observations for various applications in Earth system science • to independently compute and interpret gravity field time series
Contents of the module
• satellite gravimetry: satellite missions GRACE/GRACE-FO, CHAMP, GOCE, observation principles, error sources, degree variances, filtering, loading, computation of mass variations from variations of the gravity potential • satellite altimetry: observation principle, determination of sea level and dynamic ocean topography, • application of geodetic satellite observations to Earth system science: determination of ice mass variations, glacial isostatic adjustment, sea level change and sea level equation, computation of geostrophic currents from dynamic ocean topography, ocean tides, observation of the terrestrial water cycle, methods for assimilating geodetic data products into numerical earth system models
Recommended literature
• Hofmann-Wellenhof, B. & Moritz, H. (2006) Physical Geodesy, Springer, ISBN 978-3-211-33545-1 • Torge, W. & Müller, J. (2012) Geodesy, Walter de Gruyter, ISBN 978-3-11-025000-8
Forms of teaching and learning
Lecture and computation exercises

Assessment and ECTS awarding criteria

Precondition of examination (Pre-requisite for examination, attendance)
Successful completion of homework exercises
Assessment methods and criteria (type, duration & scope)
written examination or oral examination, respectively (graded), written: 120 min, oral: 25 min.
ECTS awarding criteria
successful completion of the module examination
Calculation of the module grade
100% grade for oral/written exam
Weighting of the module grade
4,17% of final grade

Additional Information

Previous knowledge / Requirements for participation (in form and content) in accordance with examination regulations
Physical Geodesy (content), programming skills (e.g. Python)
Applicability of Module
The module can only be used within the study program Geodesy and Geoinformatics
Special requirements for workplaces (room type / extent of use presence / extent of use project work and/or model construction in self-study)
“Helava” room and student work places for project work
Frequency of Offering
Every winter term
Course Language
English

Valid from	Valid until	Version	last updated	Adopted on
WiSe 23/24		V.1 01	05.07.2023	

3D-Visualisierung

Geodäsie und Geoinformatik (M.Sc.).

HCU Hamburg

Modulnummer	Modultyp (PF/WP/W)	SWS	Arbeitsaufwand (Workload)	CP (nach ECTS)	Studiensemester gem. Studienplan	Moduldauer
Geo-M-Mod-312	P/WP/WP GD/GI/HY	3 SWS	225 Std.	7,5	3	1 Semester

Lehr- und Lernbereich	Modulverantwortliche Person
Geodäsie	Prof. Dr.-Ing. Thomas Kersten Photogrammetrie und Laserscanning

Lehrveranstaltungen

Titel	Lehrveranstaltungsform	SWS (Kontaktzeit)	Ø Gruppengröße
1. 3D-Visualisierung -Vorlesung	Vorlesung	1 SWS (10,5 Std.)	30
1.1 3D-Visualisierung - Projekt	Projekt	2 SWS (21 Std.)	30

Studentischer Arbeitsaufwand

Titel	Kontaktzeit	Projekt-bearbeitung	Prüfungs-vorbereitung	Selbststudium	Gesamt
1. 3D-Visualisierung -Vorlesung	10,5 Std.	XX Std.	XX Std.	XX Std.	225 Std.
1.1 3D-Visualisierung - Projekt	21 Std.	XX Std.	XX Std.	XX Std.	

Ziele und Inhalte

Qualifikationsziel des Moduls (Angestrebte Kompetenzen)
Die Studierenden erhalten theoretische und praktische Kenntnisse und Fähigkeiten in der graphischen und alphanumerischen Modellierung und Visualisierung von Geodaten bzw. Geoinformationen. Im Rahmen einer Projektbearbeitung lernen die Studierende verschiedene Visualisierungsmethoden und die entsprechende Anbindung ins Internet kennen.
Inhalte des Moduls
Theoretische Grundlagen: Definitionen, Einführung in die Computergraphik, Hardware und Software, Grundlagedaten, Abbildung des Raumes in der Ebene (Koordinatensysteme, 3D-Transformationen, Farbe, Projektion, Sichtvolumen, Betrachtungs-Transformationen), Modellierung, Rasterung, Entfernen von Flächen, Beleuchtung und Schattierung, Level of Detail, Oberflächengestaltung, Rendering-Methoden, Datenformate, Datenkonvertierung, Methoden der Visualisierung und Animation, Game Engines, Virtual und Augmented Reality, Anwendungsbeispiele, Internetdarstellungen (VRML-Browser), 3D/VR im World Wide Web. Bearbeitung eines praktischen Projektes: Datenaufbereitung, 3D-Objektrekonstruktion (Modellierung), Oberflächengestaltung oder Materialvergabe (Texture Mapping), Kamerapositionen und Beleuchtung, Rendering, Erstellung von Perspektivansichten, Erstellung von Videosequenzen oder Virtual Reality Applikationen.
Empfohlene Literatur
Wechselnde Literatur (Hinweis erfolgt in Lehrveranstaltungen)
Lehr- und Lernform
Vorlesung und Projekt

Prüfungsleistungen und Voraussetzung(en) für die Vergabe von CP

Voraussetzung(en) zur Prüfungsteilnahme (Prüfungsvorleistung, Anwesenheit)
Prüfungsleistung(en) (Art, Dauer, Umfang)
Semesterarbeit (benotet)
Voraussetzung(en) für die Vergabe von CP
Erfolgreicher Abschluss der Prüfungsleistung
Berechnung der Modulnote
100% Note der Semesterarbeit
Gewichtung der Modulnote
6,25 %

Ergänzende Informationen

Vorkenntnisse/ Voraussetzungen für die Teilnahme am Modul (formal und inhaltlich)

Verwendbarkeit des Moduls/ Zugangsvoraussetzung für künftige Module (verbindlich oder empfohlen)
Modul ist verwendbar in Geodäsie und Geoinformatik (M.Sc.)
Besonderer Bedarf an Arbeitsplätzen (Raumtyp / Nutzungsumfang Präsenz / Nutzungsumfang Projektbearbeitung und/oder Modellbau im Selbststudium)
Häufigkeit des Angebots
Jedes Wintersemester
Unterrichtssprache
deutsch

Gültig ab	Gültig bis	Version	zuletzt aktualisiert	Beschlossen am
WiSe 23/24		V.1 01	04.08.2023	

Dynamic Measurement Technology

Geodesy and Geoinformatics (M.Sc.)

HCU Hamburg

Module number	Type of module (C/CE/E)	SWS	Student workload	CP (according to ECTS)	Semester (proposed)	Duration
Geo-M-Mod-301	C in GD	3 SWS	150 h	5	1 or 3	1 Semester
Subject Area				Module Coordinators		
Geodesy				Prof. Dr.-Ing. Harald Sternberg Hydrographie und Geodäsie		

Courses

Title	Course type	SWS (Contact Hours/Week)	Ø Group size
1. Dynamic Measurement Technology	Lecture	2 SWS (21 h)	10
1.1 Exercise of Dynamic Measurement Technology	Practical exercises	1 SWS (10,5 h)	10

Teaching and learning activities

Title	face-to-face teaching	Project work	examination preparation	Self study	Total student workload
1. Dynamic Measurement Technology	21 h	0 h	10 h	19 h	50 h
1.1 Exercise of Dynamic Measurement Technology	10,5 h	89,5 h	0 h	0 h	100 h

Objectives and contents

Objectives of qualifications (Competencies)
The students know procedures, sensors and evaluation techniques for dynamic measurements and are able to assess and apply them. Three scenarios are specifically considered here.
Contents of the module
Sensors, system and evaluation methods for the applications: Moving object with fixed sensor, fixed object with moving sensor and moving object with moving sensor. Applications and terms: Dynamic measurement methods in geodetic monitoring, civil engineering and mechanical engineering. Sensors and systems: single and multidimensional transducers, low-cost sensors (MEMS), interfaces and data transmission techniques, real-time measurement systems, time-dependent measurements with GPS, total stations, laser scanning of dynamic objects, strain measurement techniques, accelerometers, high-speed cameras, fiber-optic sensors Algorithms: Sensor fusion and time series analysis in applications, synchronization, dominant natural frequencies.
Recommended literature
Alternating literature that will be given in the lecture
Forms of teaching and learning
The exercises are held in small groups

Assessment and ECTS awarding criteria

Precondition of examination (Pre-requisite for examination, attendance)
Successfully completed exercises (ungraded)
Assessment methods and criteria (type, duration & scope)
Written (120 min.) or oral exam (20 min.)
ECTS awarding criteria
Regular active participation and successful completion of the module examination / examination achievements
Calculation of the module grade
Grade of written or oral exam (100%)
Weighting of the module grade
Module grade is 4.17% of the final grade.

Additional Information

Previous knowledge / Requirements for participation (in form and content) in accordance with examination regulations
Recommended Prerequisites: Knowledge from the bachelor's degree program in Geodesy and Geoinformatics can be used.

Applicability of Module
The module can only be used within the study program Geodesy and Geoinformatics
Special requirements for workplaces (room type / extent of use presence / extent of use project work and/or model construction in self-study)
Lecture: Lecture hall Practical exercises: Geodetic Laboratory, Physical presence is required.
Frequency of Offering
Every second year in the winter semester
Course Language
German

Valid from	Valid until	Version	last updated	Adopted on
WiSe 23/24		V.1 01	25.05.2023	

Projekt Geoinformatik

Geodäsie und Geoinformatik (M.Sc.)

HCU Hamburg

Modulnummer	Modultyp (PF/WP/W)	SWS	Arbeitsaufwand (Workload)	CP (nach ECTS)	Studiensemester gem. Studienplan	Moduldauer
Geo-M-Mod-106	GD / GI / HY - / PF / -	4 SWS	300 Std.	10	1	1 Semester

Lehr- und Lernbereich	Modulverantwortliche Person
Geoinformatik	Prof. Dr. Jochen Schiewe Geoinformatik mit Schwerpunkt Geovisualisierung

Lehrveranstaltungen

Titel	Lehrveranstaltungsform	SWS (Kontaktzeit)	Ø Gruppengröße
1. Projekt Geoinformatik – Vorlesung 1.1 Projekt Geoinformatik - Projekt	VL P	1 SWS (21 Std.) 3 SWS (63 Std.)	10

Studentischer Arbeitsaufwand

Titel	Kontaktzeit	Projekt-bearbeitung	Prüfungs-vorbereitung	Selbststudium	Gesamt
Projekt Geoinformatik	84 Std.	180 Std.	im Selbst-studium enth.	36 Std.	300 Std.

Ziele und Inhalte

Qualifikationsziel des Moduls (Angestrebte Kompetenzen)
• Vertiefung der bisher und parallel erworbenen Grundlagenkenntnisse im Bereich Geoinformationssysteme (GIS); • Fertigkeit, ein umfangreiches anwendungsbezogenes Fachinformationssystem selbstständig zu konzipieren und einsatzfähig aufzubereiten; • kritischer Umgang mit Datengrundlagen, • Erzeugung neuer Fachinformation durch GIS-gestützte raumzeitlicheDatenanalysen, • Durchführung von Sensitivitätsanalysen, • Visualisierung der erzeugten Fachinformationen
Inhalte des Moduls
Es wird von den Studierenden in Gruppenarbeit ein Fachinformationssystem mit vorgegebenem, wechselndem Thema erstellt.
Empfohlene Literatur
Wechselnde Literatur (Hinweis in Lehrveranstaltung)
Lehr- und Lernform
VL / P

Prüfungsleistungen und Voraussetzung(en) für die Vergabe von CP

Voraussetzung(en) zur Prüfungsteilnahme (Prüfungsvorleistung, Anwesenheit)
keine
Prüfungsleistung(en) (Art, Dauer, Umfang)
Präsentation oder Referat
Voraussetzung(en) für die Vergabe von CP
Erfolgreicher Abschluss der Prüfungsleistung
Berechnung der Modulnote
100 % Präsentation oder Referat
Gewichtung der Modulnote
8,33 %

Ergänzende Informationen

Vorkenntnisse/ Voraussetzungen für die Teilnahme am Modul (formal und inhaltlich)

Empfohlen: Grundkenntnisse in Geoinformatik und GIS-Software
Verwendbarkeit des Moduls/ Zugangsvoraussetzung für künftige Module (verbindlich oder empfohlen)
Empfohlen für alle weiteren Module im Lehrbereich Geoinformatik Modul ist verwendbar in Geodäsie und Geoinformatik (M.Sc.).
Besonderer Bedarf an Arbeitsplätzen (Raumtyp / Nutzungsumfang Präsenz / Nutzungsumfang Projektbearbeitung und/oder Modellbau im Selbststudium)
Aufbau des Fachinformationssystems bedingt Spezialsoftware (Helava-Raum) und studentische Arbeitsplätze
Häufigkeit des Angebots
Jedes WiSe
Unterrichtssprache
deutsch

Gültig ab	Gültig bis	Version	zuletzt aktualisiert	Beschlossen am
WiSe 23/24		V.1 01	23.05.2023	

Geodaten-Modellierung

Geodäsie und Geoinformatik (M.Sc.)

HCU Hamburg

Modulnummer	Modultyp (PF/WP/W)	SWS	Arbeitsaufwand (Workload)	CP (nach ECTS)	Studiensemester gem. Studienplan	Moduldauer
Geo-M-Mod-207	GD / GI / HY WP / PF / WP	3 SWS	150 Std.	5	2	1 Semester

Lehr- und Lernbereich	Modulverantwortliche Person
Geoinformatik	Prof. Dr. Jochen Schiewe Geoinformatik mit Schwerpunkt Geovisualisierung

Lehrveranstaltungen

Titel	Lehrveranstaltungsform	SWS (Kontaktzeit)	Ø Gruppengröße
1. Geodaten-Modellierung – Vorlesung	VL	1,5 SWS (15,75 Std.)	
1.1 Geodaten-Modellierung - Übung	UE	1,5 SWS (15,75 Std.)	

Studentischer Arbeitsaufwand

Titel	Kontaktzeit	Projekt-bearbeitung	Prüfungs-vorbereitung	Selbststudium	Gesamt
Geodaten-Modellierung	31,5 Std.	31,5 Std.	im Selbst-studium enth	88 Std.	150 Std.

Ziele und Inhalte

Qualifikationsziel des Moduls (Angestrebte Kompetenzen)

- Kennenlernen und Anwenden der unterschiedlichen Anforderungen und Möglichkeiten der (Geo-) Datenmodellierung
- Kennenlernen und Anwenden gängiger Geodatenformate
- Kennenlernen grundlegender Systemarchitekturen und Implementierungskonzepte für Software-Systeme in der Geoinformatik
- Fähigkeit, Klassen von algorithmischen Probleme auf konkrete Problemstellungen anzuwenden

Inhalte des Moduls

- Einführung (Daten und Modelle, Abstraktionsebenen, Geoobjekte)
- Grundlegende Konzepte der Objektorientierten Modellierung; Unified Modeling Language (UML);
- Geodatenformate (Vektorbasierte-, Rasterbasierte-, Webbasierte Datenformate),
- Modellierung von Vektordaten (Feature-Geometry-Modell, Simple-Feature-Modell, Geometrische Funktionen).
- Modellierung von Rasterdaten (u. a. Run Length Encoding, Space filling curves, Quadtrees)
- Anfragebearbeitung (Räumliche Basisanfragen, mehrstufige Anfragen)
- Indexierung von Geodaten (B-Bäume, R-Bäume, Quadtrees)
- Algorithmische Geometrie (Schnitt-, Distanz-, Inklusionsprobleme, Konvexe Hülle, Polygon-Zerlegung)
- Exemplarische programmiertechnische Umsetzung der erlernten Konzepte in den Übungen

Empfohlene Literatur

- Brinkhoff, T.: Geodatenbanksysteme in Theorie und Praxis. Wichmann, 2008, 2. Auflage.
- van Randen, J.H.: Einführung in UML: Analyse und Entwurf von Software. Springer, 2016.

Lehr- und Lernform

V / UE

Prüfungsleistungen und Voraussetzung(en) für die Vergabe von CP

Voraussetzung(en) zur Prüfungsteilnahme (Prüfungsvorleistung, Anwesenheit)

Erfolgreicher Abschluss der Semesterarbeiten (unbenotet)

Prüfungsleistung(en) (Art, Dauer, Umfang)

Klausur (120 min) oder mündlich (20 min)

Voraussetzung(en) für die Vergabe von CP

Erfolgreicher Abschluss der Prüfungsleistung

Berechnung der Modulnote

100 % Klausur (oder mündlich)

Gewichtung der Modulnote

4,17 %

Ergänzende Informationen

Vorkenntnisse/ Voraussetzungen für die Teilnahme am Modul (formal und inhaltlich)
Inhaltlich: Grundkenntnisse in der Programmierung, Grundlagenkenntnisse zur Geoinformatik
Verwendbarkeit des Moduls/ Zugangsvoraussetzung für künftige Module (verbindlich oder empfohlen)
Empfohlen für GIS Programmierung
Besonderer Bedarf an Arbeitsplätzen (Raumtyp / Nutzungsumfang Präsenz / Nutzungsumfang Projektbearbeitung und/oder Modellbau im Selbststudium)
Bearbeitung der Übungen bedingt Spezialsoftware (Helava-Raum) und studentische Arbeitsplätze
Häufigkeit des Angebots
Jedes SoSe
Unterrichtssprache
deutsch

Gültig ab	Gültig bis	Version	zuletzt aktualisiert	Beschlossen am
WiSe 23/24 / SoSe 24		V.1 01	23.05.2023	

WebGIS

Geodäsie und Geoinformatik (M.Sc.)

HCU Hamburg

Modulnummer	Modultyp (PF/WP/W)	SWS	Arbeitsaufwand (Workload)	CP (nach ECTS)	Studiensemester gem. Studienplan	Moduldauer
Geo-M-Mod-208	GD / GI / HY WP / PF / WP	3 SWS	225 Std.	7,5	2	1 Semester

Lehr- und Lernbereich	Modulverantwortliche Person
Geoinformatik	Prof. Dr. Jochen Schiewe Geoinformatik mit Schwerpunkt Geovisualisierung

Lehrveranstaltungen

Titel	Lehrveranstaltungsform	SWS (Kontaktzeit)	Ø Gruppengröße
1. WebGIS – Vorlesung	VL	2 SWS (21 Std.)	
1.1 WebGIS – Übung	UE	1 SWS (10,5 Std.)	

Studentischer Arbeitsaufwand

Titel	Kontaktzeit	Projekt-bearbeitung	Prüfungs-vorbereitung	Selbststudium	Gesamt
WebGIS	31,5 Std.	94,5 Std.	im Selbst-studium enth	99 Std.	225 Std.

Ziele und Inhalte

Qualifikationsziel des Moduls (Angestrebte Kompetenzen)

- Verständnis für Besonderheiten webbasierter GIS im Gegensatz zu stand-alone Lösungen;
- Fähigkeit, für eine Anwendung eine geeignete Client-Server-Architektur auszuwählen und prototypisch mit aktuellen Auszeichnungs- und Programmiersprachen umzusetzen und mit einer Stylesheet-Sprache zu gestalten;
- Kenntnisse über relevante internationale Standardisierungen,
- Fähigkeit OGC-konforme Implementierungen zu konzipierenbzw. zu bewerten;
- Kenntnis über aktuelle, größere Geodateninfrastrukturen im nationalen und internationalen Kontext.

Inhalte des Moduls

- Charakteristika von webbasierten Geographischen Informations-Systemen;
- Client-Server-Architekturen;
- Implementierung interaktiver Elemente;
- OGC-Standards (WMS, WFS, etc.);
- Einsatz im Bereich Geodateninfrastrukturen;
- Vorstellung von Softwarepaketen;
- Anbindung von Datenbanken.
- Praxis: Erstellung einer webbasierten GIS-Anwendung für ein Kleinprojekt mit Hilfe von HTML, CSS, JavaScript, Node.js/Python und eines aktuellen Frameworks, wie bspw. OpenLayers, zur Darstellung von Geodaten im Webbrowser.

Empfohlene Literatur

- Seip, Korduan, Zehner: Web-GIS, Wichmann
- GDI-DE: Geodatendienste im Internet
- OpenLayers Dokumentation: https://openlayers.org/

Lehr- und Lernform

VL / UE

Prüfungsleistungen und Voraussetzung(en) für die Vergabe von CP

Voraussetzung(en) zur Prüfungsteilnahme (Prüfungsvorleistung, Anwesenheit)

Erfolgreicher Abschluss der Semesterarbeiten (unbenotet)

Prüfungsleistung(en) (Art, Dauer, Umfang)

PR

Voraussetzung(en) für die Vergabe von CP

Erfolgreicher Abschluss der Prüfungsleistung

Berechnung der Modulnote

100 % PR

Gewichtung der Modulnote
Die Modulnote geht zu 6,25 % in die Abschlussnote ein.

Ergänzende Informationen

Vorkenntnisse/ Voraussetzungen für die Teilnahme am Modul (formal und inhaltlich)
inhaltlich: Grundlagenkenntnisse zur Geoinformatik, Programmierkenntnisse, insbesondere: Datenmodellierung und Datenanalyse im GIS, Erfahrungen im praktischen Einsatz eines GIS-Produktes
Verwendbarkeit des Moduls/ Zugangsvoraussetzung für künftige Module (verbindlich oder empfohlen)
Modul ist verwendbar in Geodäsie und Geoinformatik (M.Sc.).
Besonderer Bedarf an Arbeitsplätzen (Raumtyp / Nutzungsumfang Präsenz / Nutzungsumfang Projektbearbeitung und/oder Modellbau im Selbststudium)
Bearbeitung der Übungen bedingt Spezialsoftware (Helava-Raum) und studentische Arbeitsplätze
Häufigkeit des Angebots
Jedes SoSe
Unterrichtssprache
deutsch

Gültig ab	Gültig bis	Version	zuletzt aktualisiert	Beschlossen am
WiSe 23/24 / SoSe 24		V.1 01	23.05.2023	

Spatial Data Analysis

Geodesy and Geoinformatics (M.Sc.)

HCU Hamburg

Module number	Type of module (C/CE/E)	SWS	Student workload	CP (according to ECTS)	Semester (proposed)	Duration
Geo-M-Mod-209	C / C/ C GD / GI / HY	4 SWS	150 Std.	5	2	1 Semester
Subject Area				Module Coordinators		
Geoinformatics				Prof. Dr. Jochen Schiewe Geoinformatics with focus Geovisualization		

Courses

Title	Course type	SWS (Contact Hours/Week)	Ø Group size
1. Spatial Data Analysis – Lecture 1.1 Spatial Data Analysis - Exercise	VL UE	3 SWS (21 h) 1 SWS (10,5 h)	

Teaching and learning activities

Title	face-to-face teaching	Project work	examination preparation	Self study	Total student workload
Spatial Data Analysis	31,5	31,5	included in self study	87 h	150 h

Objectives and contents

Objectives of qualifications (Competencies)

- Ability to calculate and to evaluate geostatistical parameters for huge data volumes with spatial reference
- Knowledge about selected methods for and applicability of Exploratory Data Analysis (EDA)
- Ability to select and to apply deterministic interpolation methods
- Knowledge about models of spatial correlation and their application to interpolation
- Ability to select and to apply geostatistical interpolation methods (Kriging).
- Ability to apply and to evaluate different uncertainty parameters for describing the quality of DEMs;
- Knowledge to compare advantages and disadvantages of different DEM representation formats;
- Ability to describe algorithms of important processing steps;
- Ability to select suitable visualization formats for given applications

Contents of the module

- Basic Statistics (descriptive and inferential, visual exploration);
- Spatial sampling;
- Spatial Statistics (e. g., aggregation, disaggregation, cross tabulation, landscape metrics, spatial auto correlation);
- Spatial interpolation (deterministic approaches; geostatistical characteristic parameters, Kriging interpolation, evaluation);
- Further DEM processing methods (e. g., elevation features, volume, visibility).

Recommended literature

- Oyana & Margai (2015): Spatial Analysis: Statistics, Visualization, and Computational Methods. CRC Press.
- de Smith, Goodchild & Longley (2007): Geospatial Analysis. A Comprehensive Guide to Principles, Techniques and SoftwareTools, 2. Auflage, Troubador Publishing
- general GI Science literature

Forms of teaching and learning

VL / UE

Assessment and ECTS awarding criteria

Precondition of examination (Pre-requisite for examination, attendance)

Successful completion of introductory test on GNSS
Successful completion of introductory test on GI Science
Successful exercises (not graded)

Assessment methods and criteria (type, duration & scope)

K (or M)

ECTS awarding criteria
Successful completion of graded examination
Calculation of the module grade
100 % K (or M)
Weighting of the module grade
4,17 %

Additional Information

Previous knowledge / Requirements for participation (in form and content) in accordance with examination regulations
Recommended: Basics in Statistics and Geoinformatics
Applicability of Module
Recommended for Big Data Analytics The module can be used within the study program Geodesy and Geoinformatics
Special requirements for workplaces (room type / extent of use presence / extent of use project work and/or model construction in self-study)
Completion of exercises requires special software (available in Helava room) and student working places
Frequency of Offering
Every SoSe
Course Language
English

Valid from	Valid until	Version	last updated	Adopted on
WiSe 23/24 / SoSe 24		V.1 01	23.05.2023	

GIS-Programmierung

Geodäsie und Geoinformatik (M.Sc.)

HCU Hamburg

Modulnummer	Modultyp (PF/WP/W)	SWS	Arbeitsaufwand (Workload)	CP (nach ECTS)	Studiensemester gem. Studienplan	Moduldauer
Geo-M-Mod-303	GD / GI / HY WP / PF / WP	2 SWS	150 Std.	5	3	1 Semester

Lehr- und Lernbereich	Modulverantwortliche Person
Geoinformatik	Prof. Dr. Jochen Schiewe Geoinformatik mit Schwerpunkt Geovisualisierung

Lehrveranstaltungen

Titel	Lehrveranstaltungsform	SWS (Kontaktzeit)	Ø Gruppengröße
1. GIS-Programmierung - Vorlesung	VL	0,5 SWS (5,25 Std.)	
1.1 GIS-Programmierung - Übung	UE	1,5 SWS (16,75 Std.)	

Studentischer Arbeitsaufwand

Titel	Kontaktzeit	Projekt-bearbeitung	Prüfungs-vorbereitung	Selbststudium	Gesamt
GIS-Programmierung	21 Std.	42 Std.	im Selbst-studium enth	87 Std.	150 Std.

Ziele und Inhalte

Qualifikationsziel des Moduls (Angestrebte Kompetenzen)
Fähigkeit, grundlegende Algorithmen der Geoinformatik (Geodatenverarbeitung und Geovisualisierung) zu strukturieren und in einer aktuellen Programmierumgebung zu implementieren.
Inhalte des Moduls
• Konzeptioneller Software-Entwurf; • Nutzung von Algorithmen der Geoinformatik in Programmierumgebungen; • Bearbeiten wechselnder Aufgaben der Geoinformatik mit general purpose Programmiersprachen; • Verwendung von Open-Source-Softwarebibliotheken; • Ergebnispräsentation (z.B. als Plugin für OpenSource-GIS, Webanwendung, …)
Empfohlene Literatur
Wechselnde Literatur (Hinweis in Lehrveranstaltung)
Lehr- und Lernform
VL / UE

Prüfungsleistungen und Voraussetzung(en) für die Vergabe von CP

Voraussetzung(en) zur Prüfungsteilnahme (Prüfungsvorleistung, Anwesenheit)
Erfolgreicher Abschluss der Semesterarbeiten (unbenotet)
Prüfungsleistung(en) (Art, Dauer, Umfang)
PR oder H
Voraussetzung(en) für die Vergabe von CP
Erfolgreicher Abschluss der Prüfungsleistung
Berechnung der Modulnote
100 % PR (oder H)
Gewichtung der Modulnote
4,17 %

Ergänzende Informationen

Vorkenntnisse/ Voraussetzungen für die Teilnahme am Modul (formal und inhaltlich)
Empfohlene Inhalte: Programmierkenntnisse, Kenntnisse zur Geoinformatik
Verwendbarkeit des Moduls/ Zugangsvoraussetzung für künftige Module (verbindlich oder empfohlen)

Modul ist verwendbar in Geodäsie und Geoinformatik (M.Sc.).
Besonderer Bedarf an Arbeitsplätzen (Raumtyp / Nutzungsumfang Präsenz / Nutzungsumfang Projektbearbeitung und/oder Modellbau im Selbststudium)
Bearbeitung der Übungen bedingt Spezialsoftware (Helava-Raum) und studentische Arbeitsplätze
Häufigkeit des Angebots
Jedes WiSe
Unterrichtssprache
deutsch

Gültig ab	Gültig bis	Version	zuletzt aktualisiert	Beschlossen am
WiSe 23/24		V.1 01	23.05.2023	

Geovisualisierung

Geodäsie und Geoinformatik (M.Sc.)

HCU Hamburg

Modulnummer	Modultyp (PF/WP/W)	SWS	Arbeitsaufwand (Workload)	CP (nach ECTS)	Studiensemester gem. Studienplan	Moduldauer
Geo-M-Mod-313	GD / GI / HY WP / PF / WP	3 SWS	150 Std.	5	3	1 Semester

Lehr- und Lernbereich	Modulverantwortliche Person
Geoinformatik	Prof. Dr. Jochen Schiewe Geoinformatik mit Schwerpunkt Geovisualisierung

Lehrveranstaltungen

Titel	Lehrveranstaltungsform	SWS (Kontaktzeit)	Ø Gruppengröße
1. Geovisualisierung – Vorlesung 1.1 Geovisualisierung - Übung	VL UE	2 SWS (21Std.) 1 SWS (10,5 Std.)	

Studentischer Arbeitsaufwand

Titel	Kontaktzeit	Projekt-bearbeitung	Prüfungs-vorbereitung	Selbststudium	Gesamt
Geovisualisierung	31,5 Std.	31,5 Std.	im Selbst-studium enth	87 Std.	150 Std.

Ziele und Inhalte

Qualifikationsziel des Moduls (Angestrebte Kompetenzen)
• Fähigkeit, Verfahren zur Bewertung der Gebrauchstauglichkeit (Usability) auszuwählen und zu bewerten; • Kenntnis ausgewählter Aspekte der User Experience sowie ihrer Bedeutung in der Kartenerstellung; • Fähigkeit, angepasste Darstellungsformen für raumzeitliche Phänomene auszuwählen; • Fähigkeit, die Eignung multimedialer Kodierungsformen fürgegebene Objektmerkmale zu beurteilen. • Fähigkeit, aktuelle Themen aus dem Bereich der Geovisualisierung bzw. Geoinformationstechnologie an Hand von selbst recherchierter (deutsch- und englischsprachiger) Literatur selbstständig zu erarbeiten und schriftlich sowie mündlich präsentieren zu können.
Inhalte des Moduls
• Definitionen (Kartographie vs. Geovisualisierung, etc.); • Usability (u.a. nutzer- und aufgabenorientierte Sichtweisen; Design vonempirischen Studien); • Multimedia-Kartographie (u.a. Kodierungsformen, Vor- und Nachteile verschiedener Kodierungen, Medienfunktionen); • Aktuelle Themen der Forschung und Entwicklung im Bereich (Geo-)Visualisierung (z. B. AR/VR) • Praktische Übungen zu ausgewählten Themen • Spezifika von Literaturrecherche und Präsentationen im Kontext der Geovisualisierung
Empfohlene Literatur
Grundlagen-Literatur zur Kartographie und Geoinformatik sowie wechselnde Literatur (Hinweis erfolgt in Lehrveranstaltung)
Lehr- und Lernform
VL / UE

Prüfungsleistungen und Voraussetzung(en) für die Vergabe von CP

Voraussetzung(en) zur Prüfungsteilnahme (Prüfungsvorleistung, Anwesenheit)
Erfolgreicher Abschluss der Semesterarbeiten (unbenotet)
Prüfungsleistung(en) (Art, Dauer, Umfang)
PR (oder R)
Voraussetzung(en) für die Vergabe von CP
Erfolgreicher Abschluss der Prüfungsleistung
Berechnung der Modulnote
100 % PR (oder H)
Gewichtung der Modulnote
4,17 %

Ergänzende Informationen

Vorkenntnisse/ Voraussetzungen für die Teilnahme am Modul (formal und inhaltlich)
inhaltlich: Grundlagenkenntnisse zur Kartographie und Geoinformatik, Erfahrungen im praktischen Einsatz eines GIS-Produktes
Verwendbarkeit des Moduls/ Zugangsvoraussetzung für künftige Module (verbindlich oder empfohlen)
Modul ist verwendbar in Geodäsie und Geoinformatik (M.Sc.).
Besonderer Bedarf an Arbeitsplätzen (Raumtyp / Nutzungsumfang Präsenz / Nutzungsumfang Projektbearbeitung und/oder Modellbau im Selbststudium)
Bearbeitung der Übungen bedingt Spezialsoftware (Helava-Raum) und studentische Arbeitsplätze
Häufigkeit des Angebots
Jedes WiSe
Unterrichtssprache
deutsch

Gültig ab	Gültig bis	Version	zuletzt aktualisiert	Beschlossen am
WiSe 24/25		V.1 01	23.05.2023	

Big Data Analytics

Geodesy and Geoinformatics (M.Sc.)

HCU Hamburg

Module number	Type of module (C/CE/E)	SWS	Student workload	CP (according to ECTS)	Semester (proposed)	Duration
Geo-M-Mod-314	**C/C/C***	3	150	5	3	1
Subject Area				Module Coordinators		
Specialization Geoinformatics				Prof. Dr.-Ing. Youness Dehbi Computational Methods		

Courses

Title	Course type	SWS (Contact Hours/Week)	Ø Group size
1. Big Data Analytics	Lecture & practical lab	3 SWS (31,5 h)	

Teaching and learning activities

Title	face-to-face teaching	Project work	examination preparation	Self study	Total student workload
1. Big Data Analytics	31,5 h	31,5 h	Included in self study	87 h	150 h

Objectives and contents

Objectives of qualifications (Competencies)
• Understanding of concepts, methods, and algorithms in Machine Learning (ML) • Ability to select a suitable ML model and algorithm for a given application • Ability to evaluate the quality and validity of an ML model for a given application • Application of the acquired knowledge in practical use cases
Contents of the module
• Fundamentals of big data (characteristics, application areas) • Fundamentals of machine learning (learning algorithms, generalization, hyperparameters, deep learning) • Supervised learning (decision trees, random forest, naive bayes, …) • Unsupervised learning (Principal components analysis, k-means) • Neural networks and deep learning in practice (feed forward networks, Back propagation. …)
Recommended literature
Changing literature (note in the course)
Forms of teaching and learning
Lecture and practical labs

Assessment and ECTS awarding criteria

Precondition of examination (Pre-requisite for examination, attendance)
Successful completion of practical labs
Assessment methods and criteria (type, duration & scope)
Written/ oral exam or term paper
ECTS awarding criteria
Calculation of the module grade
Grade for oral/written exam or term paper (100%)
Weighting of the module grade
Module grade represents 4.17% of the final grade.

Additional Information

Previous knowledge / Requirements for participation (in form and content) in accordance with examination regulations

Applicability of Module
The module can only be used within the study program Geodesy and Geoinformatics
Special requirements for workplaces (room type / extent of use presence / extent of use project work and/or model construction in self-study)
Computer pool
Frequency of Offering
Every winter term
Course Language
Englisch

Valid from	Valid until	Version	last updated	Adopted on
WiSe 22/23 / SoSe 24		V.1 01	03.07.2023	

Basics of Hydrography

Geodesy and Geoinformatics (M.Sc.)

HCU Hamburg

Module number	Type of module (C/CE/E)	SWS	Student workload	CP (according to ECTS)	Semester (proposed)	Duration
Geo-M-Mod-107	C / C / C GD / GI / HYD	2 SWS	75 h	2.5 CP	1	1 Semester

Subject Area	Module Coordinators
Hydrography	Prof. Dr.-Ing. Harald Sternberg Hydrographie und Geodäsie

Courses

Title	Course type	SWS (Contact Hours/Week)	Ø Group size
1. Determination of Positions and Water Depths	Lecture	1,5 SWS (15,75 h)	50
2. Practical Course 1	Practical exercises	0,5 SWS (5,25 h)	50

Teaching and learning activities

Title	face-to-face teaching	Project work	examination preparation	Self study	Total student workload
1. Determination of Positions and Water Depths	15,75 h	0 h	25 h	24,25 h	65 h
2. Practical Course 1	5,25 h	4,75 h	0 h	0 h	10 h

Objectives and contents

Objectives of qualifications (Competencies)

Basic understanding of hydrography and hydrographic measurement techniques, supported by practical training in hydrographic surveying.

Contents of the module

- Determination of Positions and Water Depths:
  Introduction: Definition, tasks and application of hydrography. History. National and international organizations. Basics on underwater acoustics: history of depth measurements, acoustic wave and parameters. Single-beam echo sounder (SBES) and Multibeam echo sounder (MBES) system: Principles, components, frequencies, beam, parameters, specifications, footprint size. Introduction to other sonars: Basic working principles and measuring techniques of side-scan sonars, sub-bottom profilers, and LiDAR and their application. Horizontal and vertical reference systems: Definition and transformation between different vertical reference systems. Chart datum: Definition. Reduction of soundings to a vertical datum (GNSS, tide gauge measurements). System configuration: Additional sensors and their accuracies used in echo sounder systems: positioning systems, INS/IMU, tide information, sound velocity profilers, sound velocity probes. Sensor installation, alignment, integration. Vessel reference system. Synchronization. Transformation. MBES: Motion compensation, calibration. Error budget and estimation of single-beam and multibeam systems. Standards for hydrographicsurveys: Survey requirements for different surveys. System set-up. Survey operation: Sonar installation. Planning of surveys (SBES, MBES). Execution of a survey. Online data monitoring and real-time quality checks.
- Practical course 1:
  Planning and conducting a multibeam echosounder survey. Selecting appropriate sonar settings, taking sound velocity profiles, evaluating the behavior of the acoustic signals at different seabed areas/structures (e.g. newly dredged area, quay walls, objects like dolphins).

Recommended literature

- Bjørnø, L. (2017): Applied Underwater Acoustics. 1st ed., Elsevier Inc.
- de Jong, C.D, Lachapelle, G., Skone, S., Elema, I.A. (2010): Hydrography. VSSD.
- IHO (2020): Standards for Hydrographic Surveys – Publication S-44; IHB, Monaco, 6th ed.
- IHO (2008): Standards for Hydrographic Surveys – Publication S-44. 5th ed., International Hydrographic Bureau, Monaco.
- Lurton, X. (2010): An Introduction to Underwater Acoustics – Principles and Applications. 2nd ed., Springer.
- Urick, R.J. (2013): Principle of Underwater Sound. 3rd ed., Peninsula Publishing.
- Wille, P.C. (2005): Sound Images of the Ocean in Research and Monitoring. 1st ed., Springer
- Groves, P. D. (2013): Principles of GNSS, Inertial, and Multisensor Integrated Navigation Systems; Artech House, 2nd ed.

Forms of teaching and learning

Regular Lecture and Exercises

Assessment and ECTS awarding criteria

Precondition of examination (Pre-requisite for examination, attendance)

Successful practical training (practical course 1)
Assessment methods and criteria (type, duration & scope)
Written exam (120 min.) or oral examination (20 min.)
ECTS awarding criteria
Regular active participation and successful completion of the module examination / examination achievements
Calculation of the module grade
Grade for oral or written exam (100%)
Weighting of the module grade
Module grade is 2.08% of the final grade

Additional Information

Previous knowledge / Requirements for participation (in form and content) in accordance with examination regulations
None
Applicability of Module
The module can only be used within the study program Geodesy and Geoinformatics
Special requirements for workplaces (room type / extent of use presence / extent of use project work and/or model construction in self-study)
Lecture: Lecture hall Practical exercises: Lecture room, laboratories, field, measuring areas and PC pool, Physical presence is required.
Frequency of Offering
Each winter semester
Course Language
English

Valid from	Valid until	Version	last updated	Adopted on
WiSe 23/24		V.1 01	23.05.2023	

Hydrographic Data Acquisition and Processing

Geodesy and Geoinformatics (M.Sc.)

HCU Hamburg

Module number	Type of module (C/CE/E)	SWS	Student workload	CP (according to ECTS)	Semester (proposed)	Duration
Geo-M-Mod-108	C in HYD	4 SWS	225 h	7.5	1	1 Semester
Subject Area				Module Coordinators		
Hydrography				Prof. Dr.-Ing. Harald Sternberg Hydrographie und Geodäsie		

Courses

Title	Course type	SWS (Contact Hours/Week)	Ø Group size
1. Underwater Acoustics	Lecture	1.5 SWS (15,75 h)	30
2. Hydrographic Data Processing	Lecture	1 SWS (10,5 h)	30
2.1 Exercise of Hydrographic Data Processing	Practical exercise	1 SWS (10,5 h)	30
3. Practical Course 2	Practical exercise	0.5 SWS (5,25 h)	30

Teaching and learning activities

Title	face-to-face teaching	Project work	examination preparation	Self study	Total student workload
1. Underwater Acoustics	15,75 h	0 h	29,25 h	30 h	75 h
2. Hydrographic Data Processing	10,5 h	0 h	27 h	27,5 h	65 h
2.1 Exercise of Hydrographic Data Processing	10,5 h	49,5 h	0 h	0 h	60 h
3. Practical Course 2	5,25 h	19,75 h	0 h	0 h	25 h

Objectives and contents

Objectives of qualifications (Competencies)

Basic understanding of underwater acoustics waves and measurement techniques, supported by practical training in hydrographic surveying and introduction to hydrographic data processing.

Contents of the module

- **Underwater Acoustics:**
  Fundamental theory of acoustic waves; Pressure, velocity, density, frequency, wavelength, intensity, power, decibel, propagation loss, multiple paths, deformation of acoustics signals, Doppler effect, sound velocity models and measurement in water, acoustics propagation, wave reflection, backscattering, target strength, scattering, underwater acoustic noise, reverberation. Resistance to acoustic waves; Refraction of acoustic waves from one medium to another; reflection coefficient for the reflection at a border surface between different media, acoustic bending. Underwater electro-acoustic transducers and their characteristics. Beamforming. Transmitters, receivers. Array directivity. Time varying gain. Signal-to- noise-ratio. Examples – multichannel and swath sounding systems, possible errors of different systems. Inverse echo sounding from the sea floor to the sea surface.
- **Hydrographic Data Processing:**
  Introduction: Common sensors used in hydrography their basic principles and applications. Identification of a common reference point and reference frame for the vessel. Accuracy, precision, uncertainty and standard deviation. Quality checks during data acquisition. Data formats (raw sensor format and processed data) including conversion and data structure. Resolution and error budget of hydrographic surveys. Multibeam calibration (Patch test): Sensor alignment and static offsets. Systematic errors in multibeam survey systems, patch test procedure (latency, roll, pitch, yaw). Refraction correction procedure. Multibeam echo sounder data processing: Pre-cleaning methods, tide correction including GNSS-tide computation, sound velocity correction, validation of navigation and attitude data and validation/cleaning of multibeam data. Computation of TPU. Computation methods for digital terrain models (IDW, Median) and automatic filter methods (CUBE). Final validation and quality control. Singlebeam echo sounder data processing: Validation/cleaning of dual frequency singlebeam data. Product creation (digital terrain model, cartographic elements, cross sections, contours, maps). Side-scan sonar & backscatter processing: Digitizing of altitude height, layback, slant range correction, beam pattern correction, TVG, despeckle, gain normalisation. Mosaic creation. Seabed classification.
  Scientific Writing Seminar: Research and information literacy training and Introduction to scientific work.
- **Practical course 2:**
  Single-beam echo sounder calibration (bar check) and survey. Multibeam echo sounder calibration (patch test) and survey. Comparison of direct (GNSS) and indirect (tide gauge) reduction of depth measurements to chart datum. Processing, visualisation and evaluation of single-beam echo sounder calibration (bar check) and survey. Processing, visualisation and evaluation of multibeam echo sounder calibration (patch test) and survey.

Recommended literature

- Bjørnø, L. (2017): Applied Underwater Acoustics. 1st ed., Elsevier Inc.
- Blondel, P. (2009): The handbook od Sidescan Sonar. Springer.
- de Jong, C.D, Lachapelle, G., Skone, S., Elema, I.A. (2010): Hydrography. VSSD.
- Grewal, Weill, Andrews (2013): Global Positioning System, Inertial Navigation and Integration. 3rd ed., John Wiley & Sons.

• Lurton, X. (2010): An Introduction to Underwater Acoustics – Principles and Applications. 2nd ed., Springer. • Urick, R.J. (2013): Principle of Underwater Sound. 3rd ed., Peninsula Publishing.
Forms of teaching and learning
Lecture, lecture and exercise, Practical exercise, plenum

Assessment and ECTS awarding criteria

Precondition of examination (Pre-requisite for examination, attendance)
Successfully completed exercises (ungraded)
Assessment methods and criteria (type, duration & scope)
Several distributed semester papers (graded)
ECTS awarding criteria
Regular active participation and successful completion of the module examination / examination achievements
Calculation of the module grade
Grade of semester papers (100%)
Weighting of the module grade
Module grade is 6.25% of the final grade

Additional Information

Previous knowledge / Requirements for participation (in form and content) in accordance with examination regulations
Recommended Prerequisites: Successful completion of PC1
Applicability of Module
The module can only be used within the study program Geodesy and Geoinformatics
Special requirements for workplaces (room type / extent of use presence / extent of use project work and/or model construction in self-study)
Lecture: Lecture hall Practical exercises: Lecture room, laboratories, field, measuring areas and PC pool, Physical presence is required.
Frequency of Offering
Each winter semester
Course Language
English

Valid from	Valid until	Version	last updated	Adopted on
WiSe 23/24		V.1 01	23.05.2023	

Marine Environment

Geodesy and Geoinformatics (M.Sc.)

HCU Hamburg

Module number	Type of module (C/CE/E)	SWS	Student workload	CP (according to ECTS)	Semester (proposed)	Duration
Geo-M-Mod-109	C in HY CE in GD CE in GI	3 SWS	150 h	5	1	1 Semester

Subject Area	Module Coordinators
Hydrography	Prof. Dr.-Ing. Harald Sternberg Hydrographie und Geodäsie

Courses

Title	Course type	SWS (Contact Hours/Week)	Ø Group size
1. Marine Meteorology	Lecture	2 SWS (21 h)	50
2. Legal Aspects	Lecture	1 SWS (10,5 h)	50

Teaching and learning activities

Title	face-to-face teaching	Project work	examination preparation	Self study	Total student workload
1. Marine Meteorology	21 h	0 h	40 h	39 h	100 h
2. Legal Aspects	10,5 h	0 h	19,5 h	20 h	50 h

Objectives and contents

Objectives of qualifications (Competencies)

The students become familiarised with qualitative aspects about the marine meteorology and the law of the sea.

Contents of the module

- Marine Meteorology:
  Introduction: Terminology. Vertical structure of the atmosphere. The sun and the sun radiation. Meteorological elements: Temperature (temperature measurement, instruments, extreme values, layering). Pressure (measurement, instruments, extreme values, vertical distribution, lower and upper level weather charts). Humidity (terminology, measurement, instruments). Dew-point, frost-point. Meteorological elements: Clouds. Precipitation (rain, snow). Fog (formation,types of fog). Severe weather: Thunderstorm, lightning, hail, tornadoes, hurricanes, waterspouts. Mountain winds: Formation, typical foehn weather effects. Wind: Definitions, measurement, geo-strophic wind, computation of true wind, local wind systems (offshore wind, onshore wind, orographic influences, gusts, local wind systems, El Nino). Weather systems: Large scale atmospheric circulation. Global distribution of pressure, air and sea surface temperatures. Weather systems: Air masses, extra-tropical cyclones, anticyclones. Associated weather. Weather fronts: Development of coldfronts and warmfronts and their movement, sequence of clouds and weather at fronts, occlusions, frontal depression. Trough, secondary low. Weatherforecasting: Synoptic charts, extrapolation and steering techniques for on-board short range forecasting. International Marine Meteorological Service Systems: Collection and distribution of meteorological information, use of weather bulletins and facsimile charts.
- Legal Aspects:
  Introduction: Historical evolution of the law of the sea, participating organisations and mechanisms. International organisations: the work and functions of the IMO and IHO and the relevance of these bodies for the work of a hydrographic surveyor. Maritime boundaries: Baseline, coastal waters (characteristics, features, width), internal waters (bays and bays historical character), contiguous zone. Maritime boundaries: Continental shelf and exclusive economic zone (characteristics, extension, rights, duties and responsibilities of the coastal state). Determi-nation of outer limits of the continental shelf. Work of the Commission (submission and recommendations). Regulations for underwater cables, pipeline, offshore constructions, scientific research, environmental protection and the impact on surveys. General regulations concerning the deep sea, the peaceful passage and laws concerning islands. International Ocean Floor Authority. Deep seabed regime: the UNCLOS regime and functions of the International Seabed Authority. Mining Code- and current status of the exploration areas. Delimitation problems: Geodetic and vertical reference systems. Normal baseline, bay closure lines, middle and equidistant lines, islands in the deep ocean, dry-falling rises, river mouths, ports and roads. Delimitation between states with neighbouring or opposing coast lines. Marine Law: Study of maritime accidentsand court cases. Survey contracts: Tenders, invoices, contractual obligations, insurance, survey work and deliverables.

Recommended literature

- Lackmann, G. (2012): Midlatitude Synoptic Meteorology: Dynamics, Analysis, and Forecasting; American Meteorological Society
- Bader, M. J.; Forbes; Grant; Lilley; Waters (1995): Images in weather forecasting; Cambridge University Press
  World Meteorological Organization (1998): Guide to wave analysis and forecasting; WMO, 2nd ed.
- World Meteorological Organization (1989): Operational techniques for forecasting tropical cyclone intensity and

movement; WMO • Tanaka, Y. (2015): The International Law of the Sea; Cambridge University Press, 2nd ed. Rothwell, D. (2016): The international Law of the Sea; Bloomsbury Publishing, 2nd ed. Churchill, R.; V. Lowe (1999): The Law of the Sea; Manchester University Press, 3rd ed.
Forms of teaching and learning
Regular Lecture

Assessment and ECTS awarding criteria

Precondition of examination (Pre-requisite for examination, attendance)
None
Assessment methods and criteria (type, duration & scope)
Written (180 min.) or oral exam (30 min.)
ECTS awarding criteria
Regular active participation and successful completion of the module examination / examination achievements
Calculation of the module grade
Grade of written or oral exam (100%)
Weighting of the module grade
Module grade is 4.17% of the final grade

Additional Information

Previous knowledge / Requirements for participation (in form and content) in accordance with examination regulations
None
Applicability of Module
The module can only be used within the study program Geodesy and Geoinformatics
Special requirements for workplaces (room type / extent of use presence / extent of use project work and/or model construction in self-study)
Lecture: Lecture hall
Frequency of Offering
Every second year in the winter semester
Course Language
English

Valid from	Valid until	Version	last updated	Adopted on
WiSe 23/24		V.1 01	24.05.2023	

Advanced Hydrography

Geodesy and Geoinformatics (M.Sc.)

HCU Hamburg

Module number	Type of module (C/CE/E)	SWS	Student workload	CP (according to ECTS)	Semester (proposed)	Duration
Geo-M-Mod-212	C in HYD	5 SWS	225 h	7.5	2	1 Semester
Subject Area				Module Coordinators		
Hydrography				Prof. Dr.-Ing. Harald Sternberg Hydrographie und Geodäsie		

Courses

Title	Course type	SWS (Contact Hours/Week)	Ø Group size
1. Advanced Hydrography	Lecture	2 SWS (21 h)	30
2. Practical Course 3	Practical exercises	1 SWS (10,5 h)	30
3. Terrestrial Laser Scanning	Lecture	1 SWS (10,5 h)	40
3.1 Exercise of Terrestrial Laser Scanning	Practical exercises	1 SWS (10,5 h)	40

Teaching and learning activities

Title	face-to-face teaching	Project work	examination preparation	Self study	Total student workload
1. Advanced Hydrography	21 h	0 h	27 h	27 h	75 h
2. Practical Course 3	10,5 h	89,5 h	0 h	0 h	100 h
3. Terrestrial Laser Scanning	10,5 h	0 h	7 h	7,5 h	25 h
3.1 Exercise of Terrestrial Laser Scanning	10,5 h	14,5h	0 h	0 h	25 h

Objectives and contents

Objectives of qualifications (Competencies)

Enhancing the knowledge in hydrographic measurement and data processing techniques, particularly with multi beam echo sounding, side scan sonar and magnetometer. Extending measurement experiences in hydrographic projects. Learning basic principles of laser scanning.

Contents of the module

- Advanced Hydrography:
  Multibeam echo sounder: Performance. Bottom detection (amplitude and phase detection). Backscatter (recording modes, influences of system parameters, application). Water column data (principles, applications). Side-scan sonar: Components, data acquisition principles (directivity pattern, frequency, range, coverage, sampling rate, resolution), applications, operation, layback calculation. Sources of errors. Image geometry (display of slant ranges, rectification, corrections, mosaicking), image interpretation, survey planning, system configuration. Interferometric sonar systems: Principles, applications, advantages and disadvantages. Synthetic aperture sonar: Principles, applications, advantages and disadvantages. Seabed classification: Classification standards. Relation between acoustic signal backscattering and seafloor characteristics. Sonar image corrections. Absolute and relative backscatter. Angular range analysis. Ground- truthing. Comparison of different sonars for seabed classification. Comparison of acoustic and optical data sets for seabed classification. Sub-bottom profiler: Principles, parametric effect, chirp technique, resolution, applications, operation. Sourcesof errors (gross, systematic, random). Magnetometer: Types, applications, estimation of ferrous objects from changes in magnetic field intensity, positioning of magnetometers. Survey planning. Unmanned surface and underwater vehicles: Rosette systems, ROVs, AUVs, Gliders, towed systems. Applications, operation. Acoustic underwater positioning systems: Dead-reckoning (velocity log, INS). Position fixing (system components, principles, different methods: LBL, SBL, USBL). Integrated position solution, operation. Accuracies, error sources, calibration, application.
- Practical course 3:
  Handling of hydrographic surveying equipment and related accessories. Planning and preparation of a survey for wreck investigation using multibeam echo sounder, sub-bottom profiler, side-scansonar (backscatter), magnetometer. Multibeam echo sounder wreck survey (including backscatter and water column data).Sub-bottom profiler survey. Side-scan sonar (backscatter) survey. Magnetometer survey. Processing, visualisation and evaluation of multibeam echo sounder, sub-bottom profiler, side-scan sonar (backscatter) and magnetometer data.
- Terrestrial Laser Scanning 1 (English):
  Introduction into terrestrial laser scanning (TLS), measuring procedures, system criteria of laser scanning systems, data acquisition (scanning), sensor integration & data fusion (digital camera & scanner), registration & geo-referencing of scans, segmentation & filtering, geometric investigations in the precision/accuracy of terrestrial laser scanning systems, modelling & object reconstruction (3D triangulation/meshing and CAD modelling using point clouds) & visualization, applications, kinematic(mobile) TLS 1 Exercise: Scanning and registration of laser scans

Recommended literature

- Ainslie, M.A. (2010): Principles of sonar performance modeling. 1st ed., Springer.
- Bjørnø, L. (2017): Applied Underwater Acoustics. 1st ed., Elsevier Inc.
- Blondel, P. (2009): The handbook of Sidescan Sonar; Springer
- Groves, P.D. (2013): Principles of GNSS, Inertial, and Multisensor Integrated Navigation Systems. 2nd ed., Artech House.

- IHO (2011): Manual on Hydrography – Publication C-13; IHB, Monaco
- IHO (2020): Standards for Hydrographic Surveys – Publication S-44; IHB, Monaco, 6th ed.
- Lurton, X. (2010): An Introduction to Underwater Acoustics – Principles and Applications; Springer, 2nd ed.
- Ingham, A.E., Abbott, V.J. (1993): Hydrography for the Surveyor and Engineer. 3rd ed., Oxford.
- Medwin, H. (2005): Sounds in the Sea: From Ocean Acoustics to Acoustical Oceanography. 1. ed., Cambridge Uni Press.
- Micallef, A., Krastel, S., & Savini, A. (Eds.). (2018). Submarine Geomorphology. Springer.
- Seeber, G. (2003): Satellite Geodesy. 2nd, De Gruyer.
- Vosselman, G., & Maas, H. G. (Eds.). (2010). Airborne and terrestrial laser scanning. Whittles Publishing.
- Shan, J., & Toth, C. K. (Eds.). (2018). Topographic laser ranging and scanning: principles and processing. Second Edition, CRC press.

Forms of teaching and learning
Lecture and exercises, Practical exercises, Plenum

Assessment and ECTS awarding criteria

Precondition of examination (Pre-requisite for examination, attendance)
Successful practical training and report (practical course 3, not graded), successful exercises (TLS, not graded)
Assessment methods and criteria (type, duration & scope)
Advanced Hydrography: written (120 min.) or oral examination (20 min.) TLS: written (120 min.) or oral examination (20 min.)
ECTS awarding criteria
Successfully completed exercises (ungraded)
Calculation of the module grade
Exam grade: 67% exam Advanced Hydrography, 33% exam TLS
Weighting of the module grade
Module grade is 6.25% of the final grade

Additional Information

Previous knowledge / Requirements for participation (in form and content) in accordance with examination regulations
Recommended Prerequisites: Tutorial “Land Surveying” (for TLS). PC1, PC2 and hydro. data processing has been successfully passed (for PC3). Basic of Hydrography (for Advanced Hydrography)
Applicability of Module
The module can only be used within the study program Geodesy and Geoinformatics
Special requirements for workplaces (room type / extent of use presence / extent of use project work and/or model construction in self-study)
Lecture: Lecture hall Practical exercises: Geodetic Laboratory, vessel, Physical presence is required.
Frequency of Offering
Each summer semester
Course Language
English

Valid from	Valid until	Version	last updated	Adopted on
WiSe 23/24		V.1 01	24.05.2023	

Nautical Charting

Geodesy and Geoinformatics (M.Sc.)

HCU Hamburg

Module number	Type of module (C/CE/E)	SWS	Student workload	CP (according to ECTS)	Semester (proposed)	Duration
Geo-M-Mod-305	C in HYD CE in GD CE in GI	2 SWS	75 h	2.5	3	1 Semester
Subject Area				Module Coordinators		
Hydrography				Prof. Dr.-Ing. Harald Sternberg Hydrographie und Geodäsie		

Courses

Title	Course type	SWS (Contact Hours/Week)	Ø Group size
1. Nautical Charting	Lecture	1 SWS (10,5 h)	50
1.1 Exercises of Nautical Charting	Practical exercises	1 SWS (10,5 h)	50

Teaching and learning activities

Title	face-to-face teaching	Project work	examination preparation	Self study	Total student workload
1. Nautical Charting	10,5 h	0 h	14,5 h	20 h	55 h
1.1 Exercises of Nautical Charting	10,5 h	9,5 h	0 h	0 h	20 h

Objectives and contents

Objectives of qualifications (Competencies)

This course deals with the creation of ENCs. The students get a comprehensive knowledge of the importance of marinedatabases and the associated IHO standards S-52, S-57, S-58, and S-100. The lectures are accompanied by practical exercises.
Students shall gain the abilities:

- to define the steps and procedures in creation of ENCs
- to evaluate survey data storage and transfer strategies
- to explain the structure, components, and advantages of marine GIS bases
- to explain the importance of Marine Spatial Data Infrastructure and standards.

Contents of the module

- Introduction: IHO Standards S-52, S-57, S-58, storage and transfer formats, survey database, metadata, WMS
- Marine Spatial Data Infrastructure IHO S-100
- Feature: Digitization and editing of features (point, line, area, sounding) in respect to the S-57 object catalogue (group 1, group 2). Feature extraction. Vertical andhorizontal datum. Datum transformation.
- Filter: Filtering by attribute values, by feature acronym, feature object ID, feature type, unique feature acronym, rule wizard.
- Creation of paper charts: Layout and configuration of plot objects and chart furniture. Datums and projections. Viewports, borders, scale bar, subsidiary graduation, projected grid.
- Creation of depth information: Contouring in respect to the S-57 standard. Contour smoothing, sounding creation, difference surface, export.
- Creation of ENCs: ENC naming convention. Create, update, and customize S-57 base products for export to platform-independent exchange set or stand-alone files (HOB, PRD). Catalogue and data set files.
- Validation check: Quality control to ensure compliance with IHO standards.

Recommended literature

Hecht, H., Berking, B., Jonas, M., Alexander, L. (2009): The Electronic Chart: Functions, Potential and Limitation of a newmarine navigation system. 3rd ed., Geomares.
IHO (2014): Specifications for Chart Content and Display Aspects of ECDIS – Publication S-52. Release 6.1(.1), International Hydrographic Bureau, Monaco.
IHO (2000): IHO Transfer Standard for Digital Hydrographic Data – Publication S-57. Release 3.1, International HydrographicBureau, Monaco.
IHO (2014): ENC Validation Checks – Publication S-58. Release 5.0.0, International Hydrographic Bureau, Monaco.
IHO (2015): IHO Universal Hydrographic Data Model – Publication S-100. Release 2.0.0, International Hydrographic Bureau,Monaco.

Forms of teaching and learning

Regular Lecture and Exercises

Assessment and ECTS awarding criteria

Precondition of examination (Pre-requisite for examination, attendance)

None

Assessment methods and criteria (type, duration & scope)
Written (120 min.) or oral exam (20 min.)
ECTS awarding criteria
Regular active participation and successful completion of the module examination / examination achievements
Calculation of the module grade
Grade for oral or written exam (100%)
Weighting of the module grade
Module grade is 2.08% of the final grade

Additional Information

Previous knowledge / Requirements for participation (in form and content) in accordance with examination regulations
None
Applicability of Module
The module can only be used within the study program Geodesy and Geoinformatics
Special requirements for workplaces (room type / extent of use presence / extent of use project work and/or model construction in self-study)
Lecture: Lecture hall Practical exercises: PC-Pool, Physical presence is required.
Frequency of Offering
Each winter semester
Course Language
English

Valid from	Valid until	Version	last updated	Adopted on
WiSe 23/24		V.1 01	24.05.2023	

LiDAR and Remote Sensing

Geodesy and Geoinformatics (M.Sc.).
HCU Hamburg

Module number	Type of module (C/CE/E)	SWS	Student workload	CP (according to ECTS)	Semester (proposed)	Duration
Geo-M-Mod-310	C/C/C GD/GI/HY	2 SWS	75 Std.	2,5	3	1 Semester

Subject Area	Module Coordinators
Hydrography	Prof. Dr.-Ing. Thomas Kersten Photogrammetrie und Laserscanning

Courses

Title	Course type	SWS (Contact Hours/Week)	Ø Group size
1. LiDAR and Remote Sensing	lecture	2 SWS (21 h)	30

Teaching and learning activities

Title	face-to-face teaching	Project work	examination preparation	Self study	Total student workload
1. LiDAR and Remote Sensing	21 h	XX h	XX h	XX h	75 h

Objectives and contents

Objectives of qualifications (Competencies)

This module consists of lectures, which give the students a comprehensive knowledge of the principles of airborne LiDAR, bathymetric LiDAR, terrestrial and vessel-based LiDAR, bathymetry, satellite altimetry, and aerial photogrammetry for shoreline mapping. Moreover, LiDAR systems and the complete workflow, starting from data acquisition and ending with data processing/visualization, are also addressed.

Students shall gain abilities

- to evaluate applications of current LiDAR systems and their measurement principles
- to specific appropriate LiDAR technology for in use in hydrographic applications
- to specify and to analyze the error sources of topographic and bathymetric LiDAR
- to evaluate LiDAR data processing the results
- to know the use of terrestrial and vessel-based LiDAR for coastal applications and the system calibration
- to explain the principles and limitations of satellite altimetry
- to analyze image-based methods for hydrographic survey operations and the comparison with LiDAR

Contents of the module

Introduction: History of airborne LiDAR, basic components of airborne LiDAR and its functionality, measurements principles

Error sources: Interaction of laser beam with target (incl. full waveform analysis), error sources of airborne LiDAR

General workflow: Filtering and classification, strip adjustment

LiDAR quality: Strip adjustment, quality control

LiDAR systems: Overview of commercial airborne LiDAR systems and new developments

Applications: Overview of airborne LiDAR applications

Bathymetry: Bathymetric LiDAR – Principles, systems & applications

Kinematic laser scanning: Terrestrial and vessel-based LiDAR

Aerial and satellite photogrammetry: Systems, images, image orientation, DEM generation, ortho-rectification, shoreline mapping, and hydrographic applications

Technology comparison: Comparison of LiDAR and other remote sensing technologies

Satellite altimetry: Principles & limitations for measurements of sea surface topography

Recommended literature

Barale, V.; Gade, M. (eds.): Remote Sensing of the European Seas; Springer.

Finkl C.W.; C. Majowski (eds.) (2014): Remote Sensing and Modeling – Advances in coastal and marine resources; Springer.

Kraus, K. (2007): Photogrammetry – Geometry from images and laser scans; de Gruyter, 2nd ed.

Shan, J.; C. K. Toth (eds.) (2008): Topographic laser ranging and scanning – Principles and processing; CRC press

Vosselman, G.; H. G. Maas (eds.) (2010): Airborne and terrestrial laser scanning; Whittles Publishing

Up-to-date scientific and technical papers for topics like: LiDAR systems, system calibration, data acquisition and data processing, and LiDAR applications

Forms of teaching and learning

Lecture, Plenum

Assessment and ECTS awarding criteria

Precondition of examination (Pre-requisite for examination, attendance)
Assessment methods and criteria (type, duration & scope)
Written exam 90 min
ECTS awarding criteria
successful completion of the module examination
Calculation of the module grade
Written exam 100%
Weighting of the module grade
Module grade represents 2,08 % of the final grade.

Additional Information

Previous knowledge / Requirements for participation (in form and content) in accordance with examination regulations
Applicability of Module
The module can be used within the study program Geodesy and Geoinformatics (M.Sc.)
Special requirements for workplaces (room type / extent of use presence / extent of use project work and/or model construction in self-study)
Frequency of Offering
Each winter term
Course Language
English

Valid from	Valid until	Version	last updated	Adopted on
WiSe 23/24 / SoSe 24		V.1 01	04.08.2023	

Navigation in Hydrography

Geodesy and Geoinformatics (M.Sc.)

HCU Hamburg

Module number	Type of module (C/CE/E)	SWS	Student workload	CP (according to ECTS)	Semester (proposed)	Duration
Geo-M-Mod-306	C in HY CE in GD CE in GI	2 SWS	75 h	2.5	3	1 Semester

Subject Area	Module Coordinators
Hydrography	Prof. Dr.-Ing. Harald Sternberg Hydrographie und Geodäsie

Courses

Title	Course type	SWS (Contact Hours/Week)	Ø Group size
1. Nautical Science	Lecture	1 SWS (10,5 h)	50
2. Electronic Chart Display and Information System	Lecture	1 SWS (10,5 h)	50

Teaching and learning activities

Title	face-to-face teaching	Project work	examination preparation	Self study	Total student workload
1. Nautical Science	10,5 h	0 h	17 h	10 h	37,5 h
2. Electronic Chart Display and Information System	10,5 h	0h	17 h	10 h	37,5 h

Objectives and contents

Objectives of qualifications (Competencies)

Basic understanding for navigation methods and applications at sea and using electronic charts.

Contents of the module

Nautical Science:
This course provides the students with a comprehensive knowledge of navigation methods and their application at sea (Radar as navigation aid, for collision avoidance, target tracking; course sensors such as magnetic compass, gyro compass, electronic sensors; speed sensors such as hydro-mechanical logs, electro-magnetic logs, Doppler sonar, GNSS-based speed measurements); positioning sensors; terrestrial positioning using lines-of-position). Principles and accuracies of sensors for navigation are discussed within the course, and the use of nautical publications such as nautical charts, nautical handbook, notices of mariners, is reviewed. Furthermore, the course addresses the law of marine coastal traffic (regulations for navigation in waterways, traffic control systems, general rule of behavior, tide) and seamanship (manoeuvre techniques: steering elements, propulsion systems, safety technology).

Electronic Chart Display and Information System:
This course provides the students with an understanding of the fundamentals, potential and limits of ECDIS as well as its application in route planning and monitoring. Contents are: on-board components of ECDIS; structure and characteristics of ENC data; datum and quality of hydrographic data; base cells and updates; quality assurance by standards, source dependence, and certification. From data to chart display: Selection of information, colours and symbols, forms of display. Access to navigational information; navigational functions for chart display, route planning, and route monitoring. Proper use of ECDIS: Parameter setting, scale-related display aspects, limitations and safety-related alarms.
Carriage requirements. Integration with other navigation systems (GNSS, radar, AIS). Chart data management. Differencesbetween ECDIS/ENCs and ECS, RCDS. After the lecture a practical exercise takes place: Perform a detailed passage planning. Create, check and store the route using ECDIS. Afterwards, the planned voyage has to be executed and monitored.

Recommended literature

Blair, C.H. (1977): Seamanship – A handbook for Oceanographers. Cornell Maritime Press.
Bole, A.G., Wall, A.D., Norris, A. (2013): Radar and ARPA Manual: Radar, AIS and Target Tracking for Marine Radar Users. 3rd ed., Butterworth-Heinemann.
The Nautical Institute (2008): Principles of Navigation - The Admiralty Manual of Navigation; Vol. 1
Cunliffe, T. (2014): The Complete Yachtmaster; A&C Back, 8th ed.
Burch, D. (2009): Inland and Coastal Navigation – For Power-driven and Sailing Vessels; 2nd ed.
Kresse, W., Fadaie, K. (2010): ISO Standards for Geographic Information. 1st ed., Springer.
Hecht, H.; B. Berking; M. Jonas; M. Wöster, J. Harper (2021): The Electronic Chart – Fundamentals, Functions, Data and other Essentials – A Textbook for ECDIS use and Training; STC Publishing, 4th revised ed.

Forms of teaching and learning

Regular Lecture

Assessment and ECTS awarding criteria

Precondition of examination (Pre-requisite for examination, attendance)

None
Assessment methods and criteria (type, duration & scope)
Written (120 min.) or oral exam (30 min.)
ECTS awarding criteria
Regular active participation and successful completion of the module examination / examination achievements
Calculation of the module grade
Grade of written or oral exam (100%)
Weighting of the module grade
Module grade is 2.08% of the final grade

Additional Information

Previous knowledge / Requirements for participation (in form and content) in accordance with examination regulations
None
Applicability of Module
The module can only be used within the study program Geodesy and Geoinformatics
Special requirements for workplaces (room type / extent of use presence / extent of use project work and/or model construction in self-study)
Lecture: Lecture hall
Frequency of Offering
Each winter semester
Course Language
English

Valid from	Valid until	Version	last updated	Adopted on
WiSe 23/24		V.1 01	25.05.2023	

Oceanography

Geodesy and Geoinformatics (M.Sc.)

HCU Hamburg

Module number	Type of module (C/CE/E)	SWS	Student workload	CP (according to ECTS)	Semester (proposed)	Duration
Geo-M-Mod-307	C in HYD	3 SWS	150 h	5	3	1 Semester
Subject Area				Module Coordinators		
Hydrography				Prof. Dr.-Ing. Harald Sternberg Hydrographie und Geodäsie		

Courses

Title	Course type	SWS (Contact Hours/Week)	Ø Group size
1. Physical Oceanography and Tides	Lecture	2 SWS (21 h)	30
2. Oceanographic Data Processing	Lecture	0,5 SWS (5,25 h)	30
2.1 Exercises of Oceanographic Data Processing	Practical exercises	0,5 SWS (5,25 h)	30

Teaching and learning activities

Title	face-to-face teaching	Project work	examination preparation	Self study	Total student workload
1. Physical Oceanography and Tides	21 h	0 h	27 h	27 h	75 h
2. Oceanographic Data Processing	5,25 h	0 h	0 h	4,75 h	10 h
2.1 Exercises of Oceanographic Data Processing	5,25 h	59,75 h	0 h	0 h	65 h

Objectives and contents

Objectives of qualifications (Competencies)

- To gain basic knowledge and understanding of physical oceanographic questions, methods and results.
- To identify and relate oceanic phenomena to physical processes in the global ocean and coastal areas.
- To describe and explain these processes.

Contents of the module

Physical Oceanography and Tides

Introduction and sea floor geomorphology: Terminology, definitions, overview. Earth's topography, plate tectonics, submarine canyons, banks, coastal islands, seamounts, coastal landscape, estuaries, sea level changes. Properties of water and ice: Physical and chemical properties, temperature, dissolved matter, density, viscosity and surface tension of water, diffusivity, hydro-optics, hydro-acoustics, ice formation. Observations - instruments and methods: Marine observations, platforms (moorings, satellites), measured variables, data analysis, international programmes, coastal observation systems. Global energy and water budget: Heat budget of the ocean, fresh water budget of the ocean (hydrological cycle, residence time, hydrological pathways, climatological sea surface salinity, ice climatology), water masses (water mass concept, globally important water masses, stratification, exchange with marginal seas). Regional oceanography: Oceanographic provinces (equatorial regions, western boundary currents, upwelling regions), ocean basins (e.g. Atlantic Ocean, straits and passages, North Sea). Surface mixed layer dynamics: Air-sea interaction, penetrating solar radiation, vertical mixing static instability, upper ocean profiles, Langmuir circulation cells, SML processes, the seasonal cycle, ice-ocean interactions. Extreme phenomena: Extreme events, tropical cyclones, water sprouts, storm surges, tsunamis, density currents, rogue waves. Ocean circulation: Wind driven ocean circulation (Ekman dynamics, coastal currents).Thermohaline circulation, meridional overturningcirculation, gravitational adjustment, oceanic deep convection, global deep circulation, global conveyor belt, three-dimensional circulation, oceanic transport, shelf water drainage, flow over topography. Waves: Wave kinematics. Surface gravity waves (wave diffraction at islands or coast, wave reflection, standing waves in one dimension, co-oscillation). Gravity wave generation (wind waves, capillary waves, sea waves, rogue waves, swell). Effects of earth's rotation: Boundary waves (Kelvin waves, amphidromic systems, topographic waves, basin modes). Effects of stratification, waves in moving media, other nonlinear effects. Tides: The earth-moon system (balance of forces, tidal potential, tidal forces in geographic coordinates), the earth-sun system, combined solar and lunar tides, main partial tides, equilibrium tide, secondary tidal force, dynamic tides, shallow water tides. Tidal phenomena (regional distribution of tides, extreme tidal amplitudes, tidal currents, tidally formed coasts, tidal friction and mixing, tidal datums). Tidal measurements. Tide tables, cotidal charts, non-tidal water level variation.

Oceanographic Data Processing

Introduction: Oceanographic Data Processing, Python: Scientific modules, variables and types, operators and comparisons, compound types, control flow, loops, functions, classes, modules, exceptions. Organizing data in multidimensional numpy arrays: functions for extracting arrays, linear algebra, reshaping, resizing and stacking arrays. Scientific algorithms and their applications: integration, Fourier transformation, optimization, interpolation, statistics. Visualization, plotting and organization ofdata: Creation, access and sharing of array-oriented scientific data and services (Global Historical Climatology Network (GHCN) Data integration, KNMI Services).

Recommended literature

- Bearman, G. (Ed.) (2005): Waves, Tides and Shallow-water Processes. 2nd ed., Butterworth-Heinemann.
- LeBlond, P. H.; L. A. Mysak (1978): Waves in the Ocean; Elsevier
- Lin, J. W.-B (2012): A Hands-on Introduction to Using Python in the Atmospheric and Oceanic Sciences; www.johnny-lin.com/pyintro/
- Pedlosky, J. (2003): Waves in the Ocean and Atmosphere; Springer

- Open University Series (1995): Seawater: Its Composition, properties and Behavior; Butterworth-Heinemann, 2nd ed.
- Open University Series (1999): Waves, Tides and Shallow Water Processes; Butterworth-Heinemann
- Open University Series (2001): Ocean Circulation; Butterworth-Heinemann, 2nd ed.
- Scopatz, A., Huff, K.D. (2015): Effective Computation in Physics – Field Guide to Research with Python. 1. ed., O'Reilly and Associates.
- Talley, L.D., Pickard, W.J.E., Swift, J.H. (2011): Descriptive Physical Oceanography. 6th ed., Elsevier Ltd.

Forms of teaching and learning
Regular lecture and exercises in groups

Assessment and ECTS awarding criteria

Precondition of examination (Pre-requisite for examination, attendance)
Practical assignment (Oceanographic Data Processing, ungraded)
Assessment methods and criteria (type, duration & scope)
Physical Oceanography and Tides (lecture): Written (120 min.) or oral exam (20 min.)
ECTS awarding criteria
Regular active participation and successful completion of the module examination / examination achievements
Calculation of the module grade
Grade for oral or written exam (100%)
Weighting of the module grade
Module grade is 4.17% of the final grade

Additional Information

Previous knowledge / Requirements for participation (in form and content) in accordance with examination regulations
Recommended Prerequisites: Basic knowledge of python programming
Applicability of Module
The module can only be used within the study program Geodesy and Geoinformatics
Special requirements for workplaces (room type / extent of use presence / extent of use project work and/or model construction in self-study)
Lecture: Lecture hall Practical exercises: PC-Pool, Physical presence is required.
Frequency of Offering
Every two years, winter semester
Course Language
English

Valid from	Valid until	Version	last updated	Adopted on
WiSe 23/24		V.1 01	25.05.2023	

Marine Geology / Geophysics

Geodesy and Geoinformatics (M.Sc.)

HCU Hamburg

Module number	Type of module (C/CE/E)	SWS	Student workload	CP (according to ECTS)	Semester (proposed)	Duration
Geo-M-Mod-308	C in HYD	3 SWS	150 h	5	3	1 Semester
Subject Area				Module Coordinators		
Hydrography				Prof. Dr.-Ing. Harald Sternberg Hydrographie und Geodäsie		

Courses

Title	Course type	SWS (Contact Hours/Week)	Ø Group size
1. Geology / Geomorphology	Lecture	1 SWS (10,5 h)	30
2. Seismics	Lecture	1 SWS (10,5 h)	30
3. Magnetics and Gravimetry	Lecture	1 SWS (10,5 h)	30

Teaching and learning activities

Title	face-to-face teaching	Project work	examination preparation	Self study	Total student workload
1. Geology / Geomorphology	10,5 h	0 h	19,5 h	20 h	50 h
2. Seismics	10,5 h	0 h	19,5 h	20 h	50 h
3. Magnetics and Gravimetry	10,5 h	0 h	19,5 h	20 h	50 h

Objectives and contents

Objectives of qualifications (Competencies)

Developing a comprehensive understanding of geological processes and geomorphology and the relevant measurement methods used in the marine environment.

Contents of the module

Geology / Geomorphology

Marine Geology: Types of rocks and composition of the earth. Plate tectonics. Geological time scale. Geomorphology: Shape of the seafloor, crustal structure. Geomorphology: Geomorphological and sedimentary processes and structures,effects on the seabed topography with special reference to the continental shelf. Seabed sediment types and characteristics. Undersea features: Cartographic terminology, definitions, symbology. Paleooceanography: Seabed sampling: grabs, corers, dredges. Proxies, Milanchovich cycles, Stratigraphy – oxygen isotopes, organic petrology.

Seismics

Introduction: Fundamentals and applications. History. Theory of seismic wave propagation: Elastic characteristics of solids, types of seismic waves, signal attenuation, reflection and transmission coefficient, refraction, diffraction phenomena. Marineseismic instrumentation: Principles, seismic sources, detectors, recording instruments (analog, digital), wide-angle seismics(refraction seismics), multi-channel reflection seismics, 3D-seismics. Seismics and marine mammals. Field operation: Equipment configuration, launch and recovery. Seismic processing: Preprocessing (demultiplexing, static correction editing,resampling, gain recovery, deconvolution, filtering, CMP sorting). Processing analysis (velocity analysis, true amplitude recovery, deconvolution analysis, filter analysis). Seismic processing: Processing (normal moveout, de-multiple, dip moveout, NMO correction, CDP stack, filtering, equalisation, migration). Final stack.

Magnetics and Gravimetry

Introduction: Terminology. Thematic classification. History. Theory of geomagnetic field: Actual field (representation, variations, magnetic storms). Model geomagnetic fields (international geomagnetic reference fields). Magnetic survey instrumentation: Magnetometers (magnetic field balance, fluxgate, proton, optical pumping magnetometers). Moving platform instrumentation. Magnetic data acquisition and reduction: Consideration for moving platforms, numerical reduction,contour maps. Main error sources of marine magnetic measurements (internal, external). Applications. Marine Gravity: Gravity field and gravity potential. Geoid. Ellipsoidal models. Contributions to the measured gravity. Gravity survey instrumentation: Absolute gravimeters (pendulum, free fall instruments, rise and fall instruments). Relative gravimeters (pendulum, spring gravimeters). Airborne and vessel-based systems. Gravity data: Data acquisition and processing.

Applications in geodesy and geophysics.

Recommended literature

Bjørlykke, K. (2010): Petroleum Geoscience- From Sedimentary Environments to Rock Physics. Springer

Erickson, J. (2003): Marine Geology: Exploring the New Frontiers of the Ocean. Facts On File, Inc

Hinze, W.J., von Frese, R.R.B., Saad. A.H. (2013): Gravity and Magnetic Exploration: Principles, Practices, and Applications. 1st ed., Cambridge University Press.

Jones, E.J.W. (1999): Marine Geophysics. 1st ed., John Wiley & Sons.

Keary, Ph., Klepeis, K. A., Vine, F. J. (2009): Global Tectonics. 3rd ed., John Wiley & Sons.

Markovski, B. (2016): Basic Principles of Topography. Springer

Marshak, G.Mitra, S. (1998): Basic Methods of Structural Geology. Prentice Hall
Robinson, E. S., Coruh, C. (1988): Basic Exploration Geophysics. John Wiley & Sons.
Sheriff, R. E., & Geldart, L. P. (1995): Exploration Seismology. 2nd ed., Cambridge University Press.
Sreepat, J. (2014): Fundamentals of Physical Geology. Springer.
Sjöberg, L., Bagherbandi, M, (2017): Gravity Inversion and Integration - Theory and Applications in Geodesy and Geophysics; Springer, ISBN 978-3-319-50297-7
Turekian, K. K. (2010): Marine Geology and Geophysics; Academic Press Inc.(London), ISBN 978-0-08-096484-3
Torge, W., Mueller, J. (2012): Geodesy. 4th ed., De Gruyter.
Wille, P. C. (2005): Sound Images of the Ocean in Research and Monitoring; Springer
Yilmaz, O. (2001): Seismic Data Analysis: Processing, Inversion and Interpretation of Seismic Data
(Vol. 1 & 2). Society of Exploration.

Forms of teaching and learning
Regular and block Lectures

Assessment and ECTS awarding criteria

Precondition of examination (Pre-requisite for examination, attendance)
none
Assessment methods and criteria (type, duration & scope)
Written (180 min.) or oral exams (20 min.)
ECTS awarding criteria
Regular active participation and successful completion of the module examination / examination achievements
Calculation of the module grade
Grade of written or oral exams (100%)
Weighting of the module grade
Module grade is 4.17% of the final grade

Additional Information

Previous knowledge / Requirements for participation (in form and content) in accordance with examination regulations
None
Applicability of Module
The module can only be used within the study program Geodesy and Geoinformatics
Special requirements for workplaces (room type / extent of use presence / extent of use project work and/or model construction in self-study)
Lecture: Lecture hall
Frequency of Offering
Each winter semester
Course Language
English

Valid from	Valid until	Version	last updated	Adopted on
WiSe 23/24		V.1 01	25.05.2023	

Hydrographic Practice

Geodesy and Geoinformatics (M.Sc.)

HCU Hamburg

Module number	Type of module (C/CE/E)	SWS	Student workload	CP (according to ECTS)	Semester (proposed)	Duration
Geo-M-Mod-309	C in HYD	6 SWS	225 h	7.5	3	1 Semester
Subject Area				Module Coordinators		
Hydrography				Prof. Dr.-Ing. Harald Sternberg Hydrographie und Geodäsie		

Courses

Title	Course type	SWS (Contact Hours/Week)	Ø Group size
1. Supplementary Field Training / Practical Course	Lecture	0,5 SWS (5,25 h)	30
1.1 Exercises of Supplementary Field Training / Practical Course	Practical exercise	4,5 SWS (47,25 h)	30
2. Quality Management	Lecture	1 SWS (10,5 h)	30

Teaching and learning activities

Title	face-to-face teaching	Project work	examination preparation	Self study	Total student workload
1. Supplementary Field Training / Practical Course	5,25 h	0 h	22 h	22,75 h	50 h
1.1 Exercises of Supplementary Field Training / Practical Course	47,25 h	102,75 h	0 h	0 h	150 h
2. Quality Management	10,5 h	0 h	7,5 h	7 h	25 h

Objectives and contents

Objectives of qualifications (Competencies)

The students are acquainted with modern hydrographic sensors in the context of a practical project. Further, the students are introduced to Quality Management related to hydrographic surveying.

Contents of the module

Supplementary Field Training / Practical Course:

Levelling: Identification of benchmarks (governmental and determined by GNSS measurements) and their documentation. Collimation check/2-peg-test. Height determination of a marked point (tide gauge installation point) by levelling using official and GNSS-measured marks. Processing of the levelling. Tide gauge: Tide gauge installation. Determination of local water level variations/tide. Analysis and evaluation of the measured water level height with the official tide gauge data from surrounding tide gauges. Vessel alignment survey: Execution of a vessel alignment survey to determine the sensors position within a vessel reference frame. Computation and adjustment of a vessel reference frame. Sensor installation: Mounting and integration of sensors. Hydrographic and oceanographic survey: Survey planning including definition of areas of investigation, time schedule (including profile planning and calibration and transit time), weather considerations, etc. Survey with hydrographic and oceanographic instrumentation. Processing and visualisation of different data sets.

Quality Management:

Introduction: Relevance of quality management; what is quality? Development of the main aspects of quality. Reasons forand the evolution of quality management. Quality assurance, quality control and quality improvement as the quality trilogy.Quality management system and total quality management (TQM). ISO Standards for quality management. Guidelines to improve results in hydrography. Quality tools: introduction and application in hydrography. Development of a quality management system: Example of the BSH. Accreditation, audits and controlling: definitions, procedures, pros and cons.

Recommended literature

Supplementary Field Training

Hofmann-Wellenhof, B., Lichtenegger, H., Collins, J. (2013): GPS-Theory and Practice. 5th ed., Springer.
Lekkerkerk, H.-J. (2011): Handbook of Offshore Surveying (Volume 1): Projects, Preparation & Processing. 2nd ed.,Skillstrade.
Lekkerkerk, H.-J. (2012): Handbook of Offshore Surveying (Volume 2): Positioning & Tides. 2nd ed., Skillstrade.
Lekkerkerk, H.-J. (2012): Handbook of Offshore Surveying (Volume 3): Acquisition Sensors. 2nd ed., Skill-strade.
Torge, W., Mueller, J. (2012): Geodesy. 4th ed., De Gruyter.
recent scientific hydrographic and oceanographic publications, especially on topics such as sediment transport, behavior of currents in rivers and water column parameters (..)

Quality Management:

DIN (2016): Qualitätsmanagement – QM-Systeme und -Verfahren; DIN-Taschenbuch 226, Beuth-Verlag, 9th ed.

ISO (2016): Selection and use of the ISO 9000 family of standards; www.iso.org ISO (2015): Quality management principles; www.iso.org
Forms of teaching and learning
Regular Lecture and exercise in sub-groups

Assessment and ECTS awarding criteria

Precondition of examination (Pre-requisite for examination, attendance)
Supplementary Field Training: Successfully completed exercises (ungraded)
Assessment methods and criteria (type, duration & scope)
Several tasks distributed semester paper (graded)
ECTS awarding criteria
Regular active participation and successful completion of the module examination / examination achievements
Calculation of the module grade
Grade of Semester papers (100%)
Weighting of the module grade
Module grade is 6.25% of the final grade

Additional Information

Previous knowledge / Requirements for participation (in form and content) in accordance with examination regulations
Recommended Prerequisites: Successful completion of PC1, PC2, PC3 and Tut. “Land Surveying”
Applicability of Module
The module can only be used within the study program Geodesy and Geoinformatics
Special requirements for workplaces (room type / extent of use presence / extent of use project work and/or model construction in self-study)
Lecture: Lecture hall Practical exercises: Geodetic Laboratory, vessel, PC-Pool, field, Physical presence is required.
Frequency of Offering
Each winter semester
Course Language
English

Valid from	Valid until	Version	last updated	Adopted on
WiSe 23/24		V.1 01	25.05.2023	

[Q] STUDIES

Geodesy and Geoinformatics (M.Sc.)
Fachübergreifende Studienangebote (cross-curricular Program)
HCU Hamburg

Module Number	Type (C/CE/E)	SWS	Workload	CP	Semester (proposed)	Duration
Q-M-Mod-001 Q-M-Mod-002 Q-M-Mod-001/002	C	4 SWS	150 hours	5 CP	) to be defined by ach program	1-2 Semester
Teaching and Learning Area				Person responsible for the module		
Cross-Curricular Program				Prof. Dr. Gernot Grabher (Stadt- und Regionalökonomie)		

Courses

Title	Course Type	Contact Hours/Week (SWS)	Ø Course size
[Q] STUDIES	1)	2 SWS (21. hours.)	30
[Q] STUDIES	1)	2 SWS (21. hours)	30

Student Workload

Title	Contact Hours	Project Editing	Exam Preparation	Self-Study	Total
[Q] STUDIES	21 hours	1)	1)	1)	75 hours
[Q] STUDIES	21 hours	1)	1)	1)	75 hours

Obejctives and Contents

Obejctives and Contents (Competencies)
- Reflective Competencies: Scientific analysis and reflection: Students can analyze what they have learned and they can integrate existing and new knowledge in complex contexts - Cultural competencies: Transdisciplinary and Intercultural Communication: Students will be able to engage in factual exchange with representatives of different academic fields of activity - Perceptual and creative competencies: Students are able to apply techniques for creative and innovative design independently - Competencies for action: Proactive and responsible action
Contents
[Q] STUDIES I und **[Q] STUDIES II:** Different event formats with a theoretical focus - Offers for training perception and creativity - Practical project work such as the conception of events and their implementation <u>teaching areas:</u> - Science | Technology | Knowledge - Media | Art | Culture - economy | politics | society
Recommended Literature
To be announced in Seminar
Teaching and Learning methods
If applicable, group work, project work in interdisciplinary working groups, e-learning components in the form of videos, digital synchronous teaching, face-to-face teaching, excursions (optional)

Examination achievements and requirements for the award of CPs

Precondition of Examination
Regular active participation (attendance required for at least 80% of the session dates)
Type of Examination
[Q] STUDIES I and II: Examination performance varies depending on the course chosen and will be announced at the beginning of the semester.
Prerequisites for the award of CP
80% participation, active participation, accompanying assignments
Composition of Module Mark
Examination of [Q] STUDIES I is 50% of the module grade. Examination of [Q]STUDIES is 50% of the module grade.
Weighting of the module grade

Results from the curriculum of the respective study program.

Supplementary information

Prior knowledge for participation in the module (form and content)
Knowledge and techniques of scientific work are recommended.
Usability of the Module/ Verwendbarkeit des Moduls/ Access requirements for future modules (mandatory or recommended)
Module is usable in Architektur (M.Sc.), Bauingenieurwesen (M.Sc.), Geodäsie und Geoinformatik (M.Sc.), REAP (M.Sc.), Stadtplanung (M.Sc.) und Urban Design (M.Sc.)
Special Need for Workplaces (Type of room / extent of use Presence / extent of use Project work and/or model building in self-study)
Frequeny of Offering
Each term
Teaching Language
1)

Valid from	Valid to	Version	Last updated	Decided on
WiSe 23/24 / SoSe 24		V.1 01	17.08.2023	

1) results from selected course

BASICS Project Management

Geodesy and Geoinformatics (M.Sc.)
Fachübergreifende Studienangebote (cross-curricular Program)
HCU Hamburg

Module Number	Type (C/CE/E)	SWS	Workload	CP	Semester (proposed)	Duration
BS-M-Mod-001	C	4 SWS	150 hours	5 CP	to be defined by each program	1-2 Semester

Teaching and Learning Area	Person responsible for the module
Cross-Curricular Program	Prof. Dr.-Ing. Thomas Krüger (Projektentwicklung und Projektmanagement in der Stadtplanung)

Courses

Title	Course Type	Contact Hours/Week (SWS)	Ø Course size
1. a) Projektmanagement	Lecture	2 SWS (21. hours.)	185
or			
b) Projectmanagement Lecture	Lecture	2 SWS (21. hours)	45
2. Projektmanagement ARC/BIW/GEO/REAP/UD	Seminar	2 SWS (21 hours)	to be defined by each program

Student Workload

Title	Contact Hours	Project Editing	Exam Preparation	Self-Study	Total
1. a) Projektmanagement	21 hours	0 hours	0 hours	54 hours	75 hours
or					
b) Projectmanagement Lecture	21 hours	0 hours	0 hours	54 hours	75 hours
2. Projektmanagement ARC/BIW/GEO/REAP/UD	21 hours	will be announced in the course	will be announced in the course	will be announced in the course	75 hours

Objectives and Contents

Obejctives and Contents (Competencies)
Knowing the typical problems, instruments, methods, actors and organizational contexts of project management, its theoretical references and forms of practice, also beyond one's own discipline. Apply and reflect on the instruments and methods of project management in a discipline-specific context.
Contents
1) Lecture (depending on the study program, the German or English lecture is chosen) a) Basics: Project Management Lecture b) Basics: Project Management Lecture (for all English-language study programs) Instruments, actors, problems and organizational context of project management 2) Accompanying seminars Application and deepening of the lecture contents in the disciplinary context or according to study programs
Recommended Literature
1.) Lecture (German) a) Basics: Projektmanagement Vorlesung Bea, F. X.; Scheurer, S.; Hesselmann, S. 2020: Projektmanagement. 3. Aufl., München. Schreyögg, G.; Geiger, D. 2016: Organisation. Grundlagen moderner Organisationsgestaltung. 6. Aufl., Wiesbaden 2016. Jonas, K.; Stroebe, W.; Hewstone, M. (Hrsg.) 2014: Sozialpsychologie. Kap. 12 Gruppendynamik, 13 Gruppenleistung und Führung: 439-506 b) Basics: Project Management Lecture (English) Meredith, Jack R.; Mantel, Samuel J.; Shafer, Scott M. (2016): Project management. A managerial approach. 9. ed., internat. student version. Singapore: Wiley. Project Management Institute (2013). A Guide to the Project Management Body of Knowledge (PMBOK Guide) (5th ed.). Newton Square, PA: Project Management Institute, Inc.
Teaching and Learning methods
Vorlesung: Face-to-face event with eLearning components in the form of videos **Lecture:** Face-to-face event with eLearning components in the form of videos, digital synchronous course, excursion (optional) **Seminar:** Varies depending on the study program: group work, project work in interdisciplinary working groups, eLearning components in the form of videos, digital synchronous teaching, face-to-face teaching

Examination achievements and requirements for the award of CPs

Precondition of Examination

Lecture: none **Seminar:** 80 % Participation
Type of Examination
Lecture: Exam 90 min. **Seminar:** form of Examination tob e defined by ach program
Prerequisites for the award of CP
80% participation, active participation, accompanying assignments
Composition of Module Mark
Examination of the lecture is 50% of the module grade. Examination of the seminar is 50% of the module grade.
Weighting of the module grade
Module grade is 4.17% of the final grade.

Supplementary information

Prior knowledge for participation in the module (form and content)
None
Usability of the Module/ Verwendbarkeit des Moduls/ Access requirements for future modules (mandatory or recommended)
Module is usable in Architektur (M.Sc.), Bauingenieurwesen (M.Sc.), Geodäsie und Geoinformatik (M.Sc.), REAP (M.Sc.), Stadtplanung (M.Sc.) und Urban Design (M.Sc.)
Special Need for Workplaces (Type of room / extent of use Presence / extent of use Project work and/or model building in self-study)
Lecture: Large lecture hall (max. 200 participants) Seminar: if necessary rooms for group work; if necessary as block courses
Frequeny of Offering
1) Lecture each winter term 2) to be defined by ach program
Teaching Language
German/ English

Valid from	Valid to	Version	Last updated	Decided on
WiSe 23/24 / SoSe 24		V.1 01	17.08.2023	

Master-Thesis

Geodesy and Geoinformatics (M.Sc.).

HCU Hamburg

Module number	Type of module (C/CE/E)	SWS	Student workload	CP (according to ECTS)	Semester (proposed)	Duration
Geo-M-Mod-401	**C/C/C** (GD/GI/HY)	0 (0 h)	900 Std.	30	4	1 Semester
Subject Area				Module Coordinators		
Thesis				Prof. Dr.-Ing. Annette Eicker Geodesy and Adjustment Theory		

Courses

Title	Course type	SWS (Contact Hours/Week)	Ø Group size
1. Thesis	Thesis		

Teaching and learning activities

Title	face-to-face teaching	Project work	examination preparation	Self study	Total student workload
1. Thesis	0 h	0 h	0 h	900 h	900 h

Objectives and contents

Objectives of qualifications (Competencies)
Through the Master's thesis, students should demonstrate that they are able to work independently on problems from the scientific, application-oriented, and professional fields of Geodesy and Geoinformatics, using scientific methods and knowledge, to classify the interdisciplinary contexts and to further develop and deepen the knowledge acquired in the course of study in a scientific and application-oriented manner.
Contents of the module
Various topics from the field of Geodesy and Geoinformatics
Recommended literature
Forms of teaching and learning
Thesis

Assessment and ECTS awarding criteria

Precondition of examination (Pre-requisite for examination, attendance)
Assessment methods and criteria (type, duration & scope)
Successful completion of thesis, presentations/colloquium (graded), 22 weeks
ECTS awarding criteria
successful completion of the module examination
Calculation of the module grade
80% thesis, 20% presentation/colloquium
Weighting of the module grade
25% of final grade

Additional Information

Previous knowledge / Requirements for participation (in form and content) in accordance with examination regulations
70 CP must be earned in the study program Geodesy and Geoinformatics (M.Sc.)
Applicability of Module
The module can only be used within the study program Geodesy and Geoinformatics
Special requirements for workplaces (room type / extent of use presence / extent of use project work and/or model construction in self-study)

Frequency of Offering
Every winter/summer term
Course Language
English or German

Valid from	Valid until	Version	last updated	Adopted on
WiSe 23/24 / SoSe 24		V.1 01	05.07.2023	