# GN 1410 Mathematics 1

<table>
<thead>
<tr>
<th>Lecturer:</th>
<th>Prof. Dr. Dürrschnabel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of course unit:</td>
<td>Compulsory</td>
</tr>
<tr>
<td>Level of course unit:</td>
<td>First-cycle</td>
</tr>
<tr>
<td>Year of study:</td>
<td>First</td>
</tr>
<tr>
<td>Semester when the course is delivered:</td>
<td>First / winter semester</td>
</tr>
<tr>
<td>ECTS credits:</td>
<td>7 ECTS</td>
</tr>
<tr>
<td>Prerequisites:</td>
<td>Basic mathematical knowledge at higher secondary school level</td>
</tr>
<tr>
<td>Language of instruction:</td>
<td>German</td>
</tr>
<tr>
<td>Courses:</td>
<td>Analysis 1</td>
</tr>
<tr>
<td></td>
<td>Linear Algebra 1</td>
</tr>
<tr>
<td>Teaching method / learning activities:</td>
<td>Lecture + tutorial (max. 15 students )</td>
</tr>
<tr>
<td>Mode of delivery:</td>
<td>Face-to-face</td>
</tr>
<tr>
<td>Attendance:</td>
<td>3 hours/week 3 hours/week</td>
</tr>
<tr>
<td>Workload:</td>
<td>45 contact hours, 30 hours of independent study, 30 hours of guided study</td>
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<tr>
<td></td>
<td>45 contact hours, 30 hours of independent study, 30 hours of guided study</td>
</tr>
<tr>
<td>Assessment methods and criteria:</td>
<td>Written exam (120 min)</td>
</tr>
<tr>
<td></td>
<td>Assignments, online tests</td>
</tr>
<tr>
<td>Recommended optional programme components:</td>
<td>Student can choose courses from the General Studies' program</td>
</tr>
<tr>
<td>Course content:</td>
<td>Analysis 1: basics, functions, elementary functions, limits, differential calculus, applications of differential calculus</td>
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<tr>
<td></td>
<td>Linear Algebra 1: logics, basic algebraic structures, affine and Euklidian vector geometry, linear equation systems, matrix calculation, determinants</td>
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<tr>
<td>Learning outcomes:</td>
<td>After having successfully completed the course, the students should</td>
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<tr>
<td></td>
<td>Analysis 1:</td>
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<tr>
<td></td>
<td>- be able to use elementary functions of a variable</td>
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<td>- know the methods of differential calculus, including for complex functions.</td>
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<td></td>
<td>Linear Algebra 1:</td>
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<tr>
<td></td>
<td>- be able to work with vector geometry in the plane and in the space,</td>
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<tr>
<td></td>
<td>- be able to describe linear problems with the help of matrix calculation and be able to solve these problems,</td>
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<td>- know the advantage of using a computer algebra system.</td>
</tr>
</tbody>
</table>
Work placements: n/a

Recommended reading:
L. Papula: *Mathematik für Ingenieure und Naturwissenschaftler*; vol. 1 and vol. 2; Springer Vieweg, 2014 and 2012

Internet / Multimedia: material and online tests can be found on the HsKA ILIAS server
**Computer Science**

**Lecturer:** Prof. Dr. Bürg, Prof. Dr. Dürrschnabel  
**Type of course unit:** Compulsory  
**Level of course unit:** First-cycle  
**Year of study:** First  
**Semester when the course is delivered:** First / winter semester  
**ECTS credits:** 5 ECTS  
**Prerequisites:** Recommended: basic knowledge how to operate and use a computer  
**Language of instruction:** German  
**Courses:** Basics of Computer Science, Algorithms and Data Structures, Data Communication  
**Teaching method / learning activities:** Lectures  
**Mode of delivery:** Face-to-face  
**Attendance:** 2 hours/week, 2 hours/week, 1 hour/week  
**Workload:** 30 contact hours, 30 hours of independent study, 30 contact hours, 30 hours of independent study, 15 contact hours, 15 hours of independent study  
**Assessment methods and criteria:** Written exam (90 min)  
**Recommended optional programme components:** Student can choose courses from the General Studies' program  
**Course content:**  
Basics of Computer Science: This lecture provides theoretical basic knowledge in computer science: historical development, construction and functionality of computers, operating systems, Boolean algebra, circuits, representation of data in the computer, encryption, information exchange between person and computer, design of computer languages, software engineering  
Algorithms and Data Structures 1: This course provides detailed knowledge in dealing with algorithms and data structures. The teaching contents are: Formulation of algorithms, abstract data types, object orientation, concrete data structures (stacks, queues, linear lists, trees, hash structures, graphs), fundamental development methods, performance of algorithms, estimate calculation, analysis of algorithms from the fields of sorting, searching and optimizing.  
Data Communication: This lecture provides knowledge on the
design and the functionality of computer networks. The contents are: Network topologies, communication technologies, configuration of networks, net protocols, layer models, Internet standards, Internet protocols.

**Learning outcomes:**
After having successfully completed the course, the students should

**Basics of Computer Science:**
- know the approach of the von-Neumann computer and its theoretical basis.

**Algorithms and Data Structures 1:**
- be able to develop easy algorithms and optimize them with regard to their efficiency

**Data Communication:**
- understand computer networks
- be able to build up easy networks themselves

**Work placements:**
- n/a

**Recommended reading:**

Lecture notes on data communication will be available
GN 1430  Surveying 1

Lecturers: Prof. Dr. Klein

Type of course unit: Compulsory

Level of course unit: First-cycle

Year of study: First

Semester when the course is delivered: First / winter semester

ECTS credits: 7 cp

Prerequisites: None

Language of instruction: German

Courses: Surveying 1

Teaching method / learning activities: Lecture
Exercise (group of 2 to 5 persons)

Mode of delivery: Face-to-face

Attendance: 4 hours/week
2 hours/week

Workload: 60 contact hours, 120 hours of independent study, 30 hours of guided study (e.g. exercises, projects, lab work)

Assessment methods and criteria: Written exam (150 min) Assignments

Recommended optional programme components: Student can choose courses from the General Studies’ program

Course contents:
- Basics of surveying: reference areas, coordinate systems, reference point fields of land surveying, distance and angular measurement
- Basic skills in the simple determination of situation and height: different procedures of data acquisition, marking our of building projects, calculation and division of areas
- Calculation of standard deviations, assessment of uncertainties, error propagation
- Setting out of straight lines and right angles, measurement of distances, measurement of horizontal and vertical angles, survey (orthogonal, baseline, polar methods), stakeout of floor plan (orthogonal and polar methods), making a survey string line

Learning outcomes:
After having successfully completed the course, the students should
- be familiar with the basics of surveying
- be able to independently plan and organize simple measuring tasks and evaluate the results
- be able to use basic surveying equipments,
- know measurement methods, be familiar with the cause and effect of measurement uncertainties, have
gained the competence to evaluate and analyze survey documents, have social skills, be capable of organizing their work and time, know technical terms through the documentation, evaluation and further processing of their measurement data and results in exercises.

**Work placements:**

n/a

**Recommended reading:**


GN 1440  Geodetic Basics

<table>
<thead>
<tr>
<th>Lecturers:</th>
<th>Prof. Dr. Pfeiffer, Prof. Dr. Schwäble</th>
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<tbody>
<tr>
<td>Type of course unit:</td>
<td>Compulsory</td>
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<tr>
<td>Level of course unit:</td>
<td>First-cycle</td>
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<tr>
<td>Year of study:</td>
<td>First</td>
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<tr>
<td>Semester when the course is delivered:</td>
<td>First / winter semester</td>
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<tr>
<td>ECTS credits:</td>
<td>6 ECTS</td>
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<tr>
<td>Prerequisites:</td>
<td>None</td>
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<tr>
<td>Language of instruction:</td>
<td>German</td>
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<tr>
<td>Courses:</td>
<td>Geodetic Calculation</td>
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<td></td>
<td>Fundamentals of Metrology</td>
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<td>Trigonometry</td>
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<tr>
<td>Teaching method / learning activities:</td>
<td>Lecture, assignments</td>
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<td></td>
<td>Lecture, exercises</td>
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<td></td>
<td>Lecture</td>
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<tr>
<td>Mode of delivery:</td>
<td>Face-to-face</td>
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<td>Attendance:</td>
<td>2 hours/week</td>
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<td>2 hours/week</td>
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<td>2 hours/week</td>
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<tr>
<td>Workload:</td>
<td>30 contact hours, 30 hours of independent study</td>
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<td>25 contact hours, 30 hours of independent study, 5 hours of guided study</td>
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<td></td>
<td>30 contact hours, 30 hours of independent study</td>
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<tr>
<td>Assessment methods and criteria:</td>
<td>Written exam (150 min)</td>
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<tr>
<td>Recommended optional programme components:</td>
<td>n/a</td>
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<tr>
<td>Course content:</td>
<td>Geodetic Calculation: overview of the principles of fundamental coordination calculations and realisation of coordination calculations and transformation. Introduction to intersection calculation, coordinates transformation and the error calculation theory.</td>
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<td></td>
<td>Trigonometry: right-angled and general triangles, addition theorems, goniometric equations, spherical right-angled and spherical general triangles, mathematical geography</td>
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</tbody>
</table>
Learning outcomes: After having successfully completed the course, the students should  
Geodetic Calculation:  
- be familiar with and be able to use the basics of geodetic calculations  
Fundamentals of Metrology:  
- know the basic laws of metrology  
- be familiar with the principles of geodetic standard instruments  
- be able to use competently the geodetic standard instruments  
Trigonometry:  
- be able to realize triangular calculations in the plane and in the sphere,  
- know map projections.

Work placements: n/a

Recommended reading:  
Geodetic Calculation:  
Fundamentals of Metrology  
Trigonometry  
GN 1450  Basics of Cartography

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<thead>
<tr>
<th>Lecturer:</th>
<th>Prof. Dr. Günther-Diringer</th>
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<tbody>
<tr>
<td>Type of course unit:</td>
<td>Compulsory</td>
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<tr>
<td>Level of course unit:</td>
<td>First-cycle</td>
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<tr>
<td>Year of study:</td>
<td>First</td>
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<tr>
<td>Semester when the course is delivered:</td>
<td>First / winter semester</td>
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<tr>
<td>ECTS credits:</td>
<td>5 cp</td>
</tr>
<tr>
<td>Prerequisites:</td>
<td>none</td>
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<tr>
<td>Language of instruction:</td>
<td>German</td>
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<tr>
<td>Courses:</td>
<td>Visualization Basics and Presentation Techniques</td>
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<td></td>
<td>Cartography</td>
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<tr>
<td>Teaching method/learning activities:</td>
<td>Lecture with exercises and discussions</td>
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<tr>
<td>Mode of delivery:</td>
<td>Face-to-face</td>
</tr>
<tr>
<td>Attendance:</td>
<td>2 hours/week</td>
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<tr>
<td>Workload:</td>
<td>15 contact hours, 30 hours of independent study, 15 hours of guided study</td>
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<td></td>
<td>25 contact hours, 60 hours of independent study, 5 hours of guided study</td>
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<tr>
<td>Assessment methods and criteria:</td>
<td>Written exam (90 min)</td>
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<tr>
<td>Recommended optional programme components:</td>
<td>Student can choose courses from the General Studies’ program</td>
</tr>
<tr>
<td>Course content:</td>
<td>Visualization Basics and Presentation Techniques: Introduction into physiology and perception; perceptual and communication theories. Basics of general drawing theory, typography, design and colour theory. Basics of presentation (preparing and making a presentation, delivery, use of visual elements).</td>
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<tr>
<td>Cartography: The students are provided with a basic knowledge of the concepts and methods of cartography. The focus is on topographic maps, digital geospatial data and thematic maps. The lecture contains the following topics: map-related illustrations, principles of cartographic design, map scale, map fonts, notation of names, terrain design, cartographic generalization, thematic maps with different specifications. Practical work with topographic maps is based on scale calculations, the location identification with map grids, the generalization and analysis of various maps, and compilation of thematic maps.</td>
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</tbody>
</table>
Learning outcomes:
After having successfully completed the course, the students should
Visualization Basics and Presentation Techniques:
- be familiar with basic presentation techniques
- be able to use basic presentation techniques
- understand visual communication as part of overall communication, recognize and evaluate the purpose of aesthetics. Use standards and principles for the design of various elements, e.g. typography, shape, color, image, as well as apply different processes of abstraction. Students can discuss the relationship between form and content in a visualization exercise.

Cartography:
- be acquainted with the rules for the textual and graphic composition of maps and related illustrations,
- be able to design thematic maps,
- know the elementary principles of spatial reference, cartographic instruments (graphics, scale, generalization) and the technical implementation of paper-based maps and maps in digital form

Work placements:
n/a

Recommended reading:
Literature:
Abdullah, R., Hübner, R.: *Piktogramme und Icons*, Mainz 2005
Forsyth, P.: *30 Minuten bis zur überzeugenden Präsentation*, Offenbach 2006
Frutiger, A.: *Der Mensch und seine Zeichen*, Wiesbaden, 2004
Hake, G., Grünreich, D., Meng, L.: *Kartographie*, Berlin, 2001

Periodicals:
*Kartographische Nachrichten – Fachzeitschrift für Geoinformation und Visualisierung*
*The Cartographic Journal – The World of Mapping*

Internet / Multimedia:
Bundesamt für Kartographie und Geodäsie BKG (Federal Agency for Cartography and Geodesy) [http://www.bkg.bund.de](http://www.bkg.bund.de)
Deutsche Gesellschaft für Kartographie (German Cartographic Society) [http://www.dgfk.net](http://www.dgfk.net)
GN 2410  Mathematics 2

Lecturers:  Prof. Dr. Dürrschnabel

Type of course unit:  Compulsory

Level of course unit:  First-cycle

Year of study:  First

Semester when the course is delivered:  Second / summer semester

ECTS credits:  7 cp

Prerequisites:  Recommended: successful completion of module GN 1410, advanced knowledge of functions of a variable and their differential calculus

Language of instruction:  German

Courses:
Analysis 2
Linear Algebra 2

Teaching method/learning activities:
Lecture, tutorial (maximum number of participants: 15)
Lecture, tutorial (maximum number of participants: 15)

Mode of delivery:  Face-to-face

Attendance:
4 hours/week
2 hours/week

Workload:
60 contact hours, 40 hours of independent study, 40 hours of guided study
30 contact hours, 20 hours of independent study, 20 hours of guided study

Assessment methods and criteria:
Assignments, online-tests, written exam (120 min)

Recommended optional programme components:
Student can choose courses from the General Studies’ program

Course content:
Analysis 2: indefinite and definite integrals, series and power series, Fourier series and Fourier transformation, derivatives of functions of several variables, maximum and minimum values of functions of several variables, linear regression

Linear Algebra 2: complex numbers, coordinate transformations, affine transformations, homogeneous coordinates, eigenvalue theory, conic sections and quadrics

Learning outcomes:
Analysis 2: be able to perform series expansions, one- and multi-dimensional differential and integral calculus as well as demonstrate their useful application in practical examples

Linear Algebra 2:
be able to work with complex numbers and to handle transformation problems,
be able to use a computer algebra system as a suitable aid.

Work placements
n/a

Recommended reading:
Books:
- K. Dürrschnabel: Mathematik für Ingenieure; Springer Vieweg, 2012
- S. Goebbels, S. Ritter: Mathematik verstehen und anwenden; Springer Spektrum, 2013
- T. Rießinger: Mathematik für Ingenieure; Springer, 2013

Internet / Multimedia:
Material and online tests can be found on the HsKA ILIAS server
# GN 2420 Programming and Databases

**Lecturers:**
- Prof. Dr. Bürg
- Prof. Dr. Klein

**Type of course unit:**
Compulsory

**Level of course unit:**
First-cycle

**Year of study:**
First

**Semester when the course is delivered:**
Second / summer semester

**ECTS credits:**
6 cp

**Prerequisites:**
Recommended: successful completion of module GN 1420, basic knowledge how to operate and use a computer

**Language of instruction:**
German

**Courses:**
- Programming
- Databases

**Teaching method/learning activities:**
- Lecture
- Lecture

**Mode of delivery:**
Face-to-face

**Attendance:**
- 3 hours/week
- 2 hours/week

**Workload:**
- 45 contact hours, 45 hours of independent study
- 30 contact hours, 60 hours of independent study

**Assessment methods and criteria:**
Written exam (120 min)

**Recommended optional programme components:**
Student can choose courses from the General Studies’ program

**Course content:**
- Programming: introduction to basic programming concepts with the help of the programming language C++, structure of a C++ program, definition of data objects, fundamental data types, enumeration, pointers, reference, arrays, operators, basic input/output, input/output with files, control structures, dynamic storage management, introduction to the usage of a compiler
- Databases: general principles of databases, design of relational database systems, normalization, principles of hierarchical, network and object-oriented databases, relational algebra, QBE and SQL, data organization, data integrity

**Learning outcomes:**
After having successfully completed the course, the students should
- Programming: have basic programming skills, be able to develop, implement and test simple programs.
- Databases:
be familiar with the fundamentals of relational databases,
be able to design relational databases,
be able to use a concrete relational database.

**Work placements:**
n/a

**Recommended reading:**

**Programming:**

**Databases:**
- Steiner, R. (2014): *Relationale Datenbanken*
# GN 2430 Mathematics and Natural Science

**Lecturers:** Prof. Dr. Dürrschnabel

**Type of course unit:** Compulsory

**Level of course unit:** First-cycle

**Year of study:** First

**Semester when the course is delivered:** Second / summer semester

**ECTS credits:** 6 cp

**Prerequisites:** Recommended: successful completion of module GN 1410, knowledge of differentiation, vector geometry, and matrix calculation

**Language of instruction:** German

**Courses:**
- Analysis 3
- Physics

**Teaching method/learning activities:**
- Lecture, tutorial (maximum number of participants: 15)
- Face-to-face

**Mode of delivery:**
- Lecture, tutorial (maximum number of participants: 15)

**Attendance:**
- 2 hours/week
- 4 hours/week

**Workload:**
- 30 contact hours, 15 hours of independent study, 15 hours of guided study
- 60 contact hours, 30 hours of independent study, 30 hours of guided study

**Assessment methods and criteria:** Assignments, 2 written exams (90 min each)

**Recommended optional programme components:**
- Student can choose courses from the General Studies’ program

**Course content:**
- Analysis 3: integration techniques, numeric integration, multiple integrals, parameter curves, clothoid, differential equations
- Physics: kinematics, dynamics, conservative laws, rigid bodies, circular motion, electric and magnetic fields, electromagnetic induction, AC and DC circuits, oscillation and waves, wave optics, outlook into modern physics

**Learning outcomes:**
- After having successfully completed the course, the students should
  - be familiar with the methods of non-elementary analysis
  - be able to apply these methods to non-trivial mathematical and geodetic problems
- Physics:
  - be able to apply the basic principles of mechanics, electricity and optics
Work placements: n/a

Recommended reading:

Books:
- Analysis 3:

- Physics:
  - P. Dobrinski, G. Krakau, A. Vogel: *Physik für Ingenieure*; Springer Vieweg, 2010
  - D. Giancoli: *Physik*; Pearson Studium, 2010
  - H. Lindner: *Physik für Ingenieure*; Hanser, 2014

Internet / Multimedia:
Material can be found on the HsKA ILIAS server
**GN 2440  Instrumentation and Sensors**

<table>
<thead>
<tr>
<th>Lecturers:</th>
<th>Prof. Dr. Müller</th>
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<tbody>
<tr>
<td><strong>Type of course unit:</strong></td>
<td>Compulsory</td>
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<tr>
<td><strong>Level of course unit:</strong></td>
<td>First-cycle</td>
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<tr>
<td><strong>Year of study:</strong></td>
<td>First</td>
</tr>
<tr>
<td><strong>Semester when the course is delivered:</strong></td>
<td>Second / summer semester</td>
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<tr>
<td><strong>ECTS credits:</strong></td>
<td>6 cp</td>
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<tr>
<td><strong>Attendance:</strong></td>
<td>4 hours/week</td>
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<td>1 hour/week</td>
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<tr>
<td><strong>Workload:</strong></td>
<td>60 contact hours, 105 hours of independent study, 15 hours of guided study</td>
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<tr>
<td><strong>Prerequisites:</strong></td>
<td>Recommended: successful completion of modules GN 1410, GN 1430, GN 1440</td>
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<tr>
<td><strong>Language of instruction:</strong></td>
<td>German</td>
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<tr>
<td><strong>Teaching method/learning activities:</strong></td>
<td>Lecture</td>
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<td>Exercises (maximum number of participants: 4)</td>
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<tr>
<td><strong>Mode of delivery:</strong></td>
<td>Face-to-face</td>
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<tr>
<td><strong>Assessment methods and criteria:</strong></td>
<td>Assignments, written exam (90 min)</td>
</tr>
<tr>
<td><strong>Recommended optional programme components:</strong></td>
<td>Student can choose courses from the General Studies’ program</td>
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<tr>
<td><strong>Course content:</strong></td>
<td>• Principles of metrology. Physical components.</td>
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<td>• Principles of electronic distance and angle measurement, and of electronic tacheometry; components, influence of atmospheric parameters.</td>
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<td>• Automated leveling</td>
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<td>• Distance measurement using microwaves, radio navigation</td>
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<td>• Echosounding</td>
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<td>• Laser interferometry. EDM with elliptically polarized light. Laser scanning</td>
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<td>• Electronic measurement of smaller distance changes. Inclination sensors.</td>
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<td>• Inertial sensor technology</td>
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<td>• Practical exercises on using and calibrating electronic tacheometers. Written and oral reports</td>
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<tr>
<td><strong>Learning outcomes:</strong></td>
<td>After having successfully completed the course, the students should</td>
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<td>• be able to understand the principles of the most important measuring instruments, their physical foundation, and their electronic components,</td>
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<td>• be able to check and calibrate measuring instruments,</td>
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|                     | • be familiar with the measuring instruments and meth-
ods which are used in special cases,
- be able to present a short and precise oral and written report

**Work placements:**

n/a

**Recommended reading:**

Books:
GN 2450  Surveying 2

Lecturers: Prof. Dr. Schwäble

Type of course unit: Compulsory

Level of course unit: First-cycle

Year of study: First

Semester when the course is delivered: Second / summer semester

ECTS credits: 5 cp

Language of instruction: German

Attendance: 5 hours/week

Workload: 75 contact hours, 45 hours of independent study, 30 hours of guided study

Prerequisites: Recommended: successful completion of modules GN 1430, GN 1440. Theoretical and practical knowledge of function and use of the theodolite, elementary mathematical knowledge about coordinate systems

Teaching method/learning activities: Lecture, practical exercises

Mode of delivery: Face-to-face

Assessment methods and criteria: Assignments, written exam (120 min)

Recommended optional programme components: Student can choose courses from the General Studies’ program

Course content:
- Methods, standards and data processing in consideration of terrestrial horizontal positioning including error propagation. The focus is on polar observation, setting out, recovering, traversing, intersection, resection, point centring.
- Coordinate transformation (conformal, 5 parameters, affine)
- Variance propagation (scalar und vectorial), algebraic and physical correlation
- Practical application (planning, measurement, analysis) the most important methods for determining location points

Learning outcomes: After having successfully completed the course, the students should
- be able to plan, to evaluate and to interpret standard terrestrial positioning measurements
- have advanced knowledge in failure analysis and correction
- be able to determine location points

Work placements: n/a
Recommended reading:

GN 3410  Computer Graphics and Digital Image Processing

Lecturers: Prof. Dr. Klein  
Prof. Dr. Pfeiffer

Type of course unit: Compulsory

Level of course unit: First-cycle

Year of study: Second

Semester when the course is delivered: Third / winter semester

ECTS credits: 6 cp

Language of instruction: German

Courses: Computer Graphics  
Digital Image Processing

Attendance:  
4 hours/week  
3 hours/week

Workload:  
15 contact hours, 60 hours of independent study, 45 hours of guided study  
34 contact hours, 15 hours of independent study, 11 hours of guided study

Prerequisites:  
Recommended: basic knowledge how to operate and use a computer

Teaching method/learning activities:  
Lecture, exercises  
Lecture, lab project

Mode of delivery: Face-to-face

Assessment methods and criteria:  
Written exam (120 min)

Recommended optional programme components:  
Student can choose courses from the General Studies’ program

Course content:  
- Introduction to Computer Graphics: colour models, modelling and representation of two- and three-dimensional objects by means of vector and raster graphics or data formats, basics of representation of geographical objects, (transformations, generation of curves, filling areas, projection of space onto plane, determining visible edges and faces)
- Geometric data transfer between CAD systems, automated collection of graphical data, processing of data gained in geodetic measuring processes
- Use of AutoCAD: default settings, how to create a new drawing, drawing and editing commands for two- and three-dimensional objects, definition of user coordinate system, creation of blocks with attributes, adding external references, labeling, dimensioning, creating and printing layouts, hatching areas, generating perspective views
- Use of GEOgraf: default settings, setup and printing of orders, geodetic calculations (area division, building structure, coordinate transformation,…), reading in and output of coordinate files, automatic generation of graphics, georeferencing of digital maps, digitising, generation of a digital terrain model based on tachymetrically surveyed areas and derivation of derivatives
- Creating plans for surveying practice

**Digital Image Processing:**
- Basics of digital image processing: picture digitalisation, pictorial statistics, grayscale manipulation, digital filtering, geometric operations, segmentation and classification
- As a lab project, the students will use the remote sensing software Erdas Imagine to perform practical exercises with satellite imagery. This includes greyscale and colour manipulation, filtering, geometrical image transformation and multispectral classification

**Learning outcomes:**
After having successfully completed the course, the students should

**Computer Graphics:**
- be familiar with the information representation in computer graphics
- be able to use the CAD programs AutoCAD and GEOgraf for two- and three-dimensional design, labeling, dimensioning, creation and presentation of plans
- be able to carry out data exchange between CAD programs
- be able to carry out georeferencing of maps and data recording through on-screen digitization
- be familiar with how to derive derivatives (contour lines, quantity surveys, longitudinal and cross-sectional profiles) from digital elevation models

**Digital Image Processing:**
- be familiar with the theoretical and methodical basics of digital image processing
- be able to work with a professional image processing software tool in a remote sensing environment

**Work placements:**
- n/a

**Recommended reading:**
- *Programmdokumentation GEOgraf* (2014), HHK Datentechnik GmbH
Markt+Technik


Digital Image Processing:


Internet / Multimedia:

- [www.autodesk.com](http://www.autodesk.com)
- [www.hhk.de](http://www.hhk.de)
### GN 3420 Basics of Geographical Information Systems

**Lecturers:** Prof. Dr. Saler  
**Type of course unit:** Compulsory  
**Level of course unit:** First-cycle  
**Year of study:** Second  
**Semester when the course is delivered:** Third / winter semester  
**ECTS credits:** 6 cp  
**Language of instruction:** German  
**Courses:** Basics of Geographical Information Systems, Project Basics of Geographical Information Systems  
**Attendance:** 2 hours/week  
**Workload:** 30 contact hours, 50 hours of independent study  
**Prerequisites:** Recommended: successful completion of modules GN 1410, GN 2420  
**Teaching method/learning activities:** Lecture, Laboratory  
**Mode of delivery:** Face-to-face  
**Assessment methods and criteria:** Lab work, written Exam (90 min)  
**Recommended optional programme components:** Student can choose courses from the General Studies’ program  
**Course content:**  
- Basics of Geographical Information Systems: GIS concepts, GIS applications, overview on GIS hardware and software, data modelling, data acquisition and storage, basic functionalities, geospatial analysis, data quality and sources of errors, geodatabases  
- Project Basics of Geographical Information Systems: introductory exercises in ArcCatalog (1), ArcMap (2), editing (3), symbolizing (4), analyzing (5), layout (6)  
**Independent exercises:** site-balance (A), setup of a data model for topographic survey (B), site analysis (C)  
**Learning outcomes:** After having successfully completed the course, the students should  
- have an overview of the structure, content and applications of GIS,  
- have acquired basic knowledge in the conception, models, organization, basic functionalities and principles of spatial analysis.
Project Basics of Geographical Information Systems:
- be familiar with the basic functions of a GIS system (ArcGIS)
- be able to carry out small GIS projects independently

Work placements:
n/a

Recommended reading:

Books:
- GI Geoinformatik GmbH (ed.): ArcGIS 10 Handbuch für ArcView and ArcEditor, Heidelberg: Wichmann, 2011

Internet / Multimedia:
- www.gistutor.com/
- www.giswiki.org/wiki/Tutorials
- de.wikipedia.org/wiki/Geoinformationssystem
- www.esri.com
- www.esri.de/

eLearning platforms:
ELAN: http://elan.forst.unigoettingen.de/analyse/gisdaten.htm#ELITE@TUB:
www.zewk.tuberlin.de/vmenue/wissenschaftliche_weiterbildung/elearning/kursangebot/
ESRI: www.esri.de/schulung/kursangebot
FerGI: www.fergi-online.uniosnabrueck.de/
geoinformation.net: www.geoinformation.net
gimolus: www.gimolus.org/
<table>
<thead>
<tr>
<th><strong>Lecturers:</strong></th>
<th>Prof. Dr. Klein</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type of course unit:</strong></td>
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<tr>
<td><strong>Level of course unit:</strong></td>
<td>First-cycle</td>
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<tr>
<td><strong>Year of study:</strong></td>
<td>Second</td>
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<tr>
<td><strong>Semester when the course is delivered:</strong></td>
<td>Third / winter semester</td>
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<tr>
<td><strong>ECTS credits:</strong></td>
<td>5 cp</td>
</tr>
<tr>
<td><strong>Language of instruction:</strong></td>
<td>German</td>
</tr>
<tr>
<td><strong>Courses:</strong></td>
<td>Software Development</td>
</tr>
<tr>
<td></td>
<td>Software Development Project</td>
</tr>
<tr>
<td><strong>Attendance:</strong></td>
<td>4 hours/week self-study</td>
</tr>
<tr>
<td><strong>Workload:</strong></td>
<td>60 contact hours, 30 hours of independent study 60 hours of independent study</td>
</tr>
<tr>
<td><strong>Prerequisite:</strong></td>
<td>Recommended: successful completion of module GN 2420, basic knowledge of a programming language (C, C++, Java)</td>
</tr>
<tr>
<td><strong>Teaching method/learning activities:</strong></td>
<td>Lecture Project</td>
</tr>
<tr>
<td><strong>Mode of delivery:</strong></td>
<td>Face-to-face self-study</td>
</tr>
<tr>
<td><strong>Assessment methods and criteria:</strong></td>
<td>Assignment, written exam (120 min)</td>
</tr>
<tr>
<td><strong>Recommended optional programme components:</strong></td>
<td>Student can choose courses from the General Studies’ program</td>
</tr>
<tr>
<td><strong>Course content:</strong></td>
<td>Software Development: advanced programming techniques, functions, pre-processor directives, structures, object-oriented programming, classes, inheritance, overloaded operators, classes of the C++ standard library, templates, including libraries, exception handling</td>
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<tr>
<td></td>
<td>Software Development Project: Development of a class library for handling tasks related to linear algebra or to practical applications of geodesy</td>
</tr>
<tr>
<td><strong>Learning outcomes:</strong></td>
<td>After having successfully completed the course, the students should Software Development:</td>
</tr>
<tr>
<td></td>
<td>• have deepended the knowledge obtained in module GN 2420</td>
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<td></td>
<td>• be familiar with the concepts of object-oriented programming with C++</td>
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<td></td>
<td>• be able to develop advanced programs and to implement the programs in a C++ development environment</td>
</tr>
</tbody>
</table>
Software Development Project:
- be able to develop independently an advanced, object-oriented program
- be able to test the program with a self-provided numerical example
- be able to author a software documentation

Work placements: n/a

Recommended reading:
<table>
<thead>
<tr>
<th><strong>Lecturers:</strong></th>
<th>Prof. Dr. Schwäble</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type of course unit:</strong></td>
<td>Compulsory</td>
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<tr>
<td><strong>Level of course unit:</strong></td>
<td>First-cycle</td>
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<tr>
<td><strong>Year of study:</strong></td>
<td>Second</td>
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<tr>
<td><strong>Semester when the course is delivered:</strong></td>
<td>Third / winter semester</td>
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<td><strong>ECTS credits:</strong></td>
<td>6 cp</td>
</tr>
<tr>
<td><strong>Language of instruction:</strong></td>
<td>German</td>
</tr>
<tr>
<td><strong>Courses:</strong></td>
<td>Statistics, Adjustment</td>
</tr>
<tr>
<td><strong>Attendance:</strong></td>
<td>2 hours/week, 4 hours/week</td>
</tr>
<tr>
<td><strong>Workload:</strong></td>
<td>25 contact hours, 30 hours of independent study, 5 hours of guided study. 50 contact hours, 60 hours of independent study, 10 hours of guided study</td>
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<tr>
<td><strong>Prerequisites:</strong></td>
<td>Recommended: successful completion of modules GN 1410, GN 2410, knowledge of variance propagation, matrix calculation, linear algebra</td>
</tr>
<tr>
<td><strong>Teaching method/learning activities:</strong></td>
<td>Lecture, exercise</td>
</tr>
<tr>
<td><strong>Mode of delivery:</strong></td>
<td>Face-to-face</td>
</tr>
<tr>
<td><strong>Assessment methods and criteria:</strong></td>
<td>Assignments, written exam (120 min)</td>
</tr>
<tr>
<td><strong>Recommended optional programme components:</strong></td>
<td>Student can choose courses from the General Studies’ program</td>
</tr>
<tr>
<td><strong>Learning outcomes:</strong></td>
<td>After having successfully completed the course, the students should be able to deal with the most important test distributions; be able to define task-specific confidence regions, be able to formulate statistical tests and interpret their results.</td>
</tr>
</tbody>
</table>
Adjustment:
- know how to handle redundant observation problems and code them using a computer algebra system,
- be familiar with the geodetic standard software to be able to perform adjustment computations

Work placements: n/a

Recommended reading:
**GN 3450  Geodesy 1**

| Lecturers:          | Prof. Dr. Jäger  
<table>
<thead>
<tr>
<th></th>
<th>Prof. Dr. Klein</th>
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</thead>
<tbody>
<tr>
<td>Type of course unit:</td>
<td>Compulsory</td>
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<tr>
<td>Level of course unit:</td>
<td>First-cycle</td>
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<tr>
<td>Year of study:</td>
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<tr>
<td>Semester when the course is delivered:</td>
<td>Third / winter semester</td>
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<tr>
<td>ECTS credits:</td>
<td>7 cp</td>
</tr>
</tbody>
</table>
| Attendance:         | 3+2 hours/week  
|                    | 1 hour/week self-study |
| Workload:           | 45 contact hours, 75 hours of independent study, 30 hours of guided study  
|                    | 15 contact hours, 10 hours of independent study, 5 hours of guided study  
|                    | 30 hours of independent study |
| Prerequisites:      | Recommended: successful completion of modules GN 1430, GN 2450 |
| Language of instruction: | German |
| Courses:            | Geodesy 1  
|                    | Topography |
|                    | Project |
| Teaching method/learning activities: | Lecture, practical exercises  
|                    | Lecture |
|                    | Project |
| Mode of delivery:   | Face-to-face  
|                    | Self-study |
| Assessment methods and criteria: | Assignments, written exam (120 min) |
| Recommended optional programme components: | Student can choose courses from the General Studies' program |
| Course content:     | Geodesy 1: Height systems (potential theoretical definition and realization; historic and modern vertical datum, leveling and gravity, geopotential height; height types and height reference surfaces; historic development of the main German height system; status and trends of official height systems; transition to normal heights EUREF)  
|                    | geometric leveling (basic principle for smaller areas; reductions for larger areas; leveling equipment; classes of accuracy; evaluation of leveling data; random and systematic errors during leveling, fine leveling and in height systems; measuring methods).  
|                    | Trigonometric height determination (trigonometric |
height transfer over large distances; height transfer over short distances; earth curvature reduction; refractive correction; atmospheric reduction of slope distances; reduction of zenith distances due to deflections of the vertical; decentering of zenith distances at different instrument heights; instrument errors, random and systematic errors; simultaneous, mutual zenith distances; conventional tower height determination.

Special methods for determining heights (potential-based height determination using clocks; hydrostatic leveling and water level gauge; barometric height determination). Site survey for height and quantity survey (surface leveling; longitudinal and cross-section survey; calculation of volume).

GNSS-based height determination (GNSS measuring methods and accuracies; forms of representation of height reference surfaces; practice of GNSS-based height determination).

Basics of evaluation and adjustment of free and connected networks of height benchmarks.

Lectures with exercises followed by group exercises.

Topics: loop leveling and line leveling, trigonometric height determination, simultaneous mutual zenith determination, surface leveling with longitudinal and cross-sectional survey, volume calculations, GNSS-based height determination.

Basics of evaluation and adjustment of free and connected networks of height benchmarks.

Lectures with exercises followed by group exercises.

Topics: loop leveling and line leveling, trigonometric height determination, simultaneous mutual zenith determination, surface leveling with longitudinal and cross-sectional survey, volume calculations, GNSS-based height determination.

Topography: classic geodetic measuring for the design of topographic maps, basics of creating digital terrain models and their options, geomorphological aspects for data acquisition.

Project: Planning, measuring and evaluating a fine leveling network. Evaluation using standard adjustment software with a free and a connected network of height benchmarks, as individual group networks and as an overall network of all groups.

Learning outcomes:

After having successfully completed the course, the students should

Geodesy 1:
- be familiar with the definition of height systems and their realization as networks of height benchmarks through leveling and gravity measurements.
- be familiar with different methods of terrestrial height determination, special methods and basics of GNSS-based height determination.
- be familiar with basics of method-specific random and systematic errors and the adjustment of free and connected networks of height benchmarks.
- be able to perform and evaluate statistical analysis of different terrestrial height measurement methods, GNSS-based height determination and standard methods of volume measurement.

Topography:
- know how to plan a topographical project.

Project:
- be able to plan, carry out as well as analyze and statistically evaluate a precise network of height benchmarks using standard adjustment software.

Work placements: n/a
**Recommended reading:**

**Geodesy 1:**
- W. Großmann (1976): Vermessungskunde. Band 1,2,3
- M. Becker and K. Hehl (2012): Geodäsie. WBG Verlag, Darmstadt

**Internet/Multimedia:**
- www.lv-bw.de/lvshop2/produktinfo/wir-ueber-uns/links/vortraege/DVW_Artikel_Normalhoehen_in_BW.pdf
- www.fig.net
- www.euref.eu
- www.dfhbf.de

**Topography:**

**Project:**
BSc Modules, Course of Studies Geodesy and Navigation

GN 4410 Geodesy 2

Lecturers: Prof. Dr. Müller
            Prof. Dr. Schwäble

Type of course unit: Compulsory

Level of course unit: First-cycle

Year of study: Second

Semester when the course is delivered: Fourth / summer semester

ECTS credits: 6 cp

Attendance: 4 hours/week
            2 hours/week

Workload: 50 contact hours, 60 hours of independent study, 10 hours of guided study
            20 contact hours, 30 hours of independent study, 10 hours of guided study

Prerequisites: Recommended: successful completion of modules GN 2440, GN 2450, GN 3450, GN 3440

Language of instruction: German

Courses:
- Engineering Geodesy Basics
- Project Management in Engineering Geodesy

Teaching method/learning activities:
- Lecture
- Lecture and practical exercise

Assessment methods and criteria:
- Assignments, written exam (120 min)

Recommended optional programme components:
- Student can choose courses from the General Studies’ program

Course content:
- Engineering Geodesy Basics:
  Essential aspects, methods, procedures and standards of construction surveying: Side and height refraction, precise mechanical length measurement, hydrostatic levelling, auto-collimation, gyroscope techniques, optical and mechanical plumbing, optical and mechanical alignment, precise multi-station theodolite measuring, guidance and control in the field of tunnelling; deformation measurement and deformation analysis, special surveys.

- Project Management in Engineering Geodesy:
  Introduction to project management: project organization, scheduling, budget planning, essential work steps, coordination of work groups.
  Basics of geodetic network determination. Planning and execution of a project for geodetic network determination.

Learning outcomes: After having successfully completed the course, the students should
Engineering Geodesy Basics:
- be familiar with the most relevant methods and procedures applied in engineering geodesy

Project Management in Engineering Geodesy
- know the basics of project management for application in the field of engineering geodesy

Work placements: n/a

Recommended reading: Engineering Geodesy Basics

Project Management in Engineering Geodesy
**GN 4420 Industrial Measurement Technology**

**Lecturers:** Prof. Dr. Schwäble

**Type of course unit:** Compulsory

**Level of course unit:** First-cycle

**Year of study:** Second

**Semester when the course is delivered:** Fourth / summer semester

**ECTS credits:** 5 cp

**Attendance:** 2 hours/week

**Workload:** 2 hours/week

**Prerequisites:** Recommended: successful completion of module GN 2440

**Language of instruction:** German

**Courses:**
- Industrial Measurement Technology
- Quality Management

**Teaching method/learning activities:**
- Lecture
- Lecture

**Mode of delivery:** Face-to-face

**Assessment methods and criteria:**
- Written exam (120 min)

**Recommended optional programme components:**
- Student can choose courses from the General Studies' program

**Course content:**
- Industrial Measurement Technology: Essential methods and standards of industrial measurement technology: development, material measuring, measure uncertainty, tolerance criteria, test planning, test data acquisition and evaluation.
- Quality Management: Introduction to modern quality management: history, significance, concept, quality assurance, tools and procedures, strategy, quality manual, QM elements, quality audit, certification.

**Learning outcomes:**
- After having successfully completed the course, the students should
  - know the fundamentals and procedures applied in industrial measurement technology
  - be able to develop strategies for measuring according to requirements and industrial standard

- Quality Management:
  - be able to evaluate processes according to quality
management or standard requirements

Work placements: n/a

Recommended reading:
GN 4430 Photogrammetry and Remote Sensing

Lecturers: Prof. Dr. Pfeiffer  
            Prof. Dr. Müller  
            Prof. Dr. Klein

Type of course unit: Compulsory

Level of course unit: First-cycle

Year of study: Second

Semester when the course is delivered: Fourth / summer semester

ECTS credits: 10 cp

Attendance:
3 hours/week
2 hours/week
1 hour/week
2 hours/week

Workload:
45 contact hours, 45 hours of independent study
30 contact hours, 60 hours of independent study
10 contact hours, 15 hours of independent study, 5 hours of guided study
10 contact hours, 60 hours of independent study, 20 hours of guided study

Prerequisites:
Recommended: successful completion of modules GN 1430, GN 2450, GN 3410, GN 2440

Language of instruction: German

Courses:
Photogrammetry  
Remote Sensing  
Laserscanning  
Topographic Project

Teaching method/learning activities:
Lecture  
Lecture  
Lecture, project  
Exercises (maximum number of participants: 4)

Mode of delivery: Face-to-face

Assessment methods and criteria: Assignment, written exam (120 min)

Recommended optional programme components: Student can choose courses from the General Studies’ program

Course content:
Photogrammetry: Basics of photogrammetry, instruments and procedures related to taking and evaluating pictures. Mathematical basics, optical photographic image, stereoscopic procedures, terrestrial image recording and aerial image recording, image orientation, stereo analysis, orthophoto, introduction to aerotriangulation, image correlation.

Remote Sensing: Physical basics of remote sensing (e.g.
electromagnetic spectrum, energy sources, laws of radiation, interactions of radiation with the atmosphere and Earth’s surface; satellite image sensors (e.g. Multispectral Scanner, radar systems)

Laser Scanning: Introduction to the basics of terrestrial and airborne laser scanning, sensors and the evaluation methods. During a practical course, measurements are performed with a terrestrial 3D laser scanner and evaluated.

Topographic Project: A practical project is planned, measured and evaluated with the help of modern instruments and software

**Learning outcomes:**

After having successfully completed the course, the students should

Photogrammetry:
- are familiar with the basic principles of photogrammetry
- know how to gather and evaluate basic geospatial information
- are familiar with the vielfältigen praktischen Einsatzmöglichkeiten der Photogrammetrie zur Geodatenerfassung

Remote Sensing:
- know the physical basics of remote sensing
- be familiar with the use of different sensors for satellite imagery

Laser Scanning:
- know the methods of laser scanning
- be able to consider areas of application
- have obtained experience with the measurement method

Topographic Project:
- able to plan and perform a topographic project

**Work placements:**

n/a

**Recommended reading:**

Books:

Internet / Multimedia:
- http://www.i4.auc.dk/jh/cal.htm
GN 4440  Mathematical Geodesy

**Lecturers:** Prof. Dr. Jäger

**Type of course unit:** Compulsory

**Level of course unit:** First-cycle

**Year of study:** Second

**Semester when the course is delivered:** Fourth / summer semester

**ECTS credits:** 5 cp

**Attendance:** 2 hours/week
1 hour/week

**Workload:** 45 contact hours, 85 hours of independent study, 20 hours of guided study

**Prerequisites:** none

**Language of instruction:** German

**Teaching method/learning activities:**
- Lecture
- Exercises with project

**Mode of delivery:** Face-to-face

**Assessment methods and criteria:** Assignment, written exam (90 min)

**Recommended optional programme components:** Student can choose courses from the General Studies' program

Learning outcomes:

- know about the geometrical and gravitation field based definition and realisation of classical and geodetic modern reference systems for plan, height and gravity. They can calculate, by different types and algorithms, cartesian and curved-lined coordinate systems, georeferencing and navigation, and know the geodetic major tasks.
- be familiar with mathematical models and algorithms for the date transition in three dimensions and in a separation between the height and plan components.
- be able to work with different kinds of map projections, projection distortions and reductions.
- know about the reduction of geodetic measurements in the geometry and gravity space.
- be able to develop complex algorithms and professional software in the field of mathematical geodesy.
- be able to implement them in an adequate and professional manner in a C++ or C# Windows development environment.

Work placements:

n/a

Recommended reading:


Internet / Multimedia

- [http://www.euref.eu/](http://www.euref.eu/)
GN 4450  Satellite Geodesy

Lecturers: Prof. Dr. Jäger

Type of course unit: Compulsory

Level of course unit: First-cycle

Year of study: Second

Semester when the course is delivered: Fourth / summer semester

ECTS credits: 5 cp

Language of instruction: German

Attendance: 2 hours/week
1 hour/week

Workload: 30 contact hours, 105 hours of independent study, 15 hours of guided study

Prerequisites: None

Teaching method/learning activities: Lecture
Lecture with project

Mode of delivery: Face-to-face

Assessment methods and criteria: Assignment, written exam (90 min)

Recommended optional programme components: Student can choose courses from the General Studies’ program

Course content: Methods of satellite geodesy and satellite systems. Satellite orbit equations, undisturbed and disturbed orbit. Orbit representations and accuracy. Reference frames and transitions from the space-fixed to the earth-fixed frame. Parameterizations in Earth-fixed coordinate system, ITRS and ITRF. Satellite navigation message contents and representations. Satellite ground track and visibility. System design of modern GNSS systems (GPS / GLONASS / GALILEO) in the space, control and user segment. IGS, IGS products IGS-RTS. GNSS signal types and observation equations. Troposphere and ionosphere influence and modelling. Linear combinations and ambiguity solution strategies. GNSS positioning with code and phase observations in post-processing and real-time mode. Doppler count and cycle slips. GNSS processing modes and accuracy standards. GNSS raw data, correction data and communication standards (RTCM, RTCA, RINEX, SINEX). GNSS positioning services (SAPOS, VRSNow etc.), methods (VRS, FKP) and protocols (NTRIP). GNSS processing standards and software. Quality control, further processing and integration of GNSS results into geodetic plans and height networks. Field measurements of rapid-static GNSS sessions for the determination of precise new points in plan and height. Further processing GNSS data in the
baseline mode by using various standard softwares. Quality control of GNSS evaluation and integration of into geometric plans and height networks. RTK field measurements using RTCM corrections of type. Post processing and online transformations of GNSS position into the terrestrial plan and height network.

Learning outcomes:

After having successfully completed the course, the students should

- know the theoretical concepts, realisation and use of modern GNSS for general positioning and navigation tasks, and for a precise geodetic coordinate determination in post-processing and in online mode.
- understand about the relevant GNSS data and communication types,
- be acquainted with the observation equations, atmospheric modelling and algorithms for GNSS data processing in real-time and post-processing positioning, and with models for further processing and integrating GNSS processing results into geodetic networks.

Work placements

n/a

Recommended reading:

Books:


Internet / Multimedia:

- [www.sapos.de](http://www.sapos.de)
- [http://rts.igs.org/](http://rts.igs.org/)
## GNB 500 Internship Semester

<table>
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<tr>
<th>Lecturers:</th>
<th>Prof. Dr. Pfeiffer</th>
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<tbody>
<tr>
<td>Type of course unit:</td>
<td>Compulsory</td>
</tr>
<tr>
<td>Level of course unit:</td>
<td>First-cycle</td>
</tr>
<tr>
<td>Year of study:</td>
<td>Second</td>
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<tr>
<td>Semester when the course is delivered:</td>
<td>Fifth / winter semester</td>
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<td>ECTS credits:</td>
<td>30 cp</td>
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<tr>
<td>Attendance:</td>
<td>1 hour/week</td>
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<td>Workload:</td>
<td>1 hour/week</td>
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<tr>
<td>90 hours of guided study</td>
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<tr>
<td>720 hours of self-contained work</td>
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<tr>
<td>90 hours of guided study</td>
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<tr>
<td>Prerequisites:</td>
<td>Successful completion of preliminary examination</td>
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<td>Language of instruction:</td>
<td>German</td>
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<tr>
<td>Courses:</td>
<td>Internship Preparation</td>
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<td>Internship</td>
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<td>Internship Follow-up</td>
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<td>Teaching method/learning activities:</td>
<td>Lecture</td>
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<td>Internship</td>
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<td></td>
<td>Presentation</td>
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<tr>
<td>Mode of delivery:</td>
<td>Face-to-face</td>
</tr>
<tr>
<td>Assessment methods and criteria:</td>
<td>Assignments, project</td>
</tr>
<tr>
<td>Recommended optional programme components:</td>
<td>Student can choose courses from the General Studies’ program</td>
</tr>
<tr>
<td>Course content:</td>
<td>Internship Preparation: One-week seminar to teach varied soft skills (e.g. project work, working in a team, presentation techniques, oration)</td>
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<tr>
<td></td>
<td>Internship: Self-dependent activity outside of the university in the field of geomatics. Contents are the preparation and realisation of measurements and the processing, visualisation and interpretation of geodetical information.</td>
</tr>
<tr>
<td></td>
<td>Internship Follow-up: The student writes an internship report, prepares and carries out the presentation, within one week.</td>
</tr>
<tr>
<td>Learning outcomes:</td>
<td>After having successfully completed the course, the students should</td>
</tr>
<tr>
<td></td>
<td>Internship Preparation: be able to assess their skills, be able to carry out practical work successfully</td>
</tr>
<tr>
<td><strong>Internship:</strong></td>
<td>be able to apply their theoretical knowledge in a professional environment</td>
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<tr>
<td><strong>Internship Follow-up:</strong></td>
<td>be able to present results in written and spoken form to a specialized audience as well as share information with other students</td>
</tr>
</tbody>
</table>

**Work placements:**

n/a

**Recommended reading:**

Will be communicated by lecturer during Internship Preparation
GN 6410  Cadastre and Land Division

Lecturers:  Prof. Dr. Saler  Mr. Rayling  Mr. Wiese

Type of course unit:  Compulsory

Level of course unit:  First-cycle

Year of study:  Third

Semester when the course is delivered:  Sixth / summer semester

ECTS credits:  6 cp

Language of instruction:  German

Courses:
- Cadastre
- Land Division

Attendance:
- 3 hours/week
- 2 hours/week

Workload:
- 45 contact hours, 75 hours of independent study
- 30 contact hours, 30 hours of independent study

Prerequisites:
- None

Teaching method/learning activities:
- Lecture
- Lecture

Mode of delivery:
- Face-to-face

Assessment methods and criteria:
- Written exam (90 min)
- Written exam (60 min)

Recommended optional programme components:
- Student can choose courses from the General Studies’ program

Course content:
- Cadastre:
  - Historic development of cadastre from the 19th century until present
  - The task of cadastre administration in Germany and its organisation
  - Legal foundations
  - Cadastre documents (ALKIS, AFIS)
  - Data transfer between cadaster administration and land register office
  - Point positioning methods for cadastre points
  - Recent developments in the field of cadastre

- Land Division: Requirements for carrying out land consolidation procedures as well as knowledge of processes and legal issues is imparted. Special focus is on the following content:
  - involvement of land owners in procedure,
  - appraisal as basis of an equivalent compensation as well as
Learning outcomes:

After having successfully completed the course, the students should

Cadastre:
1. understand the relations between cadastre documents,
2. be able to collect information from cadastre documents for preparing surveying in the field of cadastre,
3. understand the basics in cadastre surveying and cadastre updating.

Land Division:
1. know of land consolidation procedure as an instrument for solving problems in rural areas,
2. in addition to traditional tasks of improvement of production and working conditions, become particularly familiar with land preparation for larger enterprises (e.g. roads, train tracks, artificial lakes)
3. be capable of solving conflicts of use (farming, environmental protection, leisure and recreational use, communal goals and tasks)

Work placements:

n/a

Recommended reading:

Cadastre:
1. Lecture notes
2. Rules and regulations of Vermessungsverwaltung BaWü (VwVFP, VwVLK, VwVLV) (cadaster administration)
3. Vermessungsgesetz (Cadaster Law) von Baden-Württemberg

Land Division:
1. Flurbereinigungsgesetz i.d.F. vom 16.03.1976, BGBl I, p. 546

Internet / Multimedia:
1. www.lgl-bw.de
GN 6420 Photogrammetry and Infrastructure Information Systems

Lecturers: Prof. Dr. Pfeiffer
Prof. Dr. Saler

Type of course unit: Compulsory

Level of course unit: First-cycle

Year of study: Third

Semester when the course is delivered: Sixth / summer semester

ECTS credits: 5 cp

Language of instruction: German

Courses:
- Infrastructure Information Systems
- Photogrammetry Practical

Attendance:
- 2 hours/week
- 2 hours/week

Workload:
- 25 contact hours, 60 hours of independent study, 5 hours of guided study
- 30 contact hours, 30 hours of independent study

Prerequisites:
- Recommended: experience with CAD, successful completion of modules GN 3420, GN 4430

Teaching method/learning activities:
- Lecture
- Exercises

Mode of delivery:
- Face-to-face

Assessment methods and criteria:
- Assignment, written exam (90 min)
- Lab project, written exam (90 min)

Recommended optional programme components:
- Student can choose courses from the General Studies’ program

Course content:
- Infrastructure Information Systems: Basics of and geobasis data for small-scale spatial information systems, pipe information systems with a focus on sewer information systems. Introduction into Facility Management and Computer Aided Facility Management (CAFM). As an assignment, parts of a building are surveyed and the results are compared with existing planning data.
- Photogrammetry Practical: Based on the lecture Photogrammetry, the following special aspects of surveying are dealt with, by means of practical exercises with special digital imagery analysis software (Erdas Imagine and PhotoModeler): bundle block adjustment, digital stereoscopic procedures, automatic image coordination measurements, terrestreal metric image taking, and photogrammetric 3D-modeling of spatial objects.

Learning outcomes:
After having successfully completed the course, the students should
Infrastructure Information Systems:
- understand the basics of pipe and building information systems
- be able to plan and realize data models and survey data for CAFM

Photogrammetry Practical:
- be able to do practical work in the photogrammetric workflow
- be familiar with terrestrial metric image taking as well as standard analysis of aerial photos and their different measurement accuracies.

Work placements:
- n/a

Recommended reading:

Books:
- Infrastructure Information Systems:

Photogrammetry Practical:

Internet / Multimedia:
- http://www.buildingsmart.de
- http://www.gefma.de/
- www.wvgw.de
GN 6430  Geographical Information Systems

Lecturers:  
Prof. Dr. Schaab  
Prof. Dr. Vetter

Type of course unit:  
Compulsory for specialization in Geodesy

Level of course unit:  
First-cycle

Year of study:  
Third

Semester when the course is delivered:  
Sixth / summer semester

ECTS credits:  
7 cp

Language of instruction:  
German

Courses:  
Geographical Information Systems  
GIS Practical  
Mobile GIS

Attendance:  
2 hours/week  
2 hours/week self-study

Workload:  
30 contact hours, 30 hours of independent study  
75 hours of independent study, 45 hours of guided study  
20 hours of independent study, 10 hours of guided study

Prerequisite:  
Recommended: successful completion of modules GN 3420, GN 2420

Teaching method/learning activities:  
Lecture, excursion  
Lab work  
Project

Mode of delivery:  
Face-to-face

Assessment methods and criteria:  
Assignments, lab work, written exam (90 min)

Recommended optional programme components:  
Student can choose courses from the General Studies’ program

Course content:  
Geographical Information Systems: Advanced spatial analysis: digital terrain models (interpolation, triangulation), cartographic modelling / map algebra (drainage operations, accumulation of costs), network analysis (shortest way, best location, round trip problem), GIS programming options, metadata and data exchange, Internet GIS (strategies, techniques, main fields of application), including reference to ESRI software

GIS Practical: Advanced exercises in:  
- Digital Terrain Models,  
- Hydrological Modelling, (3D Analyst, Spatial Analyst)  
- Routing (Network Analyst),  
- Cost Surfaces (Spatial Analyst, Model Builder),  
- ArcGIS for Server
ESRI is used.

Mobile GIS: Development and design of mobile GIS interface (data model, data presentation). An interface for quick entry of technical data, using previously defined key lists (additionally programmed). Entry of topography data, using the configured mobile GIS.

**Learning outcomes:**

Geographical Information Systems:
- have an advanced knowledge of GIS,
- know different possibilities for an advanced analysis,
- be qualified to solve complex spatial problems by using GIS technology

GIS Practical:
- be able perform advanced GIS projects,
- be able to apply their theoretical knowledge to practical work

Mobile GIS:
- understand the correlation between data modeling, symbolization and GIS data entry

**Work placements:**

n/a

**Recommended reading:**

Books:
- Zeiler, M.: *Modeling our world – The ESRI guide to
geodatabase concepts. 2nd ed., Redlands (CA) 2010

Journals:
- gis.BUSINESS – Das Magazin für Geoinformation
- gis.SCIENCE – Die Zeitschrift für Geoinformatik
- International Journal of Geographical Information Science (IJGIS)

Internet / Multimedia:
- http://www.esri.com/what-is-gis
- http://training.esri.com/gateway/index.cfm (ESRI Virtual Campus)
- http://www.gsdi.org/
# GN 6440 Engineering Geodesy

| Lecturers:       | Prof. Dr. Jäger  
                    | Prof. Dr. Müller |
|------------------|------------------|
| Type of course unit: | Compulsory for specialization in Geodesy |
| Level of course unit: | First-cycle |
| Year of study:   | Third |
| Semester when the course is delivered: | Sixth / summer semester |
| ECTS credits:    | 6 cp |
| Language of instruction: | German |
| Courses:         | Route planning  
                    | Geodetic Networks |
| Attendance:      | 3 hours/week  
                    | 2 hours/week |
| Workload:        | 45 contact hours, 55 hours of independent study, 20 hours of guided study  
                    | 10 contact hours, 10 hours of independent study, 40 hours of guided study |
| Prerequisites:   | Recommended: successful completion of modules GN 3450, GN 4410, GN 3440, GN 4440, GN 4450 |
| Teaching method/learning activities: | Lecture and exercise (no more than 5 participants)  
                    | Lecture and exercise (no more than 5 participants) |
| Mode of delivery: | Face-to-face |
| Assessment methods and criteria: | Assignment, written exam (90 min) |
| Recommended optional programme components: | Student can choose courses from the General Studies’ program |

### Course content:
- **Route planning**: Route selection by using straight lines, circular arcs and transition curves. Computation and design of methods for circular arcs, compound curves, clothoid, compound transition curves, ovals and inflectional curves. Application of route planning elements in road construction. Individual computation of a compound curve and a compound transition curve. Route planning using a route planning program and stakeout of the route on site.
- **Geodetic Networks**: Mathematical models of combined adjustment of GNSS and terrestrial survey measurements in geometry and gravity. Integrated and virtually integrated 3D modeling as well as 2D/1D adjustment approaches and correlations. Static evaluation of net adjustments. Exemplary calculations with software.
packages NETZ3D and NETZCG. Planning of a free engineering network under the aspect of economic efficiency and according to a set of accuracy and reliability measurements. Terrestrial and GNSS-based observation and complete evaluation and adjustment of a free and stochastically connected, combined engineering network (GNSS evaluations. 3D individual and combined adjustments. Transition of GNSS and terrestrial measurements to 2D/1D). Analysis and comparison of the results.

Learning outcomes:

After having successfully completed the course, the students should

Route planning:
- know the methods for computing and designing routes,
- be able to apply their theoretical knowledge to practical work
- be able to work in a team
- be able to calculate surveying costs.

Geodetic Networks:
- be able to plan, measure, analyse, adjust and statistically evaluate combined GNSS and terrestrial engineering networks by means of integrated/virtually integrated 3D modeling and 2D/1D adjustment concept.

Work placements:

n/a

Recommended reading:

Trassierung:

Geodätische Netze:
Books:

Internet / Multimedia
- http://derletztekick.com/software/netzausgleichung
- http://geozilla.de/software.heidiwin.php
- http://www.gik.kit.edu/softwareentwicklung.php
<table>
<thead>
<tr>
<th>GN 6450</th>
<th>Positioning and Navigation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lecturers:</strong></td>
<td>Prof. Dr. Klein</td>
</tr>
<tr>
<td><strong>Type of course unit:</strong></td>
<td>Compulsory for specialization in Navigation</td>
</tr>
<tr>
<td><strong>Level of course unit:</strong></td>
<td>First-cycle</td>
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<tr>
<td><strong>Year of study:</strong></td>
<td>Third</td>
</tr>
<tr>
<td><strong>Semester when the course is delivered:</strong></td>
<td>Sixth / summer semester</td>
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<tr>
<td><strong>ECTS credits:</strong></td>
<td>6 cp</td>
</tr>
<tr>
<td><strong>Language of instruction:</strong></td>
<td>German</td>
</tr>
<tr>
<td><strong>Courses:</strong></td>
<td>Basics of Positioning and Navigation</td>
</tr>
<tr>
<td></td>
<td>Integrated Navigation</td>
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<tr>
<td><strong>Attendance:</strong></td>
<td>3 hours/week</td>
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<td></td>
<td>2 hours/week</td>
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<tr>
<td><strong>Workload:</strong></td>
<td>35 contact hours, 55 hours of independent study, 10 hours of guided study</td>
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<tr>
<td></td>
<td>20 contact hours, 50 hours of independent study, 10 hours of guided study</td>
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<tr>
<td><strong>Prerequisites:</strong></td>
<td>Recommended: basic geodetic knowledge</td>
</tr>
<tr>
<td><strong>Teaching method/learning activities:</strong></td>
<td>Lecture, practical exercises</td>
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<td></td>
<td>Lecture, practical exercises</td>
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<tr>
<td><strong>Mode of delivery:</strong></td>
<td>Face-to-face</td>
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<tr>
<td><strong>Assessment methods and criteria:</strong></td>
<td>Written exam (120 min)</td>
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<tr>
<td><strong>Recommended optional programme components:</strong></td>
<td>Student can choose courses from the General Studies’ program</td>
</tr>
</tbody>
</table>
Learning outcomes: After having successfully completed the course, the students should

Basics of Positioning and Navigation:
- be familiar with the objectives and terminology
- know about reference systems of navigation
- be able to apply methods, procedures and sensors for conventional terrestrial and celestial navigation

Integrierte Navigation:
- know about satellite navigation procedures
- know about modeling, purpose and properties of multi-sensor systems for integrated navigation
- be able to develop adjusted approaches and systems for vehicle and air navigation

Work placements: n/a

Recommended reading:
Basics of Positioning and Navigation

Integrierte Navigation:
GN 6460 Navigation Algorithms

Lecturers: Prof. Dr. Jäger

Type of course unit: Compulsory for specialization in Navigation

Level of course unit: First-cycle

Year of study: Third

Semester when the course is delivered: Sixth / summer semester

ECTS credits: 6 cp

Language of instruction: German

Prerequisites: Recommended: successful completion of modules GN 4440, GN 4450, GN 3440, GN 6450. Knowledge of physics and advanced mathematical methods, geodetic surveying, digital image processing.

Course: Basics of Navigation Algorithms
Mathematical models of sensor fusion

Attendance: 2 hours/week
3 hours/week

Workload: 25 contact hours, 35 hours of independent study, 5 hours of guided study
35 contact hours, 70 hours of independent study, 10 hours of guided study

Teaching method/learning activities: Lecture
Lecture, project

Mode of delivery: Face-to-face

Assessment methods and criteria: Assignment, written exam (120 min)

Recommended optional programme components: Student can choose courses from the General Studies’ program

Course content: Basics of Navigation Algorithms: Navigation status vector and navigation reference systems (i-frame, e-frame, n-frame, p-frame, s-frame). Mathematical basics of navigation algorithms. Sensor observation equations for inertial sensor components (accelerometers, gyroscopes in i-, e- and n-frame) and principle of dead reckoning. Status description of general navigation status vector. Sensor calibration parameters. Terrestrial magnetic field and observation equations for magnetometer sensors. Earth gravity field and observation equations for inclinometers. GNSS for train control systems (GPS, GLONASS, GALILEO) and algorithms for i- and e-frame. GNSS signals and observation equations for absolute and relative GNSS. Problems of object georeferencing. Positioning and orientation with GNSS. General forecast model. Loose, tight and deep coupling and navigation algorithms. Integration of forecast and sensor observation...
equations as Kalman filtering. Setup and data structures of multisensor-multiplatform design according to general, so-called lever arm description. Overview of MEMS sensors and interfaces.

Mathematical models of sensor fusion: dealing with special cases of status descriptions (automotive mode, integration of dynamic status recognition, integration of status conditions and additional info). Indoor navigation based on map matching. Orientation determination and reduced navigation status vector. Algorithmic integration of autonomous, inertial sensor observations (accelerometers, gyroscopes) as well as Earth gravity field and Earth rotation model. Algorithmic integration of magnetometer sensors and terrestrial magnetic field. Integration of camera coordinate observations. Integration of barometer observations. Algorithmic fusion of additional autonomous sensors (inclinometers, odometers). Description and assessment of offsets and drifts with MEMS sensors. Algorithmic concepts for assessment of initial status (default, initial alignment, assessments "on the fly"). Status modeling and observation equations for non-autonomous infrastructure sensors.

Learning outcomes:
After having successfully completed the course, the students should
Basics of Navigation Algorithms:
• have the knowledge and skills to model raw data observations of GNSS and MEMS sensors with reference to geometry, inertia, gravity and terrestrial magnetic field in all navigation-relevant reference frames.
• be familiar with sensor fusion for any type of platform and algorithmic concepts of precise observation equations

Mathematische Modelle der Sensorfusion:
• based on observation equations for GNSS- and MEMS sensor raw data, special cases of status description and the integration of additional info, be able to design multi-sensor navigation platforms and devise the corresponding mathematical models algorithms for sensor fusion.
• be familiar with different algorithms and status assessments for the navigation status vector

Work placements:
n/a

Recommended reading:
Books:

Internet / Multimedia:
• www.navka.de
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Geomatics Elective</th>
</tr>
</thead>
</table>

**Lecturers:** Prof. Dr. Saler  
**Type of course unit:** Compulsory; student must choose elective/s from a list to be published  
**Level of course unit:** First-cycle  
**Year of study:** Third  
**Semester when the course is delivered:** Sixth / summer semester  
**ECTS credits:** 6 cp  
**Language of instruction:** German  
**Prerequisites:** None, unless informed otherwise  
**Course:** Geomatics elective, as published  
Geodetic Seminar  
**Attendance:**  
**Workload:** 3 hours/week  
30 contact hours, 30 hours of independent study  
**Teaching method/learning activities:** Depending on elective  
**Mode of delivery:** Face-to-face  
**Assessment methods and criteria:** Depending on elective  
Presentation (20 min)  
**Recommended optional programme components:** Student can choose courses from the General Studies’ program  
**Course content:** Geomatics Elective: Depending on elective  
Geodetic Seminar: 20 minute presentation by student about a geodesy-related subject in a special field which is not part of the curriculum.  
**Learning outcomes:** After having successfully completed the course, the students should  
Geomatics Elective:  
- have advanced knowledge about particular fields in Geomatics  
Geodetic Seminar:  
- be able to ability to prepare a special question by means of technical literature  
- present the findings to an expert audience  
- be able to use modern presentation techniques  
- be able to lead a discussion about the findings  
**Work placements:** n/a  
**Recommended reading:** Will be communicated
GN 7410  **Spatial Planning and Law**

**Lecturers:**
- Prof. Dr. Saler
- Prof. Dr. Eggert
- Ms. Möwes
- Mr. Harms

**Type of course unit:** Compulsory

**Level of course unit:** First-cycle

**Year of study:** Fourth

**Semester when the course is delivered:** Seventh / winter semester

**ECTS credits:** 6 cp

**Language of instruction:** German

**Prerequisites:** None

**Course:**
- Administrative Law and EU Law
- Civil Law and Real Estate Law
- Spatial Planning and Environmental Protection

**Attendance:** 6 hours/week

**Workload:**
- 30 contact hours, 30 hours of independent study
- 25 contact hours, 30 hours of independent study, 5 hours of guided study

**Teaching method/learning activities:** Lectures, exercises

**Mode of delivery:** Face-to-face

**Assessment methods and criteria:** Written exams (120 min, 60 min)

**Recommended optional programme components:** Student can choose courses from the General Studies’ program

**Course content:**

Administrative Law and EU Law: The fundamentals of both administrative law and European Union law will be discussed. The basic conditions for the different action forms of an administration are pointed out and numerous cases are discussed. The cadastre law will be discussed. At the same time, EU law is presented and the basic European aim regulations in theory and in practice will be accompanied by exemplifications. In particular, the primary Union law, the secondary (derived) Union law and the proceedings before the Court of Justice of the European Union as well as the so-called fundamental freedoms will be discussed.

Civil Law and Real Estate Law: In the first part of the lecture, the development of the fundamental ideas of the German right will be introduced in particular considera-
tion of the partitioning into private and public right. Apart from a legal basic knowledge, the students will be provided with both an understanding of the legal language and an insight into the legislation technology and methods. In the second part, the practical emphasis is placed on the material law on real estate and formal land register right. A main goal is the capability to practically handle the land register. Besides, an idea of the most important real estate transactions will be given.

Spatial Planning and Environmental Protection: The students are provided with a basic knowledge on land use planning and environmental protection in Germany both on the regional and local level. In this context, the relevance of these disciplines is pointed out with an emphasis on geo-ecological, economical and social aspects. Visualization of data and processes. After having successfully completed the course, the students should

**Learning outcomes:**

**Administrative Law and EU Law:**
- understand the fundamentals of administrative law and EU law;
- be able to interpret and apply regulations in these areas

**Civil Law and Real Estate Law:**
- understand the fundamentals of civil law and real estate law;
- be able to independently comprehend other regulations
- be able to handle small cases

**Spatial Planning and Environmental Protection:**
- have an overview on the tasks of land use planning on different spatial levels, such as cities, regions, states and continents, with regard to the conflicting aspects of transportation and traffic, environment, population and economy, and to resolve these as well as develop new strategies
- be aware of the protection of nature, environment and resources,
- know about environmental influences like air pollution, global warming and sealed natural ground.

**Work placements:**

*n/a*

**Recommended reading:**

**Books**

**Law:**
- *BGB*. Beck-Texte im dtv. Beck, München
- *Staats- und Verwaltungsrecht Baden-Württemberg*. C.F. Müller, Heidelberg
- *Staats- und Verwaltungsrecht Bundesrepublik Deutschland*. C.F. Müller, Heidelberg

**Spatial Planning and Environmental Protection:**
- *Spitzer, H.: Einführung in die Räumliche Planung*. Stuttgart 1995
- Akademie für Raumforschung und Landesplanung: *Handwörterbuch der Raumordnung*. Hannover 2005
- Langhagen-Rohrbach, Chr.: *Räumordnung und Raumplanung*. Darmstadt 2005

**Internet / Multimedia**
- *Akademie für Raumordnung und Landesplanung*
(Academy for Spatial Research and Planning) –
www.arl-net.de
- Bundesamt für Bauwesen und Raumordnung (Federal Office for Building and Regional Planning) –
www.bbr.bund.de
- Umweltbundesamt – www.umweltbundesamt.de
- Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety) –
www.bmu.de
GN 7420  Land Management

Lecturers:  
Prof. Dr. Saler  
Prof. Dr. Drixler  
Mr. Wiese

Type of course unit:  
Compulsory for specialization in Geodesy

Level of course unit:  
First-cycle

Year of study:  
Forth

Semester when the course is delivered:  
Seventh / winter semester

ECTS credits:  
5 cp

Language of instruction:  
German

Prerequisites:  
Recommended: successful completion of module GN 6410

Course:  
Land Management and Planning  
Cadastre Project

Attendance:  
4 hours/week  
1 hour/week

Workload:  
60 contact hours, 60 hours of independent study  
15 hours of independent study, 15 hours of guided study

Teaching method/learning activities:  
Lecture  
Project  
Face-to-face

Mode of delivery:  
Assignment, written exam (90 min)

Assessment methods and criteria:  
Student can choose courses from the General Studies’ program

Course content:  
Land Management and Planning: Cooperation between town planning, land division, technical municipal administration and estate appraisement. Planning regulations in Germany, tasks and principles of town planning in the German federal building code (= Baugesetzbuch), content and purpose of development plans, land use planning. Economic, legal and political significance of land ownership; instruments of municipal land management; methods of official land consolidation (value measure and area scale factor), procedure of official land consolidation; simplified reallocation process; voluntary land consolidation; urban development contracts; compensation measures for impact on environment and landscape. Value definitions and real estate market; market value definition; tasks of property valuation committee; data on purchasing prices, standard land values, derivation
of required data; valuation methods (comparative value method, income approach to valuation, asset value method); property market report.

Cadastre Project: preparation work for and determination of boundaries and cadastral surveys in small groups. Elaboration of surveying according to the respective, current regulations.

After having successfully completed the course, the students should

Land Management and Planning: know about complex interrelations between and common strategic objectives of town planning, land management, technical municipal administration and estate appraisement.

- Town planning: This module is aimed at imparting knowledge of various planning types and the hierarchy of town planning in Germany. Students learn about the procedures and instruments used and the interplay between municipal departments becomes transparent. Students understand the significance and role of land surveyors in town planning.

- Land management: Based on „Basics of private real estate property rights and public construction law“, this module aims at imparting knowledge of the methods and procedures used to design lots according to location, shape and size for building use or other purposes. Students also learn about how to efficiently control and manage land development in urban and rural areas. Private and public land consolidation are compared.

- Estate appraisement: In this module, students learn to describe the basics of the real estate market and the instruments that make this market transparent. They further learn how to apply valuation methods in order to determine the market value of developed and undeveloped real estate property.

Cadastre Project: The practical determination of boundaries and cadastral surveys performed lay the foundation for a position in cadastral administration, e.g. during the internship semester. With the surveys, students learn the basics for subsequent surveying internships.

Work placements:

n/a

Recommended reading:

Books:

- Land Management and Planning:
  - Lecture notes
  - Thomas Burmeister. *Praxishandbuch Städtebauliche Verträge*. 2nd ed. dhw-Verlag, Bonn 2005

- Cadastre Project:
  - Lecture notes
  - Regulations of Vermessungsverwaltung BaWü (VwFVP, VwVLK, VwVLV)
- Vermessungsgesetz (law on survey) of Baden-Württemberg
- Internet / Multimedia
  - www.lgl-bw.de
  - www.gutachterausschuesse-online.de
  - www.karlsruhe.de/b3/bauen/umlegung.de
GN 7430 Mobile IT

**Lecturers:**
- Prof. Dr. Jäger
- Prof. Dr. Schwäble

**Type of course unit:** Compulsory for specialization in Navigation

**Level of course unit:** First-cycle

**Year of study:** Forth

**Semester when the course is delivered:** Seventh / winter semester

**ECTS credits:** 6 cp

**Language of instruction:** German

**Prerequisites:** Recommended: successful completion of modules GN 4440, GN 4450, GN 6450, GN 6460. Knowledge in programming.

**Course:**
- Basics of Mobile IT
- Mobile IT – Development of Software and Systems

**Attendance:**
- 2 hours/week
- 3 hours/week

**Workload:**
- 25 contact hours, 35 hours of independent study, 5 hours of guided study
- 35 contact hours, 70 hours of independent study, 10 hours of guided study

**Teaching method/learning activities:**
- Lecture
- Lecture and project

**Mode of delivery:** Face-to-face

**Assessment methods and criteria:**
- Assignment, written exam (90 min)

**Recommended optional programme components:**
- Student can choose courses from the General Studies’ program

**Course content:**
- Basics of Mobile IT: Mobile IT systems and services linked to the field of navigation – current technologies, developments and market overview
- Operating systems (Google Android, Windows Mobile, IPhone OS), development environments, programming languages and hardware platforms
- Geo data and interfaces 1 (OGC, WMS, WFS) and free map servers (GreatMap, etc.)
- Geo data and interfaces 2 (City and building models, visualisation components)
- GNSS services, algorithms and interfaces (IGS-IP, NTRIP, RTCM)
- Navigation sensors and interfaces of mobile platforms (GNSS, gyroscope, magnetometer, accelerometer)
- Positioning and navigation algorithms
Communication interfaces (Mobile Internet, RFID, Bluetooth, WLAN)
Hardware and software design of mobile IT systems
(Server-Client services, out-/indoor navigation, mobile data collection systems)

Mobile IT – Development of software and systems for out-/indoor navigation and mobile IT
Basics of app programming using Google Android (Android Software Stack, SDK, NDK, Core Libraries, Dalvik Virtual Machine)
Implementation of a smartphone application ready to receive Internet-based GNSS correction data for precise real-time positioning. Integration with a map server
Implementation of a smartphone application for out-and indoor navigation using GNSS, gyroscope and magnetometer sensors. Integration with indoor visualisation
Implementation of a smartphone application for positioning and orientation using GNSS, gyroscope and magnetometer sensors for navigating drones and vehicles.

Learning outcomes:
After having successfully completed the course, the students should
Basics of Mobile IT: This course provides the basic knowledge required to develop mobile applications linked to the field of navigation, including applications for mobile data collection and for the implementation of mobile client server services using different operating systems. A focus will be on the integration with external infrastructure and navigation sensors relevant to mobile IT applications, including different types of navigation algorithms and a representative range of different mobile IT applications (hardware, algorithm and software design). The course will enable students to develop mobile IT applications used in the field of navigation which run on any platform and operating system.

Mobile IT – Development of Software and Systems: This course focuses on the development of a representative range of mobile clients for mobile IT navigation applications for smartphones and tablet PCs as end devices. Based on the operating system Google Android apps are programmed for smartphones and tablet PCs equipped with GNSS and other navigation sensors. A mobile emulator is used during the development process. The apps are then validated in the laboratory under real conditions on platforms for GNSS and navigation. The course will enable students to develop and implement mobile IT applications for navigation purposes.

Work placements:
n/a

Recommended reading:
Books:
Basics of Mobile IT
• Böser, W., Dürrschnabel, K., Girndt, U., Hanauer, R., Hell, G., Jäger, R., Klein, U., Müller, T., Saler, H.,

Mobile IT – Development of Software and Systems:


Multimedia

- www.markana.com/
### GN 7440 Interdisciplinary Skills

**Lecturers:** Prof. Dr. Saler  
**Type of course unit:** Compulsory  
**Level of course unit:** First-cycle  
**Year of study:** Fourth  
**Semester when the course is delivered:** Seventh / winter semester, summer semester  
**ECTS credits:** 4 cp  
**Language of instruction:** Depending on course  
**Attendance:**  
**Workload:** 4 hours/week  
**Prerequisites:** None  
**Teaching method/learning activities:** Lecture, seminar or exercise  
**Mode of delivery:** Face-to-face  
**Assessment methods and criteria:** Depending on course  
**Recommended optional programme components:** n/a  
**Course content:** Students choose a course from the General Studies program [http://www.hs-karlsruhe.de/studierende/career/studiumgenerale.html](http://www.hs-karlsruhe.de/studierende/career/studiumgenerale.html) which has one of the following subject matters:  
- Economy and globalization  
- Innovations in engineering and economy  
- Ethics in engineering, economy and society  
- Law in economy and engineering  
- Entrepreneurship  
- Self-management and communication  
- English and international business  
- Additional language courses with consent of the Director of the study program  
**Learning outcomes:** After having successfully completed the course, the students should  
- have acquired and improved interdisciplinary key competences which are nowadays among the most important selection criteria to get a job  
**Work placements:** n/a  
**Recommended reading:** Depending on course
### GN BT00 Bachelor’s Thesis

<table>
<thead>
<tr>
<th>Lecturers:</th>
<th>Prof. Dr. Saler</th>
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</thead>
<tbody>
<tr>
<td>Type of course unit:</td>
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<td>Level of course unit:</td>
<td>First-cycle</td>
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<td>Year of study:</td>
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<tr>
<td>Semester when the course is delivered:</td>
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<td></td>
<td>Bachelor’s Thesis Colloquium</td>
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<td>Workload:</td>
<td>360 hours of independent study</td>
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<tr>
<td></td>
<td>60 hours of independent study</td>
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<tr>
<td>Prerequisites:</td>
<td>Successful completion of almost all modules</td>
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<tr>
<td>Teaching method/learning activities:</td>
<td>Individual work and will include basic literature research, system analysis, coding, documentation, and oral presentation</td>
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<tr>
<td>Mode of delivery:</td>
<td>Supervision</td>
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<td>Assessment methods and criteria:</td>
<td>Bachelor’s thesis</td>
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<tr>
<td>Recommended optional programme components:</td>
<td>n/a</td>
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<tr>
<td>Course content:</td>
<td>The thesis may address any subject within the field of geodesy, navigation, and geomatics, which will be agreed upon by the student and the advisor</td>
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<td>Learning outcomes:</td>
<td>The student can work on a set subject using the scientific method in a specific timeframe (4 months). The thesis will demonstrate that the student has the knowledge and ability to work as an engineer. The student must work self-dependently. Only the indicated resources may be used. Finally, the student will be required to orally present and defend the results in a colloquium.</td>
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<tr>
<td>Work placements:</td>
<td>n/a</td>
</tr>
<tr>
<td>Recommended reading:</td>
<td>n/a</td>
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