



# **Module Manual**

Bachelor of Science (B.Sc.)

# **Civil- and Environmental Engineering**

Cohort: Winter Term 2019

Updated: 30th April 2020

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## **Program description**

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### **Content**

## Core qualification

### Module M0580: Principles of Building Materials and Building Physics

#### Courses

Title	Typ	Hrs/wk	CP
Building Physics (L0217)	Lecture	2	2
Building Physics (L0219)	Recitation (large)	Section 1	1
Building Physics (L0247)	Recitation (small)	Section 1	1
Principles of Building Materials (L0215)	Lecture	2	2

<b>Module Responsible</b>	Prof. Frank Schmidt-Döhl
<b>Admission Requirements</b>	None
<b>Recommended Previous Knowledge</b>	Knowledge of physics, chemistry and mathematics from school
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results
<b>Professional Competence</b>	
<i>Knowledge</i>	The students are able to identify fundamental effects of action to materials and structures, to explain different types of mechanical behaviour, to describe the structure of building materials and the correlations between structure and other properties, to show methods of joining and of corrosion processes and to describe the most important regularities and properties of building materials and structures and their measurement in the field of protection against moisture, coldness, fire and noise.
<i>Skills</i>	The students are able to work with the most important standardized methods and regularities in the field of moisture protection, the German regulation for energy saving, fire protection and noise protection in the case of a small building.
<b>Personal Competence</b>	
<i>Social Competence</i>	The students are able to support each other to learn the very extensive specialist knowledge.
<i>Autonomy</i>	The students are able to make the timing and the operation steps to learn the specialist knowledge of a very extensive field.
<b>Workload in Hours</b>	Independent Study Time 96, Study Time in Lecture 84
<b>Credit points</b>	6
<b>Course achievement</b>	None
<b>Examination</b>	Written exam
<b>Examination duration and scale</b>	2 h written exam
<b>Assignment for</b>	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory Civil- and Environmental Engineering: Core qualification: Compulsory

<b>the Following Curricula</b>	General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory Orientierungsstudium: Core qualification: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory
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Course L0217: Building Physics	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Frank Schmidt-Döhl
<b>Language</b>	DE
<b>Cycle</b>	WiSe
<b>Content</b>	Heat transport, thermal bridges, balances of energy consumption, German regulation for energy saving, heat protection in summer, moisture transport, condensation moisture, protection against mold, fire protection, noise protection
<b>Literature</b>	Fischer, H.-M. ; Freymuth, H.; Häupl, P.; Homann, M.; Jenisch, R.; Richter, E.; Stohrer, M.: Lehrbuch der Bauphysik. Vieweg und Teubner Verlag, Wiesbaden, ISBN 978-3-519-55014-3

Course L0219: Building Physics	
<b>Typ</b>	Recitation Section (large)
<b>Hrs/wk</b>	1
<b>CP</b>	1
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
<b>Lecturer</b>	Prof. Frank Schmidt-Döhl
<b>Language</b>	DE
<b>Cycle</b>	WiSe
<b>Content</b>	See interlocking course
<b>Literature</b>	See interlocking course

Course L0247: Building Physics	
<b>Typ</b>	Recitation Section (small)
<b>Hrs/wk</b>	1
<b>CP</b>	1
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
<b>Lecturer</b>	Prof. Frank Schmidt-Döhl
<b>Language</b>	DE
<b>Cycle</b>	WiSe
<b>Content</b>	See interlocking course
<b>Literature</b>	See interlocking course

<b>Course L0215: Principles of Building Materials</b>	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Frank Schmidt-Döhl
<b>Language</b>	DE
<b>Cycle</b>	WiSe
<b>Content</b>	<p>Structure of building materials                      Effects of action                      Fundamentals of mechanical behaviour</p> <p>Material testing</p> <p>Principles of metals</p> <p>Joining methods</p>
<b>Literature</b>	<p>Wendehorst, R.: Baustoffkunde. ISBN 3-8351-0132-3</p> <p>Scholz, W.: Baustoffkenntnis. ISBN 3-8041-4197-8</p>

<b>Module M0687: Chemistry</b>							
<b>Courses</b>							
<b>Title</b>	<b>Typ</b>	<b>Hrs/wk</b>	<b>CP</b>				
Chemistry I (L0460)	Lecture	2	2				
Chemistry I (L0475)	Recitation (large)	Section 1	1				
Chemistry II (L0465)	Lecture	2	2				
Chemistry II (L0476)	Recitation (large)	Section 1	1				
<b>Module Responsible</b>	Dr. Dorothea Rechtenbach						
<b>Admission Requirements</b>	None						
<b>Recommended Previous Knowledge</b>	none						
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results						
<b>Professional Competence</b>	<p><i>Knowledge</i> The students are able to name and to describe basic principles and applications of general chemistry (structure of matter, periodic table, chemical bonds), physical chemistry (aggregate states, separating processes, thermodynamics, kinetics), inorganic chemistry (acid/base, pH-value, salts, solubility, redox, metals) and organic chemistry (aliphatic hydrocarbons, functional groups, carbonyl compounds, aromates, reaction mechanisms, natural products, synthetic polymers). Furthermore students are able to explain basic chemical terms.</p> <p><i>Skills</i> After successful completion of this module students are able to describe substance groups and chemical compounds. On this basis, they are capable of explaining, choosing and applying specific methods and various reaction mechanisms.</p> <p><b>Personal Competence</b></p> <p><i>Social Competence</i> Students are able to take part in discussions on chemical issues and problems as a member of an interdisciplinary team. They can contribute to those discussion by their own statements.</p> <p><i>Autonomy</i> After successful completion of this module students are able to solve chemical problems independently by defending proposed approaches with arguments. They can also document their approaches.</p>						
<b>Workload in Hours</b>					Independent Study Time 96, Study Time in Lecture 84		
<b>Credit points</b>					6		
<b>Course achievement</b>					None		
<b>Examination</b>	Written exam						
<b>Examination duration and scale</b>	120 min						

<b>Assignment for the Following Curricula</b>	General Engineering Science (German program, 7 semester): Core qualification: Compulsory Civil- and Environmental Engineering: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory
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Course L0460: Chemistry I	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Lecturer</b>	Dr. Christoph Wutz
<b>Language</b>	DE
<b>Cycle</b>	WiSe
<b>Content</b>	<ul style="list-style-type: none"> <li>- Structure of matter</li> <li>- Periodic table</li> <li>- Electronegativity</li> <li>- Chemical bonds</li> <li>- Solid compounds and solutions</li> <li>- Chemistry of water</li> <li>- Chemical reactions and equilibria</li> <li>- Acid-base reactions</li> <li>- Redox reactions</li> </ul>
<b>Literature</b>	<ul style="list-style-type: none"> <li>- Blumenthal, Linke, Vieth: Chemie - Grundwissen für Ingenieure</li> <li>- Kickelbick: Chemie für Ingenieure (Pearson)</li> <li>- Mortimer: Chemie. Basiswissen der Chemie.</li> <li>- Brown, LeMay, Bursten: Chemie. Studieren kompakt.</li> </ul>

Course L0475: Chemistry I	
<b>Typ</b>	Recitation Section (large)
<b>Hrs/wk</b>	1
<b>CP</b>	1
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
<b>Lecturer</b>	Dr. Dorothea Rechtenbach
<b>Language</b>	DE
<b>Cycle</b>	WiSe
<b>Content</b>	See interlocking course
<b>Literature</b>	See interlocking course



<b>Course L0465: Chemistry II</b>	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Lecturer</b>	Dr. Christoph Wutz
<b>Language</b>	DE
<b>Cycle</b>	WiSe
<b>Content</b>	<ul style="list-style-type: none"> <li>- Simple compounds of carbon, aliphatic hydrocarbons, aromatic hydrocarbons,</li> <li>- Alcohols, phenols, ether, aldehydes, ketones, carbonic acids, ester, amines, amino acids, fats, sugars</li> <li>- Reaction mechanisms, radical reactions, nucleophilic substitution, elimination reactions, addition reaction</li> <li>- Practical applications and examples</li> </ul>
<b>Literature</b>	<ul style="list-style-type: none"> <li>- Blumenthal, Linke, Vieth: Chemie - Grundwissen für Ingenieure</li> <li>- Kickelbick: Chemie für Ingenieure (Pearson)</li> <li>- Schmuck: Basisbuch Organische Chemie (Pearson)</li> </ul>

<b>Course L0476: Chemistry II</b>	
<b>Typ</b>	Recitation Section (large)
<b>Hrs/wk</b>	1
<b>CP</b>	1
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
<b>Lecturer</b>	Dr. Dorothea Rechtenbach
<b>Language</b>	DE
<b>Cycle</b>	WiSe
<b>Content</b>	See interlocking course
<b>Literature</b>	See interlocking course

## Module M0889: Mechanics I (Statics)

### Courses

<b>Title</b>	<b>Typ</b>	<b>Hrs/wk</b>	<b>CP</b>
Mechanics I (Statics) (L1001)	Lecture	2	3
Mechanics I (Statics) (L1002)	Recitation (small)	Section 2	2
Mechanics I (Statics) (L1003)	Recitation (large)	Section 1	1
<b>Module Responsible</b>	Prof. Robert Seifried		
<b>Admission Requirements</b>	None		
<b>Recommended Previous Knowledge</b>	Solid school knowledge in mathematics and physics.		
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results		
<b>Professional Competence</b>	<p>The students can</p> <ul style="list-style-type: none"> <li>describe the axiomatic procedure used in mechanical contexts;</li> <li>explain important steps in model design;</li> <li>present technical knowledge in stereostatics.</li> </ul>		
<i>Knowledge</i>			
<i>Skills</i>	<p>The students can</p> <ul style="list-style-type: none"> <li>explain the important elements of mathematical / mechanical analysis and model formation, and apply it to the context of their own problems;</li> <li>apply basic statical methods to engineering problems;</li> <li>estimate the reach and boundaries of statical methods and extend them to be applicable to wider problem sets.</li> </ul>		
<b>Personal Competence</b>			
<i>Social Competence</i>	The students can work in groups and support each other to overcome difficulties.		
<i>Autonomy</i>	Students are capable of determining their own strengths and weaknesses and to organize their time and learning based on those.		
<b>Workload in Hours</b>	Independent Study Time 110, Study Time in Lecture 70		
<b>Credit points</b>	6		
<b>Course achievement</b>	<b>Compulsory</b> No	<b>Bonus</b> 20 %	<b>Form</b> Midterm
<b>Examination</b>	<b>Description</b> Wird nur im WiSe angeboten		
<b>Examination duration and scale</b>	Written exam		
<b>Assignment for the Following Curricula</b>	90 min		
<b>Assignment for the Following Curricula</b>	General Engineering Science (German program, 7 semester): Core qualification: Compulsory Civil- and Environmental Engineering: Core qualification: Compulsory Mechanical Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Orientierungsstudium: Core qualification: Elective Compulsory Naval Architecture: Core qualification: Compulsory		

<b>Course L1001: Mechanics I (Statics)</b>	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	3
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Robert Seifried
<b>Language</b>	DE
<b>Cycle</b>	WiSe
<b>Content</b>	<ul style="list-style-type: none"> <li>• Tasks in Mechanics</li> <li>• Modelling and model elements</li> <li>• Vector calculus for forces and torques</li> <li>• Forces and equilibrium in space</li> <li>• Constraints and reactions, characterization of constraint systems</li> <li>• Planar and spatial truss structures</li> <li>• Internal forces and moments for beams and frames</li> <li>• Center of mass, volumn, area and line</li> <li>• Computation of center of mass by intergals, joint bodies</li> <li>• Friction (sliding and sticking)</li> <li>• Friction of ropes</li> </ul>
<b>Literature</b>	<b>K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009).</b> <b>D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 1. 11. Auflage, Springer (2011).</b>

<b>Course L1002: Mechanics I (Statics)</b>	
<b>Typ</b>	Recitation Section (small)
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Robert Seifried
<b>Language</b>	DE
<b>Cycle</b>	WiSe
<b>Content</b>	Forces and equilibrium Constraints and reactions Frames Center of mass Friction Internal forces and moments for beams
<b>Literature</b>	K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009). D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 1. 11. Auflage, Springer (2011).

<b>Course L1003: Mechanics I (Statics)</b>	
<b>Typ</b>	Recitation Section (large)
<b>Hrs/wk</b>	1
<b>CP</b>	1
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
<b>Lecturer</b>	Prof. Robert Seifried
<b>Language</b>	DE
<b>Cycle</b>	WiSe
<b>Content</b>	Forces and equilibrium Constraints and reactions Frames Center of mass Friction Internal forces and moments for beams
<b>Literature</b>	K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009). D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 1. 11. Auflage, Springer (2011).

## Module M0850: Mathematics I

### Courses

Title	Typ	Hrs/wk	CP
Analysis I (L1010)	Lecture	2	2
Analysis I (L1012)	Recitation (small)	Section 1	1
Analysis I (L1013)	Recitation (large)	Section 1	1
Linear Algebra I (L0912)	Lecture	2	2
Linear Algebra I (L0913)	Recitation (small)	Section 1	1
Linear Algebra I (L0914)	Recitation (large)	Section 1	1

<b>Module Responsible</b>	Prof. Anusch Taraz
<b>Admission Requirements</b>	None
<b>Recommended Previous Knowledge</b>	School mathematics
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results
<b>Professional Competence</b>	
<i>Knowledge</i>	<ul style="list-style-type: none"> <li>• Students can name the basic concepts in analysis and linear algebra. They are able to explain them using appropriate examples.</li> <li>• Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples.</li> <li>• They know proof strategies and can reproduce them.</li> </ul>
<i>Skills</i>	<ul style="list-style-type: none"> <li>• Students can model problems in analysis and linear algebra with the help of the concepts studied in this course. Moreover, they are capable of solving them by applying established methods.</li> <li>• Students are able to discover and verify further logical connections between the concepts studied in the course.</li> <li>• For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results.</li> </ul>
<b>Personal Competence</b>	
<i>Social Competence</i>	<ul style="list-style-type: none"> <li>• Students are able to work together in teams. They are capable to use mathematics as a common language.</li> <li>• In doing so, they can communicate new concepts according to the needs of their cooperating partners. Moreover, they can design examples to check and deepen the understanding of their peers.</li> </ul>
<i>Autonomy</i>	<ul style="list-style-type: none"> <li>• Students are capable of checking their understanding of complex concepts on their own. They can specify open questions precisely and know where to get help in solving them.</li> <li>• Students have developed sufficient persistence to be able to work for longer</li> </ul>

	periods in a goal-oriented manner on hard problems.
<b>Workload in Hours</b>	Independent Study Time 128, Study Time in Lecture 112
<b>Credit points</b>	8
<b>Course achievement</b>	None
<b>Examination</b>	Written exam
<b>Examination duration and scale</b>	60 min (Analysis I) + 60 min (Linear Algebra I)
<b>Assignment for the Following Curricula</b>	General Engineering Science (German program, 7 semester): Core qualification: Compulsory Civil- and Environmental Engineering: Core qualification: Compulsory Bioprocess Engineering: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory Logistics and Mobility: Core qualification: Compulsory Mechanical Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Orientierungsstudium: Core qualification: Elective Compulsory Naval Architecture: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory

<b>Course L1010: Analysis I</b>	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Lecturer</b>	Dozenten des Fachbereiches Mathematik der UHH
<b>Language</b>	DE
<b>Cycle</b>	WiSe
<b>Content</b>	Foundations of differential and integrational calculus of one variable <ul style="list-style-type: none"> <li>• statements, sets and functions</li> <li>• natural and real numbers</li> <li>• convergence of sequences and series</li> <li>• continuous and differentiable functions</li> <li>• mean value theorems</li> <li>• Taylor series</li> <li>• calculus</li> <li>• error analysis</li> <li>• fixpoint iteration</li> </ul>
<b>Literature</b>	<ul style="list-style-type: none"> <li>• <a href="http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html">http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html</a></li> </ul>

<b>Course L1012: Analysis I</b>	
<b>Typ</b>	Recitation Section (small)
<b>Hrs/wk</b>	1
<b>CP</b>	1
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
<b>Lecturer</b>	Dozenten des Fachbereiches Mathematik der UHH
<b>Language</b>	DE
<b>Cycle</b>	WiSe
<b>Content</b>	See interlocking course
<b>Literature</b>	See interlocking course

<b>Course L1013: Analysis I</b>	
<b>Typ</b>	Recitation Section (large)
<b>Hrs/wk</b>	1
<b>CP</b>	1
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
<b>Lecturer</b>	Dozenten des Fachbereiches Mathematik der UHH
<b>Language</b>	DE
<b>Cycle</b>	WiSe
<b>Content</b>	See interlocking course
<b>Literature</b>	See interlocking course

<b>Course L0912: Linear Algebra I</b>	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Anusch Taraz, Prof. Marko Lindner
<b>Language</b>	DE
<b>Cycle</b>	WiSe
<b>Content</b>	<ul style="list-style-type: none"> <li>• vectors: intuition, rules, inner and cross product, lines and planes</li> <li>• systems of linear equations: Gauß elimination, matrix product, inverse matrices, transformations, block matrices, determinants</li> <li>• orthogonal projection in <math>\mathbb{R}^n</math>, Gram-Schmidt-Orthonormalization</li> </ul>
<b>Literature</b>	<ul style="list-style-type: none"> <li>• T. Arens u.a. : Mathematik, Spektrum Akademischer Verlag, Heidelberg 2009</li> <li>• W. Mackens, H. Voß: Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994</li> <li>• W. Mackens, H. Voß: Aufgaben und Lösungen zur Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994</li> <li>• G. Strang: Lineare Algebra, Springer-Verlag, 2003</li> <li>• G. und S. Teschl: Mathematik für Informatiker, Band 1, Springer-Verlag, 2013</li> </ul>

<b>Course L0913: Linear Algebra I</b>	
<b>Typ</b>	Recitation Section (small)
<b>Hrs/wk</b>	1
<b>CP</b>	1
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
<b>Lecturer</b>	Prof. Anusch Taraz, Prof. Marko Lindner
<b>Language</b>	DE
<b>Cycle</b>	WiSe
<b>Content</b>	<ul style="list-style-type: none"> <li>• vectors: intuition, rules, inner and cross product, lines and planes</li> <li>• general vector spaces: subspaces, Euclidean vector spaces</li> <li>• systems of linear equations: Gauß-elimination, matrix product, inverse matrices, transformations, LR-decomposition, block matrices, determinants</li> </ul>
<b>Literature</b>	<ul style="list-style-type: none"> <li>• T. Arens u.a. : Mathematik, Spektrum Akademischer Verlag, Heidelberg 2009</li> <li>• W. Mackens, H. Voß: Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994</li> <li>• W. Mackens, H. Voß: Aufgaben und Lösungen zur Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994</li> </ul>

<b>Course L0914: Linear Algebra I</b>	
<b>Typ</b>	Recitation Section (large)
<b>Hrs/wk</b>	1
<b>CP</b>	1
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
<b>Lecturer</b>	Dr. Christian Seifert
<b>Language</b>	DE
<b>Cycle</b>	WiSe
<b>Content</b>	See interlocking course
<b>Literature</b>	See interlocking course



## Module M0577: Non-technical Courses for Bachelors

<b>Module Responsible</b>	Dagmar Richter
<b>Admission Requirements</b>	None
<b>Recommended Previous Knowledge</b>	None
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results
<b>Professional Competence</b>	<p><b>The Non-technical Academic Programms (NTA)</b></p> <p>imparts skills that, in view of the TUHH’s training profile, professional engineering studies require but are not able to cover fully. Self-reliance, self-management, collaboration and professional and personnel management competences. The department implements these training objectives in its <b>teaching architecture</b>, in its <b>teaching and learning arrangements</b>, in <b>teaching areas</b> and by means of teaching offerings in which students can qualify by opting for <b>specific competences</b> and a <b>competence level</b> at the Bachelor’s or Master’s level. The teaching offerings are pooled in two different catalogues for nontechnical complementary courses.</p> <p><b>The Learning Architecture</b></p> <p>consists of a cross-disciplinarily study offering. The centrally designed teaching offering ensures that courses in the nontechnical academic programms follow the specific profiling of TUHH degree courses.</p> <p>The learning architecture demands and trains independent educational planning as regards the individual development of competences. It also provides orientation knowledge in the form of “profiles”</p> <p>The subjects that can be studied in parallel throughout the student’s entire study program - if need be, it can be studied in one to two semesters. In view of the adaptation problems that individuals commonly face in their first semesters after making the transition from school to university and in order to encourage individually planned semesters abroad, there is no obligation to study these subjects in one or two specific semesters during the course of studies.</p> <p><b>Teaching and Learning Arrangements</b></p> <p>provide for students, separated into B.Sc. and M.Sc., to learn with and from each other across semesters. The challenge of dealing with interdisciplinarity and a variety of stages of learning in courses are part of the learning architecture and are deliberately encouraged in specific courses.</p> <p><b>Fields of Teaching</b></p> <p>are based on research findings from the academic disciplines cultural studies, social studies, arts, historical studies, migration studies, communication studies and sustainability research, and from engineering didactics. In addition, from the winter semester 2014/15 students on all Bachelor’s courses will have the opportunity to learn about business management and start-ups in a goal-oriented way.</p> <p>The fields of teaching are augmented by soft skills offers and a foreign language offer. Here, the focus is on encouraging goal-oriented communication skills, e.g. the skills required by outgoing engineers in international and intercultural situations.</p> <p><b>The Competence Level</b></p> <p>of the courses offered in this area is different as regards the basic training objective</p>

*Knowledge*

	<p>in the Bachelor's and Master's fields. These differences are reflected in the practical examples used, in content topics that refer to different professional application contexts, and in the higher scientific and theoretical level of abstraction in the B.Sc.</p> <p>This is also reflected in the different quality of soft skills, which relate to the different team positions and different group leadership functions of Bachelor's and Master's graduates in their future working life.</p> <p><b>Specialized Competence (Knowledge)</b></p> <p>Students can</p> <ul style="list-style-type: none"> <li>• locate selected specialized areas with the relevant non-technical mother discipline,</li> <li>• outline basic theories, categories, terminology, models, concepts or artistic techniques in the disciplines represented in the learning area,</li> <li>• different specialist disciplines relate to their own discipline and differentiate it as well as make connections,</li> <li>• sketch the basic outlines of how scientific disciplines, paradigms, models, instruments, methods and forms of representation in the specialized sciences are subject to individual and socio-cultural interpretation and historicity,</li> <li>• Can communicate in a foreign language in a manner appropriate to the subject.</li> </ul> <p><b>Professional Competence (Skills)</b></p> <p>In selected sub-areas students can</p> <ul style="list-style-type: none"> <li>• apply basic methods of the said scientific disciplines,</li> <li>• question a specific technical phenomena, models, theories from the viewpoint of another, aforementioned specialist discipline,</li> <li>• to handle simple questions in aforementioned scientific disciplines in a successful manner,</li> <li>• justify their decisions on forms of organization and application in practical questions in contexts that go beyond the technical relationship to the subject.</li> </ul> <p><b>Personal Competence</b></p> <p><b>Personal Competences (Social Skills)</b></p> <p>Students will be able</p> <ul style="list-style-type: none"> <li>• to learn to collaborate in different manner,</li> <li>• to present and analyze problems in the abovementioned fields in a partner or group situation in a manner appropriate to the addressees,</li> <li>• to express themselves competently, in a culturally appropriate and gender-sensitive manner in the language of the country (as far as this study-focus would be chosen),</li> <li>• to explain nontechnical items to auditorium with technical background knowledge.</li> </ul> <p><b>Personal Competences (Self-reliance)</b></p> <p>Students are able in selected areas</p> <ul style="list-style-type: none"> <li>• to reflect on their own profession and professionalism in the context of real-life fields of application</li> <li>• to organize themselves and their own learning processes</li> <li>• to reflect and decide questions in front of a broad education background</li> <li>• to communicate a nontechnical item in a competent way in written form or verbally</li> <li>• to organize themselves as an entrepreneurial subject country (as far as this study-focus would be chosen)</li> </ul>
<b>Workload in Hours</b>	Depends on choice of courses

<b>Credit points</b>	6
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<b>Courses</b>
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<b>Information regarding lectures and courses can be found in the corresponding module handbook published separately.</b>
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## Module M0579: Structural Design

### Courses

Title	Typ	Hrs/wk	CP
Basics of Structural Design (L0205)	Lecture	2	1
Exercises in Structural Design (L0208)	Recitation (large)	Section 1	1
Seminar in Structural Design (L0209)	Project-/problem-based Learning	2	4

<b>Module Responsible</b>	Prof. Frank Schmidt-Döhl
<b>Admission Requirements</b>	None
<b>Recommended Previous Knowledge</b>	Contents of module "Principles of Building Materials and Building Physics"
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results
<b>Professional Competence</b>	
<i>Knowledge</i>	<p>After attending the course students are able</p> <ul style="list-style-type: none"> <li>to define the basics of building regulations law</li> <li>to specify typical building components</li> <li>to distinguish different possibilities of load bearing behaviour and risks due to lack of stability</li> <li>to explain the main objectives of fire control</li> </ul>
<i>Skills</i>	<p>After attending the course students are able</p> <ul style="list-style-type: none"> <li>to evaluate development plans and to convert the main objectives of building regulation laws to a architect's plan</li> <li>to decide which building components should be used to get a correct building envelope and a sufficient building stability</li> <li>to proof the moisture behaviour, the energy consumption, the acoustic protection and the fire control of a construction</li> <li>to plot the results of drafts and decisions</li> </ul>
<b>Personal Competence</b>	
<i>Social Competence</i>	<p>After attending the course students are able</p> <ul style="list-style-type: none"> <li>to work in a team and to present the results of the team work</li> <li>to use the feedback from other students to improve the own results</li> <li>to give a feedback to other students in a constructive manner</li> </ul>
<i>Autonomy</i>	<p>After attending the course students are able</p> <ul style="list-style-type: none"> <li>to control and improve their knowledge with the help of weekly presentations (lecture room) and tests (STUD.IP)</li> <li>to divide the main task in different parts, to deduce the needed knowledge and to schedule the different work steps</li> </ul>
<b>Workload in Hours</b>	Independent Study Time 110, Study Time in Lecture 70
<b>Credit points</b>	6
<b>Course achievement</b>	None

<b>Examination</b>	Subject theoretical and practical work
<b>Examination duration and scale</b>	Written exam (construction application) and written theory exam
<b>Assignment for the Following Curricula</b>	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory Civil- and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory

<b>Course L0205: Basics of Structural Design</b>	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	1
<b>Workload in Hours</b>	Independent Study Time 2, Study Time in Lecture 28
<b>Lecturer</b>	Thomas Kölzer
<b>Language</b>	DE
<b>Cycle</b>	SoSe
<b>Content</b>	<ul style="list-style-type: none"> <li>• Basics of building regulation laws</li> <li>• Foundation of buildings</li> <li>• Sealing of basements</li> <li>• facades</li> <li>• Ceilings</li> <li>• Roofs</li> <li>• Windows, doors and post-and-beam constructions</li> <li>• Staircases</li> <li>• Basics of structural engineering design</li> <li>• Structural fire prevention</li> <li>• Optional tests on STUD.IP</li> </ul>
<b>Literature</b>	<p><b>Vortragsfolien der Lehrveranstaltung</b> stehen über STUD.IP zum download zur Verfügung</p> <p><b>Neumann, Dietrich</b> (Hestermann, Ulf.; Rongen, Ludwig.; Weinbrenner, Ulrich) Frick/Knöll Baukonstruktionslehre 1 / [Internet-Ressource] ISBN: 978-3-8351-9121-1 Wiesbaden : B.G. Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2006</p> <p><b>Frick[Begr.], Otto</b> (Knöll[Begr.], Karl.; Neumann, Dietrich.; Hestermann, Ulf.; Rongen, Ludwig.) Baukonstruktionslehre 2 / [Internet-Ressource] ISBN: 978-3-8348-9486-1 Wiesbaden : Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008</p> <p><b>Dierks, Klaus</b> (Wormuth, Rüdiger.) Baukonstruktion : [Einführung, Grundlagen, Gründungen, technische Ausrüstung, Wände, Geschossdecken, Treppen, Dächer, Fenster, Türen, Konstruktionsatlas] ISBN: 3804150454 (Gb.) ISBN: 978-3-8041-5045-4 Neuwied : Werner, 2007</p> <p><b>Neufert, Ernst</b> (Kister, Johannes) Bauentwurfslehre : Grundlagen, Normen, Vorschriften über Anlage, Bau, Gestaltung, Raumbedarf, Raumbeziehungen, Maße für Gebäude, Räume, Einrichtungen, Geräte mit dem Menschen als Maß und Ziel ; Handbuch für den Baufachmann, Bauherrn, Lehrenden und Lernend ISBN: 978-3-8348-0732-8 (GB.) Wiesbaden : Vieweg + Teubner, 2009</p>

Course L0208: Exercises in Structural Design	
<b>Typ</b>	Recitation Section (large)
<b>Hrs/wk</b>	1
<b>CP</b>	1
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
<b>Lecturer</b>	Falk Wagemann
<b>Language</b>	DE
<b>Cycle</b>	SoSe
<b>Content</b>	<ul style="list-style-type: none"> <li>• Constructing a small individuell building in groups of 4 persons</li> <li>• Analysing the informations and the contents of development plans and building regulation laws</li> <li>• Design of building components and approving of the functionality (sealing, facades, roofs)</li> <li>• Design and approve of the functionality of the component interconnections</li> <li>• Proofing and assessing of moisture behaviour, energy consumption, acoustic protection and fire control</li> <li>• Assessing the building stability</li> <li>• Basics of building services</li> <li>• Each week the results of different work steps are presented in oral and written form</li> </ul>
<b>Literature</b>	<p><b>Vortragsfolien der Lehrveranstaltung</b> stehen über STUD.IP zum download zur Verfügung</p> <p><b>Neumann, Dietrich</b> (Hestermann, Ulf.; Rongen, Ludwig.; Weinbrenner, Ulrich) Frick/Knöll Baukonstruktionslehre 1 / [Internet-Ressource] ISBN: 978-3-8351-9121-1 Wiesbaden : B.G. Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2006</p> <p><b>Frick[Begr.], Otto</b> (Knöll[Begr.], Karl.; Neumann, Dietrich.; Hestermann, Ulf.; Rongen, Ludwig.) Baukonstruktionslehre 2 / [Internet-Ressource] ISBN: 978-3-8348-9486-1 Wiesbaden : Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008</p> <p><b>Dierks, Klaus</b> (Wormuth, Rüdiger.) Baukonstruktion : [Einführung, Grundlagen, Gründungen, technische Ausrüstung, Wände, Geschossdecken, Treppen, Dächer, Fenster, Türen, Konstruktionsatlas] ISBN: 3804150454 (Gb.) ISBN: 978-3-8041-5045-4 Neuwied : Werner, 2007</p> <p><b>Schneider, Klaus-Jürgen</b> (Goris, Alfons.; Berner, Klaus) Bautabellen für Ingenieure : mit Berechnungshinweisen und Beispielen ; [auf CD-ROM: Stabwerksprogramm IQ 100 B, Tools für den konstr. Ingenieurbau, Fachinformationen, Normentexte] ISBN: 3804152287 Neuwied : Werner, 2006</p> <p><b>Wendehorst, Reinhard</b> (Wetzell, Otto W.;; Baumgartner, Herwig.;; Deutsches Institut für Normung) Wendehorst Bautechnische Zahlentafeln ISBN: 978-3-8351-0055-8 ISBN: 3835100556 Stuttgart [u.a.] : Teubner Berlin [u.a.] : Beuth, 2007</p> <p><b>Neufert, Ernst</b> (Kister, Johannes) Bauentwurfslehre : Grundlagen, Normen, Vorschriften über Anlage, Bau, Gestaltung, Raumbedarf, Raumbeziehungen, Maße für Gebäude, Räume, Einrichtungen, Geräte mit dem Menschen als Maß und Ziel ; Handbuch für den Baufachmann, Bauherrn, Lehrenden und Lernenden</p>

ISBN: 978-3-8348-0732-8 (GB.)  
Wiesbaden : Vieweg + Teubner, 2009

**Course L0209: Seminar in Structural Design**

<b>Typ</b>	Project-/problem-based Learning
<b>Hrs/wk</b>	2
<b>CP</b>	4
<b>Workload in Hours</b>	Independent Study Time 92, Study Time in Lecture 28
<b>Lecturer</b>	Thomas Kölzer
<b>Language</b>	DE
<b>Cycle</b>	SoSe

- Content**
- Constructing a small individuell building in groups of 4 persons
  - Analysing the informations and the contents of development plans and building regulation laws
  - Design of building components and approving of the functionality (sealing, facades, roofs)
  - Design and approve of the functionality of the component interconnections
  - Proofing and assessing of moisture behaviour, energy consumption, acoustic protection and fire control
  - Assessing the building stability
  - Basics of building services
  - Each week the results of different work steps are presented in oral and written form

**Vortragsfolien der Lehrveranstaltung** stehen über STUD.IP zum download zur Verfügung

**Neumann, Dietrich** (Hestermann, Ulf.; Rongen, Ludwig.; Weinbrenner, Ulrich)  
Frick/Knöll Baukonstruktionslehre 1 / [Internet-Ressource]  
ISBN: 978-3-8351-9121-1  
Wiesbaden : B.G. Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2006

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ISBN: 978-3-8348-9486-1  
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Baukonstruktion : [Einführung, Grundlagen, Gründungen, technische Ausrüstung, Wände, Geschossdecken, Treppen, Dächer, Fenster, Türen, Konstruktionsatlas]  
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**Literature**

**Schneider, Klaus-Jürgen** (Goris, Alfons.; Berner, Klaus)  
Bautabellen für Ingenieure : mit Berechnungshinweisen und Beispielen ; [auf CD-ROM: Stabwerksprogramm IQ 100 B, Tools für den konstr. Ingenieurbau, Fachinformationen, Normentexte]  
ISBN: 3804152287  
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Wendehorst Bautechnische Zahlentafeln  
ISBN: 978-3-8351-0055-8 ISBN: 3835100556  
Stuttgart [u.a.] : Teubner Berlin [u.a.] : Beuth, 2007

**Neufert, Ernst** (Kister, Johannes)

	Bauentwurfslehre : Grundlagen, Normen, Vorschriften über Anlage, Bau, Gestaltung, Raumbedarf, Raumbeziehungen, Maße für Gebäude, Räume, Einrichtungen, Geräte mit dem Menschen als Maß und Ziel ; Handbuch für den Baufachmann, Bauherrn, Lehrenden und Lernenden ISBN: 978-3-8348-0732-8 (GB.) Wiesbaden : Vieweg + Teubner, 2009
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## Module M0696: Mechanics II: Mechanics of Materials

### Courses

Title	Typ	Hrs/wk	CP
Mechanics II (L0493)	Lecture	2	2
Mechanics II (L0494)	Recitation (small)	Section 2	2
Mechanics II (L1691)	Recitation (large)	Section 2	2
<b>Module Responsible</b>	Prof. Christian Cyron		
<b>Admission Requirements</b>	None		
<b>Recommended Previous Knowledge</b>	Mechanics I		
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results		
<b>Professional Competence</b>	<p><i>Knowledge</i> The students name the fundamental concepts and laws of statics such as stresses, strains, Hooke's linear law.</p> <p><i>Skills</i> The students apply the mathematical/mechanical analysis and modeling.</p> <p>The students apply the fundamental methods of elasto statics to simply engineering problems.</p> <p>The students estimate the validity and limitations of the introduced methods.</p>		
<i>Personal Competence</i>			
<i>Social Competence</i>			
<i>Autonomy</i>			
<b>Workload in Hours</b>	Independent Study Time 96, Study Time in Lecture 84		
<b>Credit points</b>	6		
<b>Course achievement</b>	None		
<b>Examination</b>	Written exam		
<b>Examination duration and scale</b>	90 min		
<b>Assignment for the Following Curricula</b>	General Engineering Science (German program, 7 semester): Core qualification: Compulsory Civil- and Environmental Engineering: Core qualification: Compulsory Mechanical Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Orientierungsstudium: Core qualification: Elective Compulsory Naval Architecture: Core qualification: Compulsory		

<b>Course L0493: Mechanics II</b>	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Christian Cyron
<b>Language</b>	DE
<b>Cycle</b>	SoSe
<b>Content</b>	stresses and strains Hooke's law tension and compression torsion bending stability buckling energy methods
<b>Literature</b>	<ul style="list-style-type: none"> <li>• Gross, D., Hauger, W., Schröder, J., Wall, W.A.: Technische Mechanik 1, Springer</li> <li>• Gross, D., Hauger, W., Schröder, J., Wall, W.A.: Technische Mechanik 2 Elastostatik, Springer</li> </ul>

<b>Course L0494: Mechanics II</b>	
<b>Typ</b>	Recitation Section (small)
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Christian Cyron
<b>Language</b>	DE
<b>Cycle</b>	SoSe
<b>Content</b>	See interlocking course
<b>Literature</b>	See interlocking course

<b>Course L1691: Mechanics II</b>	
<b>Typ</b>	Recitation Section (large)
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Christian Cyron, Dr. Konrad Schneider
<b>Language</b>	DE
<b>Cycle</b>	SoSe
<b>Content</b>	See interlocking course
<b>Literature</b>	See interlocking course

## Module M0851: Mathematics II

### Courses

Title	Typ	Hrs/wk	CP
Analysis II (L1025)	Lecture	2	2
Analysis II (L1026)	Recitation (large)	Section 1	1
Analysis II (L1027)	Recitation (small)	Section 1	1
Linear Algebra II (L0915)	Lecture	2	2
Linear Algebra II (L0916)	Recitation (small)	Section 1	1
Linear Algebra II (L0917)	Recitation (large)	Section 1	1

<b>Module Responsible</b>	Prof. Anusch Taraz
<b>Admission Requirements</b>	None
<b>Recommended Previous Knowledge</b>	Mathematics I
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results
<b>Professional Competence</b>	
<i>Knowledge</i>	<ul style="list-style-type: none"> <li>• Students can name further concepts in analysis and linear algebra. They are able to explain them using appropriate examples.</li> <li>• Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples.</li> <li>• They know proof strategies and can reproduce them.</li> </ul>
<i>Skills</i>	<ul style="list-style-type: none"> <li>• Students can model problems in analysis and linear algebra with the help of the concepts studied in this course. Moreover, they are capable of solving them by applying established methods.</li> <li>• Students are able to discover and verify further logical connections between the concepts studied in the course.</li> <li>• For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results.</li> </ul>
<b>Personal Competence</b>	
<i>Social Competence</i>	<ul style="list-style-type: none"> <li>• Students are able to work together in teams. They are capable to use mathematics as a common language.</li> <li>• In doing so, they can communicate new concepts according to the needs of their cooperating partners. Moreover, they can design examples to check and deepen the understanding of their peers.</li> </ul>
<i>Autonomy</i>	<ul style="list-style-type: none"> <li>• Students are capable of checking their understanding of complex concepts on their own. They can specify open questions precisely and know where to get help in solving them.</li> <li>• Students have developed sufficient persistence to be able to work for longer</li> </ul>

	periods in a goal-oriented manner on hard problems.
<b>Workload in Hours</b>	Independent Study Time 128, Study Time in Lecture 112
<b>Credit points</b>	8
<b>Course achievement</b>	None
<b>Examination</b>	Written exam
<b>Examination duration and scale</b>	60 min (Analysis II) + 60 min (Linear Algebra II)
<b>Assignment for the Following Curricula</b>	General Engineering Science (German program, 7 semester): Core qualification: Compulsory Civil- and Environmental Engineering: Core qualification: Compulsory Bioprocess Engineering: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory Logistics and Mobility: Core qualification: Compulsory Mechanical Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Orientierungsstudium: Core qualification: Elective Compulsory Naval Architecture: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory

<b>Course L1025: Analysis II</b>	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Lecturer</b>	Dozenten des Fachbereiches Mathematik der UHH
<b>Language</b>	DE
<b>Cycle</b>	SoSe
<b>Content</b>	<ul style="list-style-type: none"> <li>• power series and elementary functions</li> <li>• interpolation</li> <li>• integration (proper integrals, fundamental theorem, integration rules, improper integrals, parameter dependent integrals)</li> <li>• applications of integration (volume and surface of bodies of revolution, lines and arc length, line integrals)</li> <li>• numerical quadrature</li> <li>• periodic functions</li> </ul>
<b>Literature</b>	<ul style="list-style-type: none"> <li>• <a href="http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html">http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html</a></li> </ul>

<b>Course L1026: Analysis II</b>	
<b>Typ</b>	Recitation Section (large)
<b>Hrs/wk</b>	1
<b>CP</b>	1
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
<b>Lecturer</b>	Dozenten des Fachbereiches Mathematik der UHH
<b>Language</b>	DE
<b>Cycle</b>	SoSe
<b>Content</b>	See interlocking course
<b>Literature</b>	See interlocking course

<b>Course L1027: Analysis II</b>	
<b>Typ</b>	Recitation Section (small)
<b>Hrs/wk</b>	1
<b>CP</b>	1
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
<b>Lecturer</b>	Dozenten des Fachbereiches Mathematik der UHH
<b>Language</b>	DE
<b>Cycle</b>	SoSe
<b>Content</b>	See interlocking course
<b>Literature</b>	See interlocking course

<b>Course L0915: Linear Algebra II</b>	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Anusch Taraz, Prof. Marko Lindner
<b>Language</b>	DE
<b>Cycle</b>	SoSe
<b>Content</b>	<ul style="list-style-type: none"> <li>• general vector spaces: subspaces, Euclidean vector spaces</li> <li>• linear mappings: basis transformation, orthogonal projection, orthogonal matrices, householder matrices</li> <li>• linear regression: normal equations, linear discrete approximation</li> <li>• eigenvalues: diagonalising matrices, normal matrices, symmetric and Hermite matrices</li> <li>• system of linear differential equations</li> <li>• matrix factorizations: LR-decomposition, QR-decomposition, Schur decomposition, Jordan normal form, singular value decomposition</li> </ul>
<b>Literature</b>	<ul style="list-style-type: none"> <li>• T. Arens u.a. : Mathematik, Spektrum Akademischer Verlag, Heidelberg 2009</li> <li>• W. Mackens, H. Voß: Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994</li> <li>• W. Mackens, H. Voß: Aufgaben und Lösungen zur Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994</li> <li>• G. Strang: Lineare Algebra, Springer-Verlag, 2003</li> <li>• G. und S. Teschl: Mathematik für Informatiker, Band 1, Springer-Verlag, 2013</li> </ul>

<b>Course L0916: Linear Algebra II</b>	
<b>Typ</b>	Recitation Section (small)
<b>Hrs/wk</b>	1
<b>CP</b>	1
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
<b>Lecturer</b>	Prof. Anusch Taraz, Prof. Marko Lindner
<b>Language</b>	DE
<b>Cycle</b>	SoSe
<b>Content</b>	<ul style="list-style-type: none"> <li>• linear mappings: basis transformation, orthogonal projection, orthogonal matrices, householder matrices</li> <li>• linear regression: QR-decomposition, normal equations, linear discrete approximation</li> <li>• eigenvalues: diagonalising matrices, normal matrices, symmetric and Hermite matrices, Jordan normal form, singular value decomposition</li> <li>• system of linear differential equations</li> </ul>
<b>Literature</b>	<ul style="list-style-type: none"> <li>• W. Mackens, H. Voß: Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994</li> <li>• W. Mackens, H. Voß: Aufgaben und Lösungen zur Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994</li> </ul>

<b>Course L0917: Linear Algebra II</b>	
<b>Typ</b>	Recitation Section (large)
<b>Hrs/wk</b>	1
<b>CP</b>	1
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
<b>Lecturer</b>	Prof. Anusch Taraz, Prof. Marko Lindner, Dr. Christian Seifert, Dr. Julian Großmann
<b>Language</b>	DE
<b>Cycle</b>	SoSe
<b>Content</b>	See interlocking course
<b>Literature</b>	See interlocking course

## Module M0976: Waste and Soil

### Courses

<b>Title</b>	<b>Typ</b>	<b>Hrs/wk</b>	<b>CP</b>
Waste, Biology and Soil (L1174)	Lecture	2	2
Waste resource Management (L0322)	Lecture	2	2
Waste resource Management (L1173)	Recitation (large)	Section 1	2
<b>Module Responsible</b>	Prof. Kerstin Kuchta		
<b>Admission Requirements</b>	None		
<b>Recommended Previous Knowledge</b>	chemical basics		
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results		
<b>Professional Competence</b>	<p><i>Knowledge</i></p> <p>The students know how to describe relevant waste resources as well as the principles for the collection, the treatment of waste resources and primary resource mining. They are able to discuss resource strategies, like decoupling and urban mining as well as the consequences of worldwide demand on renewable and non-renewable resources. Additional, obstacles and efforts of waste resource management and urban mining and new technological approaches can be identified by the students.</p> <p><i>Skills</i></p> <p>The students know relevant waste resources as well as the principles for the collection, the treatment of waste resources and primary resource mining. They have knowledge about resource strategies, like decoupling and urban mining as well as the consequences of worldwide demand on renewable and non-renewable resources. Additional, obstacles and efforts of waste resource management and urban mining and new technological approaches are identified.</p> <p>The students are capable to make their own decisions with respect to the selection of suitable resources and ecologically/economically feasible treatment processes.</p>		
<b>Personal Competence</b>	<p><i>Social Competence</i></p> <p>Students can</p> <ul style="list-style-type: none"> <li>• participate in subject-specific and interdisciplinary discussions,</li> <li>• develop cooperated solutions</li> <li>• defend their own work results in front of others</li> <li>• promote the scientific development of colleagues.</li> <li>• Furthermore, they can give and accept professional constructive criticism.</li> </ul> <p><i>Autonomy</i></p> <p>Furthermore, they can define targets for new application-or research-oriented duties in accordance with the potential social, economic and cultural impact.</p>		
<b>Workload in Hours</b>	Independent Study Time 110, Study Time in Lecture 70		
<b>Credit points</b>	6		
<b>Course achievement</b>	None		
<b>Examination</b>	Written exam		
<b>Examination duration and</b>	1 hour		

<b>scale</b>	
<b>Assignment for the Following Curricula</b>	Civil- and Environmental Engineering: Core qualification: Compulsory Orientierungsstudium: Core qualification: Elective Compulsory

<b>Course L1174: Waste, Biology and Soil</b>	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Kerstin Kuchta
<b>Language</b>	EN
<b>Cycle</b>	SoSe
<b>Content</b>	<p>Students will learn ecological and economical consequences as well as appropriate alternatives to conventional treatment of organic wastes, focusing integrated solution and concepts. Therefore, biological processes in soil, composting and anaerobic digestion will be the main topic of the course. Based on general roles, biological basics, entropic discussions and efficiency definition, specific technologies and combined or integrated processes will be taught. Seldom-used technologies, foreign developments and innovative own research concepts are presented. Students learn recycling of organic wastes in the context of sustainable material management and learn to develop systematic solutions. Topics are, e.g.</p> <ul style="list-style-type: none"> <li>• Basics of biology</li> <li>• Degradation principles of organic substances in soil and waste</li> <li>• Contaminate soils and sites</li> <li>• Identification, evaluation and remediation of contaminate soils</li> <li>• Microbiological remediation processes</li> </ul>
<b>Literature</b>	<p>1) <b>Waste Management.</b> Bernd Bilitewski; Georg Härdtle; Klaus Marek (Eds.), ISBN: 9783540592105 , Springer Verlag Lehrbuchsammlung der TUB, Signatur USH-305</p> <p>2) <b>Solid Waste Technology and Management.</b> Thomas Christensen (Ed.), ISBN: 978-1-4051-7517-3 , Wiley Verlag Lesesaal 2: US - Umweltschutz, Signatur USH-332</p> <p>3 ) <b>Natural attenuation of fuels and chlorinated solvents in the subsurface.</b> Todd H. Wiedemeier(Ed.), ISBN: 0471197491 Lesesaal 2: US - Umweltschutz, Signatur USH-844</p>



<b>Course L0322: Waste resource Management</b>	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Kerstin Kuchta, Mehmet Kücükler
<b>Language</b>	EN
<b>Cycle</b>	SoSe
<b>Content</b>	<ul style="list-style-type: none"> <li>• Decoupling</li> <li>• Waste as a resource</li> <li>• Resource Biomass - Food Waste</li> <li>• Resource Biomass - Waste Wood</li> <li>• Resource Biomass- Paper</li> <li>• Ores and industrial minerals - Aluminum</li> <li>• Ores and industrial minerals- Gold</li> <li>• Ores and industrial minerals - Copper</li> <li>• Fossil Energy carrier- RDF</li> <li>• Fossil Energy carrier - Biogas</li> <li>• Fossil Energy carrier - Plastic</li> <li>• Construction Material</li> </ul>
<b>Literature</b>	<ul style="list-style-type: none"> <li>• Decoupling natural Resource Use and Environmental impacts from economic growth UNEP 2011</li> <li>• Waste Management International: Journal of Integrated Waste Management, Science and Technology, Elsevier</li> <li>• <b>International Journal of Waste Resources (IJWR)</b>[ISSN: 2252-5211]</li> </ul>

<b>Course L1173: Waste resource Management</b>	
<b>Typ</b>	Recitation Section (large)
<b>Hrs/wk</b>	1
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 46, Study Time in Lecture 14
<b>Lecturer</b>	Prof. Kerstin Kuchta, Mehmet Kücükler
<b>Language</b>	EN
<b>Cycle</b>	SoSe
<b>Content</b>	<p>Decoupling  Waste as a resource  Resource Biomass - Food Waste  Resource Biomass - Waste Wood  Resource Biomass- Paper  Ores and industrial minerals - Aluminum  Ores and industrial minerals- Gold  Ores and industrial minerals - Copper  Fossil Energy carrier- RDF  Fossil Energy carrier - Biogas  Fossil Energy carrier - Plastic  Construction Material</p>
<b>Literature</b>	

Module M0590: Building Materials and Building Chemistry				
<b>Courses</b>				
<b>Title</b>		<b>Typ</b>	<b>Hrs/wk</b>	<b>CP</b>
Building Materials and Building Chemistry (L0248)		Lecture	4	4
Building Materials and Building Chemistry (L0249)		Recitation (small)	Section 1	2
<b>Module Responsible</b>	Prof. Frank Schmidt-Döhl			
<b>Admission Requirements</b>	None			
<b>Recommended Previous Knowledge</b>	Module Principles of Building Materials and Building Physics			
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results			
<b>Professional Competence</b>				
<i>Knowledge</i>	The students are able to explain the most important components, the manufacture, the structure, the most important characteristics of the mechanical behaviour and the corrosion behaviour, the material testing and the fields of utilization of all relevant building materials.			
<i>Skills</i>	The students are able to assess the usability of building materials for different applications and to select building materials according to their specific advantages and disadvantages. The students are able to prepare the mixture of a normal type concrete and to consider the mixture in respect to the actual rules and the connections between the characteristic concrete parameters. They are able to select suitable materials and mixtures to avoid damage processes.			
<b>Personal Competence</b>				
<i>Social Competence</i>	The students are able to support each other to learn the very extensive specialist knowledge in learning groups and to carry out exercises in small groups in the lab.			
<i>Autonomy</i>	The students are able to make the timing and the operation steps to learn the specialist knowledge of a very extensive field.			
<b>Workload in Hours</b>	Independent Study Time 110, Study Time in Lecture 70			
<b>Credit points</b>	6			
<b>Course achievement</b>	<b>Compulsory</b>	<b>Bonus</b>	<b>Form</b>	<b>Description</b>
	No	10 %	Presentation	
<b>Examination</b>	Written exam			
<b>Examination duration and scale</b>	2 h written exam			
<b>Assignment for the Following Curricula</b>	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory Civil- and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory Orientierungsstudium: Core qualification: Elective Compulsory			

<b>Course L0248: Building Materials and Building Chemistry</b>	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	4
<b>CP</b>	4
<b>Workload in Hours</b>	Independent Study Time 64, Study Time in Lecture 56
<b>Lecturer</b>	Prof. Frank Schmidt-Döhl
<b>Language</b>	DE
<b>Cycle</b>	SoSe
<b>Content</b>	Cementing materials, aggregates, admixtures and other components in mortar and concrete, concrete, durability of cement bonded materials, repair of concrete structures, steel, cast iron, non-ferrous metals, metal corrosion, timber, plastics, natural stone, synthetic stones, mortar, masonry, glass, bitumen
<b>Literature</b>	Wendehorst, R.: Baustoffkunde. ISBN 3-8351-0132-3 Scholz, W.: Baustoffkenntnis. ISBN 3-8041-4197-8 Henning, O.; Knöfel, D.: Baustoffchemie. ISBN 3-345-00799-1 Knoblauch, H.; Schneider, U.: Bauchemie. ISBN 3-8041-5174-4

<b>Course L0249: Building Materials and Building Chemistry</b>	
<b>Typ</b>	Recitation Section (small)
<b>Hrs/wk</b>	1
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 46, Study Time in Lecture 14
<b>Lecturer</b>	Prof. Frank Schmidt-Döhl, André Rössler
<b>Language</b>	DE
<b>Cycle</b>	SoSe
<b>Content</b>	See interlocking course
<b>Literature</b>	See interlocking course

Module M0740: Structural Analysis I				
<b>Courses</b>				
<b>Title</b>		<b>Typ</b>	<b>Hrs/wk</b>	<b>CP</b>
Structural Analysis I (L0666)		Lecture	2	3
Structural Analysis I (L0667)		Recitation (large)	Section 2	3
<b>Module Responsible</b>	Prof. Uwe Starossek			
<b>Admission Requirements</b>	None			
<b>Recommended Previous Knowledge</b>	Mechanics I, Mathematics I			
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results			
<b>Professional Competence</b>				
<i>Knowledge</i>	After successfully completing this module, students can express the basic aspects of linear frame analysis of statically determinate systems.			
<i>Skills</i>	After successful completion of this module, the students are able to distinguish between statically determinate and indeterminate structures. They are able to analyze state variables and to construct influence lines of statically determinate plane and spatial frame and truss structures.			
<b>Personal Competence</b>	Students can			
<i>Social Competence</i>	<ul style="list-style-type: none"> <li>• participate in subject-specific and interdisciplinary discussions,</li> <li>• defend their own work results in front of others</li> <li>• promote the scientific development of colleagues</li> <li>• Furthermore, they can give and accept professional constructive criticism</li> </ul>			
<i>Autonomy</i>	The students are able work in-term homework assignments. Due to the in-term feedback, they are enabled to self-assess their learning progress during the lecture period, already.			
<b>Workload in Hours</b>	Independent Study Time 124, Study Time in Lecture 56			
<b>Credit points</b>	6			
<b>Course achievement</b>	<b>Compulsory</b>	<b>Bonus</b>	<b>Form</b>	<b>Description</b>
	No	10 %	Written elaboration	Hausübungen mit Testat, betreut durch Studentische Tutoren (Tutorium)
<b>Examination</b>	Written exam			
<b>Examination duration and scale</b>	90 Minuten			
<b>Assignment for the Following Curricula</b>	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory Civil- and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory			

<b>Course L0666: Structural Analysis I</b>	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	3
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Uwe Starossek
<b>Language</b>	DE
<b>Cycle</b>	WiSe
<b>Content</b>	<p>Statically determinate structural systems</p> <ul style="list-style-type: none"> <li>• basics: statically determinacy, equilibrium, method of sections</li> <li>• forces: determination of support reactions and internal forces</li> <li>• influence lines of forces</li> <li>• displacements: calculation of discrete displacements and rotations, calculation of deflection curves</li> <li>• principle of virtual displacements and virtual forces</li> <li>• work-energy theorem</li> <li>• differential equation of beam</li> </ul>
<b>Literature</b>	Krätzig, W.B., Harte, R., Meskouris, K., Wittek, U.: Tragwerke 1 - Theorie und Berechnungsmethoden statisch bestimmter Stabtragwerke. 4. Aufl., Springer, Berlin, 1999.

<b>Course L0667: Structural Analysis I</b>	
<b>Typ</b>	Recitation Section (large)
<b>Hrs/wk</b>	2
<b>CP</b>	3
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Uwe Starossek
<b>Language</b>	DE
<b>Cycle</b>	WiSe
<b>Content</b>	See interlocking course
<b>Literature</b>	See interlocking course

## Module M0728: Hydromechanics and Hydrology

### Courses

Title	Typ	Hrs/wk	CP
Hydrology (L0909)	Lecture	1	1
Hydrology (L0956)	Project-/problem-based Learning	1	1
Hydromechanics (L0615)	Lecture	2	2
Hydromechanics (L0616)	Project-/problem-based Learning	1	2

<b>Module Responsible</b>	Prof. Peter Fröhle
<b>Admission Requirements</b>	None
<b>Recommended Previous Knowledge</b>	Mathematics I, II and III Mechanics I und II
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results
<b>Professional Competence</b>	<p><i>Knowledge</i></p> <p>The students are able to define the basic terms of hydromechanics, hydrology groundwater hydrology and water management. They are able to derive the basic formulations of i) hydrostatics, ii) kinematics of flows and iii) conservation laws and to describe and quantify the relevant processes of the hydrological water cycle. Besides, the students can describe the main aspects of rainfall-run-off-modelling and of established reservoir / storage models as well as the concepts of the determination of a unit-hydrograph.</p> <p><i>Skills</i></p> <p>The students are able to apply the fundamental formulations of hydromechanics to basic practical problems. Furthermore, they are able to run, explain and document basic hydraulic experiments.</p> <p>Besides, they are able to apply basic hydrological approaches and methods to simple hydrological problems. The students have the capability to exemplarily apply simple reservoir/storage models and a unit-hydrograph to given problems.</p> <p>In addition, the basic concepts of field-measurements of hydrological and hydrodynamic values can be described and the students are able to perform, analyze and assess respective measurements.</p> <p style="text-align: center;"><b>Personal Competence</b></p> <p><i>Social Competence</i></p> <p>The students are able to work in groups in a goal-orientated, structured manner. They can explain their results sustainably in plenary sessions by use of peer learning approaches. Furthermore, they are able to prepare and present technical presentations for given topics in groups.</p> <p><i>Autonomy</i></p> <p>Students are capable of organising their individual work flow to contribute to the conduct of experiments and to present discipline-specific knowledge. They can provide each other with feedback and suggestions on their results. They are capable of reflecting their study techniques and learning strategy on an individual basis.</p>
<b>Workload in Hours</b>	Independent Study Time 110, Study Time in Lecture 70
<b>Credit points</b>	6
<b>Course achievement</b>	None

<b>Examination</b>	Written exam
<b>Examination duration and scale</b>	120 minutes
<b>Assignment for the Following Curricula</b>	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory Civil- and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory

<b>Course L0909: Hydrology</b>	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	1
<b>CP</b>	1
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
<b>Lecturer</b>	Prof. Peter Fröhle
<b>Language</b>	DE
<b>Cycle</b>	WiSe
<b>Content</b>	<p>Introduction to basics of hydrology and groundwater hydrology:</p> <ul style="list-style-type: none"> <li>• Hydrological cycle</li> <li>• Data acquisition in hydrology</li> <li>• Data analyses and statistical assessment</li> <li>• Statistics of extremes</li> <li>• Regionalization methods for hydrological values</li> <li>• rainfall-run-off modelling on the basis of a unit hydrograph concept</li> </ul>
<b>Literature</b>	<p>Maniak, U. (2017). Hydrologie und Wasserwirtschaft: Eine Einführung für Ingenieure. Springer Vieweg.</p> <p>Skript "Hydrologie und Gewässerkunde"</p>

<b>Course L0956: Hydrology</b>	
<b>Typ</b>	Project-/problem-based Learning
<b>Hrs/wk</b>	1
<b>CP</b>	1
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
<b>Lecturer</b>	Prof. Peter Fröhle
<b>Language</b>	DE
<b>Cycle</b>	WiSe
<b>Content</b>	<p>Introduction to basics of Hydrology:</p> <ul style="list-style-type: none"> <li>• Hydrological cycle</li> <li>• Data acquisition</li> <li>• Data analyses and statistical assessment</li> <li>• Statistics of extremes</li> <li>• Regionalization methods for hydrological values</li> </ul> <p>Rainfall-run-off modelling on the basis of a unit hydrograph concepts</p>
<b>Literature</b>	<p>Maniak, Hydrologie und Wasserwirtschaft, Eine Einführung für Ingenieure, Springer</p> <p>Skript Hydrologie und Gewässerkunde</p>

<b>Course L0615: Hydromechanics</b>	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Peter Fröhle
<b>Language</b>	DE
<b>Cycle</b>	WiSe
<b>Content</b>	<p>Fundamentals of Hydromechanics</p> <ul style="list-style-type: none"> <li>• Characteristics of fluids</li> <li>• Hydrostatics</li> <li>• Kinematics of flows, laminar and turbulent flows</li> <li>• Conservation laws <ul style="list-style-type: none"> <li>◦ Conservation of mass</li> <li>◦ Conservation of Energy</li> <li>◦ Momentum Equation</li> </ul> </li> <li>• Application of conservation laws to flow conditions</li> </ul>
<b>Literature</b>	<p>Skript zur Vorlesung Hydromechanik/Hydraulik, Kapitel 1-2</p> <p>E-Learning Werkzeug: Hydromechanik und hydraulik (Link): (<a href="http://www.tu-harburg.de/.../hydraulik_tool/index.html">http://www.tu-harburg.de/ ... hydraulik_tool/index.html</a>)</p> <p>Truckenbrodt, E.: Lehrbuch der angewandten Fluidmechanik, Springer Verlag, Berlin, 1998.</p> <p>Truckenbrodt, E.: Grundlagen und elementare Strömungsvorgänge dichtebeständiger Fluide / Fluidmechanik, Springer Verlag, Berlin, 1996.</p>

<b>Course L0616: Hydromechanics</b>	
<b>Typ</b>	Project-/problem-based Learning
<b>Hrs/wk</b>	1
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 46, Study Time in Lecture 14
<b>Lecturer</b>	Prof. Peter Fröhle
<b>Language</b>	DE
<b>Cycle</b>	WiSe
<b>Content</b>	See interlocking course
<b>Literature</b>	See interlocking course



## Module M0853: Mathematics III

### Courses

Title	Typ	Hrs/wk	CP
Analysis III (L1028)	Lecture	2	2
Analysis III (L1029)	Recitation (small)	Section 1	1
Analysis III (L1030)	Recitation (large)	Section 1	1
Differential Equations 1 (Ordinary Differential Equations) (L1031)	Lecture	2	2
Differential Equations 1 (Ordinary Differential Equations) (L1032)	Recitation (small)	Section 1	1
Differential Equations 1 (Ordinary Differential Equations) (L1033)	Recitation (large)	Section 1	1

<b>Module Responsible</b>	Prof. Anusch Taraz
<b>Admission Requirements</b>	None
<b>Recommended Previous Knowledge</b>	Mathematics I + II
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results
<b>Professional Competence</b>	
<i>Knowledge</i>	<ul style="list-style-type: none"> <li>• Students can name the basic concepts in the area of analysis and differential equations. They are able to explain them using appropriate examples.</li> <li>• Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples.</li> <li>• They know proof strategies and can reproduce them.</li> </ul>
<i>Skills</i>	<ul style="list-style-type: none"> <li>• Students can model problems in the area of analysis and differential equations with the help of the concepts studied in this course. Moreover, they are capable of solving them by applying established methods.</li> <li>• Students are able to discover and verify further logical connections between the concepts studied in the course.</li> <li>• For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results.</li> </ul>
<b>Personal Competence</b>	
<i>Social Competence</i>	<ul style="list-style-type: none"> <li>• Students are able to work together in teams. They are capable to use mathematics as a common language.</li> <li>• In doing so, they can communicate new concepts according to the needs of their cooperating partners. Moreover, they can design examples to check and deepen the understanding of their peers.</li> </ul>
<i>Autonomy</i>	<ul style="list-style-type: none"> <li>• Students are capable of checking their understanding of complex concepts on their own. They can specify open questions precisely and know where to get help in solving them.</li> <li>• Students have developed sufficient persistence to be able to work for longer</li> </ul>

	periods in a goal-oriented manner on hard problems.
<b>Workload in Hours</b>	Independent Study Time 128, Study Time in Lecture 112
<b>Credit points</b>	8
<b>Course achievement</b>	None
<b>Examination</b>	Written exam
<b>Examination duration and scale</b>	60 min (Analysis III) + 60 min (Differential Equations 1)
<b>Assignment for the Following Curricula</b>	<p>General Engineering Science (German program, 7 semester): Core qualification: Compulsory</p> <p>Civil- and Environmental Engineering: Core qualification: Compulsory</p> <p>Bioprocess Engineering: Core qualification: Compulsory</p> <p>Computer Science: Core qualification: Compulsory</p> <p>Data Science: Core qualification: Compulsory</p> <p>Digital Mechanical Engineering: Core qualification: Compulsory</p> <p>Electrical Engineering: Core qualification: Compulsory</p> <p>Energy and Environmental Engineering: Core qualification: Compulsory</p> <p>Engineering Science: Core qualification: Compulsory</p> <p>General Engineering Science (English program, 7 semester): Core qualification: Compulsory</p> <p>Computational Science and Engineering: Core qualification: Compulsory</p> <p>Mechanical Engineering: Core qualification: Compulsory</p> <p>Mechatronics: Core qualification: Compulsory</p> <p>Naval Architecture: Core qualification: Compulsory</p> <p>Process Engineering: Core qualification: Compulsory</p>

<b>Course L1028: Analysis III</b>	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Lecturer</b>	Dozenten des Fachbereiches Mathematik der UHH
<b>Language</b>	DE
<b>Cycle</b>	WiSe
<b>Content</b>	<p>Main features of differential and integrational calculus of several variables</p> <ul style="list-style-type: none"> <li>• Differential calculus for several variables</li> <li>• Mean value theorems and Taylor's theorem</li> <li>• Maximum and minimum values</li> <li>• Implicit functions</li> <li>• Minimization under equality constraints</li> <li>• Newton's method for multiple variables</li> <li>• Double integrals over general regions</li> <li>• Line and surface integrals</li> <li>• Theorems of Gauß and Stokes</li> </ul>
<b>Literature</b>	<ul style="list-style-type: none"> <li>• <a href="http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html">http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html</a></li> </ul>

<b>Course L1029: Analysis III</b>	
<b>Typ</b>	Recitation Section (small)
<b>Hrs/wk</b>	1
<b>CP</b>	1
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
<b>Lecturer</b>	Dozenten des Fachbereiches Mathematik der UHH
<b>Language</b>	DE
<b>Cycle</b>	WiSe
<b>Content</b>	See interlocking course
<b>Literature</b>	See interlocking course

<b>Course L1030: Analysis III</b>	
<b>Typ</b>	Recitation Section (large)
<b>Hrs/wk</b>	1
<b>CP</b>	1
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
<b>Lecturer</b>	Dozenten des Fachbereiches Mathematik der UHH
<b>Language</b>	DE
<b>Cycle</b>	WiSe
<b>Content</b>	See interlocking course
<b>Literature</b>	See interlocking course

<b>Course L1031: Differential Equations 1 (Ordinary Differential Equations)</b>	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Lecturer</b>	Dozenten des Fachbereiches Mathematik der UHH
<b>Language</b>	DE
<b>Cycle</b>	WiSe
<b>Content</b>	<p>Main features of the theory and numerical treatment of ordinary differential equations</p> <ul style="list-style-type: none"> <li>• Introduction and elementary methods</li> <li>• Existence and uniqueness of initial value problems</li> <li>• Linear differential equations</li> <li>• Stability and qualitative behaviour of the solution</li> <li>• Boundary value problems and basic concepts of calculus of variations</li> <li>• Eigenvalue problems</li> <li>• Numerical methods for the integration of initial and boundary value problems</li> <li>• Classification of partial differential equations</li> </ul>
<b>Literature</b>	<ul style="list-style-type: none"> <li>• <a href="http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html">http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html</a></li> </ul>

<b>Course L1032: Differential Equations 1 (Ordinary Differential Equations)</b>	
<b>Typ</b>	Recitation Section (small)
<b>Hrs/wk</b>	1
<b>CP</b>	1
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
<b>Lecturer</b>	Dozenten des Fachbereiches Mathematik der UHH
<b>Language</b>	DE
<b>Cycle</b>	WiSe
<b>Content</b>	See interlocking course
<b>Literature</b>	See interlocking course

<b>Course L1033: Differential Equations 1 (Ordinary Differential Equations)</b>	
<b>Typ</b>	Recitation Section (large)
<b>Hrs/wk</b>	1
<b>CP</b>	1
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
<b>Lecturer</b>	Dozenten des Fachbereiches Mathematik der UHH
<b>Language</b>	DE
<b>Cycle</b>	WiSe
<b>Content</b>	See interlocking course
<b>Literature</b>	See interlocking course

## Module M0878: Applications in Civil and Environmental Engineering

### Courses

Title	Typ	Hrs/wk	CP
Applied Structural Dynamics (L0791)	Lecture	2	2
Soil Laboratory Course (L0499)	Practical Course	1	2
Building Information Modeling (L1903)	Lecture	1	1
Building Information Modeling (L1904)	Project-/problem-based Learning	2	2
Computational Analysis of Structures (L0370)	Lecture	2	3
Introduction in Statitics with R (L0286)	Lecture	1	1
Introduction in Statitics with R (L0776)	Recitation (large) Section	1	1
Principles of Geomatics (L0470)	Lecture	2	2
Principles of Geomatics (L0471)	Recitation (small) Section	2	2
Numeric and Matlab (L0125)	Practical Course	2	2
Practical Course in Drinking Water Chemistry (L1744)	Practical Course	1	2
Projects II (L1228)	Project Seminar	2	2
Special topics of Civil- and Environmental Engineering (L2411)		1	1
Special topics of Civil- and Environmental Engineering 2 LP (L2412)		2	2
Special topics of Civil- and Environmental Engineering 3LP (L2413)		3	3
Fire Protection and Prevention (L0472)	Lecture	2	2

<b>Module Responsible</b>	Prof. Peter Fröhle
<b>Admission Requirements</b>	None
<b>Recommended Previous Knowledge</b>	none
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results
<b>Professional Competence</b>	
<i>Knowledge</i>	The students are at home doing with typical applications of the study programme.
<i>Skills</i>	The students are able to use the methods that are provided during the lectures for practical questions. They are able to work in the learnt methods into new forms of application independently".
<b>Personal Competence</b>	
<i>Social Competence</i>	According to the course chosen students are able to perform tasks or to conduct a project in teams. If so, they can present, discuss and document results accordingly.
<i>Autonomy</i>	According to the course chosen individual students can plan and document tasks and work flow for themselves or for the team.
<b>Workload in Hours</b>	Depends on choice of courses
<b>Credit points</b>	6
<b>Assignment for</b>	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Elective Compulsory

<b>the Following Curricula</b>	Civil- and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Elective Compulsory
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<b>Course L0791: Applied Structural Dynamics</b>	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Examination Form</b>	Mündliche Prüfung
<b>Examination duration and scale</b>	15 min
<b>Lecturer</b>	Dr. Kira Holtzendorff
<b>Language</b>	DE
<b>Cycle</b>	WiSe
<b>Content</b>	<p>The lecture gives an introduction into the classical structural dynamics, whereas the focus lies on the practical applications. The theoretical basics are worked out in order to apply them for typical issues in practice. For an effective vibration isolation due to vibration excitations by e.g. railway traffic, operating machines oder moving people, different structural measures are presented. The lecture is completed by performing examples of vibration measurements as well as interactive dynamic experiments in the laboratory.</p> <p>The following topics are covered:</p> <ul style="list-style-type: none"> <li>Particular features in structural dynamics</li> <li>Basic terms of time-dependent excitations</li> <li>Free vibrations (natural frequencies)</li> <li>Induced vibrations</li> <li>Impact excitations of structures</li> <li>Methods of amplitude reduction (vibration isolation)</li> <li>Introduction to soil dynamics</li> <li>Vibration measurements and requirements for vibration protection</li> <li>Vibrations induced by people</li> </ul>
<b>Literature</b>	<p>Helmut Kramer: Angewandte Baudynamik, Ernst &amp; Sohn Verlag, 2. Auflage 2013</p> <p>Christian Petersen: Dynamik der Baukonstruktionen, Vieweg Verlag, 2. Auflage von 2000</p>

<b>Course L0499: Soil Laboratory Course</b>	
<b>Typ</b>	Practical Course
<b>Hrs/wk</b>	1
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 46, Study Time in Lecture 14
<b>Examination Form</b>	Schriftliche Ausarbeitung
<b>Examination duration and scale</b>	Die gesamte Arbeitszeit im Praktikum plus anschließender Bericht = 90 Stunden Arbeitszeit (Das Erstellen der Ausarbeitung = Bearbeitungszeitraum von 4 Wochen und ein Umfang von maximal 50 Seiten.)
<b>Lecturer</b>	Prof. Jürgen Grabe
<b>Language</b>	DE
<b>Cycle</b>	WiSe
<b>Content</b>	<ul style="list-style-type: none"> <li>• Field experiments</li> <li>• Short lecture on laboratory tests</li> <li>• soil analysis</li> <li>• laboratory test</li> <li>• soil clasification</li> <li>• Creating a ground and foundation report</li> </ul>
<b>Literature</b>	<ul style="list-style-type: none"> <li>• DIN-Taschenbuch 113, Erkundung und Untersuchung des Baugrundes</li> </ul>

Course L1903: Building Information Modeling	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	1
<b>CP</b>	1
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
<b>Examination Form</b>	Schriftliche Ausarbeitung
<b>Examination duration and scale</b>	siehe Modulhandbuch
<b>Lecturer</b>	Prof. Frank Schmidt-Döhl, Thomas Kölzer
<b>Language</b>	DE
<b>Cycle</b>	WiSe/SoSe
<b>Content</b>	<p>Basic knowledge of Building Information Modeling:</p> <ul style="list-style-type: none"> <li>• <b>Introduction to BIM</b> (development, backgrounds, history, opportunities, risks, levels)</li> <li>• <b>Current standards and guidelines</b> (national and international standardisation, structures)</li> <li>• <b>Applications of BIM</b> (openBIM, closedBIM, littleBIM, data and interchange formats)</li> <li>• <b>Object oriented modeling</b> (requirements, structure, classification, parts catalogues)</li> <li>• <b>BIM-Implementation</b> (structures, cycles, professions, job profiles, execution plan)</li> <li>• <b>BIM-Tools</b> (software, hardware, application areas)</li> <li>• <b>Execution examples</b> (national and international construction projects)</li> </ul> <p>Basic knowledge for the use of the software Allplan 2018:</p> <ul style="list-style-type: none"> <li>• <b>Basic settings</b> (project administration, building structures, fileset structures, layers)</li> <li>• <b>Construction fundamentals 2D</b> (e. g. line, circle, spline, ellipse, parallel etc.)</li> <li>• <b>Modifying of construction elements</b> (e. g. copy, mirror, intersect, fillet etc.)</li> <li>• <b>Dimensioning and text adding of designed elements and structural components</b></li> <li>• <b>Generating of areas</b> (hatchings, patterns, fills)</li> <li>• <b>Construction fundamentals 3D</b> (floor concept, floor manager, building structures)</li> <li>• <b>Walls and columns</b> (height definitions, parameters, attributes, format properties)</li> <li>• <b>Slabs</b> (height definitions, parameters, attributes, format properties)</li> <li>• <b>Use of libraries</b> (u. a. furnitures, surroundings etc.)</li> <li>• <b>Opening Elements and SmartParts</b> (doors and windows)</li> <li>• <b>Stairs and ramps</b> (stair wizard, IFC-Ramp)</li> <li>• <b>Roof frame and roof covering</b> (custom planes, parameters, attributes, format properties)</li> <li>• <b>Attributes and characteristic values</b> (allocations and modifications)</li> <li>• <b>Export and Import of IFC-Data</b> (basics, floor allocation, fileset selection)</li> <li>• <b>Generating of sections and views</b> (architectural sections and associative sections)</li> <li>• <b>Generating of printable drawings</b> (layouts, scales, page settings)</li> </ul>
<b>Literature</b>	-



<b>Course L1904: Building Information Modeling</b>	
<b>Typ</b>	Project-/problem-based Learning
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Examination Form</b>	Schriftliche Ausarbeitung
<b>Examination duration and scale</b>	siehe Modulhandbuch
<b>Lecturer</b>	Prof. Frank Schmidt-Döhl, Thomas Kölzer
<b>Language</b>	DE
<b>Cycle</b>	WiSe/SoSe
<b>Content</b>	See interlocking course
<b>Literature</b>	See interlocking course

<b>Course L0370: Computational Analysis of Structures</b>	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	3
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28
<b>Examination Form</b>	Klausur
<b>Examination duration and scale</b>	60 min
<b>Lecturer</b>	Prof. Günter Rombach
<b>Language</b>	DE
<b>Cycle</b>	WiSe
<b>Content</b>	<ul style="list-style-type: none"> <li>• basics of the Finite Element Method, Spreadsheets</li> <li>• basics of software 'SOFISTIK'</li> <li>• modeling of an arbitrary cross-section</li> <li>• modeling of an arbitrary 2D truss structure incl. loads</li> <li>• Teddy: usage of global and local variables</li> <li>• design of a concrete section</li> <li>• modeling of a T-beam bridge by means of a grillage system</li> <li>• modeling and design of a rectangular slab</li> <li>• building models</li> </ul>
<b>Literature</b>	<ul style="list-style-type: none"> <li>• Vorlesungsunterlagen können im STUDiP heruntergeladen werden</li> <li>• Tutorials von SOFiSTIK</li> <li>• Rombach G.: Anwendung der Finite - Elemente - Methode im Betonbau. 2. Auflage. Verlag Ernst &amp; Sohn, Berlin, 2007</li> <li>• Rombach G.: Finite-Element Design of Concrete Structures. 2nd edition, ICE Publishing, London, 2011, ISBN 0 7277 32749</li> <li>• Rombach G.: EDV-unterstützte Berechnungen im Stahlbetonbau. in: „Stahlbetonbau aktuell 2014“ (ed. Gorris A., Hegger J., Mark P.), Berlin 2014 (S. C1.-C.36)</li> </ul>

<b>Course L0286: Introduction in Statistics with R</b>	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	1
<b>CP</b>	1
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
<b>Examination Form</b>	Klausur
<b>Examination duration and scale</b>	60 min
<b>Lecturer</b>	Dr. Joachim Behrendt
<b>Language</b>	DE
<b>Cycle</b>	WiSe
<b>Content</b>	<p>Introduction to R</p> <p>Graphics with R</p> <p>Descriptive Statistic (Boxplot, Percentiles, outliers)</p> <p>Propability (Combinatorics, relative frequency, dependand probability)</p> <p>random numbers and distibutions (confidence interval, uniform and discrete distributions, test-distributions (t-F-X<sup>2</sup>-distribuition))</p> <p>Correlation and Regression analysis (Confidence interval of calibration curves, linearity)</p> <p>Statistic test procedures (mean value-t-Test, Chi<sup>2</sup>-Test, F-Test)</p> <p>Analysis of variance (ANOVA, Bartlett-Test, Kruskal-Wallis Rank sum test)</p> <p>Introduction time series (tseries)</p> <p>Introduction cluster analysis (k-means)</p>
<b>Literature</b>	<p><b>Regionales Rechenzentrum für Niedersachsen</b></p> <p>Statistik mit R Grundlagen der Datenanalyse , 2013</p> <p>Einführung in die Statistik mit R, Andreas Handl, Skript Uni Bielefeld <a href="http://www.wiwi.uni-bielefeld.de/fileadmin/emeriti/frohn/handl_grundausbildung/statskript.pdf">http://www.wiwi.uni-bielefeld.de/fileadmin/emeriti/frohn/handl_grundausbildung/statskript.pdf</a></p> <p>und die dazugehörige Aufgabensammlung <a href="http://www.wiwi.uni-bielefeld.de/fileadmin/emeriti/frohn/handl_grundausbildung/statauf.pdf">http://www.wiwi.uni-bielefeld.de/fileadmin/emeriti/frohn/handl_grundausbildung/statauf.pdf</a></p> <p>Induktive Statistik [Elektronische Ressource] : eine Einführung mit R und SPSS / Helge... von Toutenburg, Helge 2008 <a href="http://dx.doi.org/10.1007/978-3-540-77510-2">http://dx.doi.org/10.1007/978-3-540-77510-2</a><a href="http://dx.doi.org/10.1007/978-3-540-77510-2">http://dx.doi.org/10.1007/978-3-540-77510-2</a></p> <p>R-Referenzcard: <a href="http://cran.r-project.org/doc/contrib/Short-refcard.pdf">http://cran.r-project.org/doc/contrib/Short-refcard.pdf</a><a href="http://cran.r-project.org/doc/contrib/Short-refcard.pdf">http://cran.r-project.org/doc/contrib/Short-refcard.pdf</a></p> <p>Grafiken und Statistik in R von Andreas Plank Nachschlage Skript mit Beispielen: <a href="http://www.geo.fu-berlin.de/geol/fachrichtungen/pal/mitarbeiter/plank/Formeln_in_R.pdf">http://www.geo.fu-berlin.de/geol/fachrichtungen/pal/mitarbeiter/plank/Formeln_in_R.pdf</a><a href="http://www.geo.fu-berlin.de/geol/fachrichtungen/pal/mitarbeiter/plank/Formeln_in_R.pdf">http://www.geo.fu-berlin.de/geol/fachrichtungen/pal/mitarbeiter/plank/Formeln_in_R.pdf</a></p>

<b>Course L0776: Introduction in Statistics with R</b>	
<b>Typ</b>	Recitation Section (large)
<b>Hrs/wk</b>	1
<b>CP</b>	1
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
<b>Examination Form</b>	Klausur
<b>Examination duration and scale</b>	siehe Vorlesung
<b>Lecturer</b>	Dr. Joachim Behrendt
<b>Language</b>	DE
<b>Cycle</b>	WiSe
<b>Content</b>	See interlocking course
<b>Literature</b>	See interlocking course

<b>Course L0470: Principles of Geomatics</b>	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Examination Form</b>	Schriftliche Ausarbeitung
<b>Examination duration and scale</b>	schriftliche Ausarbeitungen zu allen fünf Übungen, ggf. Testklausur
<b>Lecturer</b>	Prof. Peter Andree
<b>Language</b>	DE
<b>Cycle</b>	SoSe
<b>Content</b>	<ul style="list-style-type: none"> <li>• Overview of geomatics in general</li> <li>• Units of measurements</li> <li>• Generating of topographical maps</li> <li>• Basic surveying instruments and handling</li> <li>• Geodetic surveying lines and verification of measurements</li> <li>• Methods of horizontal survey</li> <li>• Components of geodetic surveying instruments</li> <li>• Height determination</li> <li>• Setting out points</li> <li>• Topographical survey</li> <li>• Directions and angles</li> <li>• Determination of coordinates</li> <li>• Traversing</li> <li>• Basics on surveying and positioning with GNSS</li> </ul>
<b>Literature</b>	<p>Andree, P.: Grundlagen der Geomatik (Skript)</p> <p>Resnik, B. / Bill, R.: Vermessungskunde für den Planungs- Bau- und Umweltbereich, Wichmann-verlag</p> <p>Witte, B. / Sparla, P.: Vermessungskunde und Grundlagen der Statistik für das Bauwesen, Wichmann-Verlag</p> <p>Gruber, F.J. / Joeckel, R.: Formelsammlung für das Vermessungswesen, Vieweg + Teubner-Verlag</p>

<b>Course L0471: Principles of Geomatics</b>	
<b>Typ</b>	Recitation Section (small)
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Examination Form</b>	Schriftliche Ausarbeitung
<b>Examination duration and scale</b>	.
<b>Lecturer</b>	Prof. Peter Andree
<b>Language</b>	DE
<b>Cycle</b>	SoSe
<b>Content</b>	See interlocking course
<b>Literature</b>	See interlocking course

<b>Course L0125: Numeric and Matlab</b>	
<b>Typ</b>	Practical Course
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Examination Form</b>	Fachtheoretisch-fachpraktische Arbeit
<b>Examination duration and scale</b>	5 Übungsaufgaben jeweils mit Testat am Ende
<b>Lecturer</b>	Prof. Siegfried Rump, Weitere Mitarbeiter
<b>Language</b>	DE
<b>Cycle</b>	SoSe
<b>Content</b>	<ol style="list-style-type: none"> <li>1. Programming in Matlab</li> <li>2. Numerical methods for systems of nonlinear equations</li> <li>3. Basics in computer arithmetic</li> <li>4. Linear and nonlinear optimization</li> <li>5. Condition of problems and algorithms</li> <li>6. Verified numerical results with INTLAB</li> </ol>
<b>Literature</b>	<p><b>Literatur (Software-Teil):</b></p> <ol style="list-style-type: none"> <li>1. Moler, C., Numerical Computing with MATLAB, SIAM, 2004</li> <li>2. The Math Works, Inc. , MATLAB: The Language of Technical Computing, 2007</li> <li>3. Rump, S. M., INTLAB: Interval Laboratory, <a href="http://www.ti3.tu-harburg.de">http://www.ti3.tu-harburg.de</a></li> <li>4. Highham, D. J.; Highham, N. J., MATLAB Guide, SIAM, 2005</li> </ol>

<b>Course L1744: Practical Course in Drinking Water Chemistry</b>	
<b>Typ</b>	Practical Course
<b>Hrs/wk</b>	1
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 46, Study Time in Lecture 14
<b>Examination Form</b>	Fachtheoretisch-fachpraktische Arbeit
<b>Examination duration and scale</b>	6 Versuchsprotokolle
<b>Lecturer</b>	Dr. Klaus Johannsen
<b>Language</b>	DE
<b>Cycle</b>	WiSe
<b>Content</b>	<p>!Max.12 students!                      The students learn basic experimental work in the laboratory. The experiments give an overview about the most important chemical analysis methods of drinking water. This includes sampling, photometric measurement, complexometric titration as well as acid/base titration. The experiments are strongly related to the processes in drinking water treatment and water distribution (e. g. removal of iron and manganese, softening and conditioning). Instrumental analytics is not subject of this practical course.</p> <ol style="list-style-type: none"> <li>1. Day: Introduction, safety instructions</li> <li>2. Day: Electrical conductivity, saturation with respect to calcite, hardness</li> <li>3. Day: Organic carbon, iron, acid and base neutralization capacity</li> <li>4. Day: Writing protocols of experiments and presentations</li> <li>5. Day: Evaluation of the protocols and presentations, final discussion</li> </ol>
<b>Literature</b>	<p>Siehe Skript.                      See Script.</p>

<b>Course L1228: Projects II</b>	
<b>Typ</b>	Project Seminar
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Examination Form</b>	Referat
<b>Examination duration and scale</b>	ca. zehnmütige Präsentation
<b>Lecturer</b>	Prof. Jürgen Grabe
<b>Language</b>	DE
<b>Cycle</b>	SoSe
<b>Content</b>	Excursions to different construction and environmental projects.
<b>Literature</b>	keine

<b>Course L2411: Special topics of Civil- and Environmental Engineering</b>	
<b>Typ</b>	
<b>Hrs/wk</b>	1
<b>CP</b>	1
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
<b>Examination Form</b>	laut FSPO
<b>Examination duration and scale</b>	wird zu Beginn der Lehrveranstaltung festgelegt
<b>Lecturer</b>	Dozenten des SD B
<b>Language</b>	DE/EN
<b>Cycle</b>	WiSe/SoSe
<b>Content</b>	The course occurs only if required. The content is defined at short notice.
<b>Literature</b>	Die Literatur wird kurzfristig festgelegt.

<b>Course L2412: Special topics of Civil- and Environmental Engineering 2 LP</b>	
<b>Typ</b>	
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Examination Form</b>	laut FSPO
<b>Examination duration and scale</b>	wird zu Beginn der Lehrveranstaltung festgelegt
<b>Lecturer</b>	Dozenten des SD B
<b>Language</b>	DE/EN
<b>Cycle</b>	WiSe/SoSe
<b>Content</b>	The course occurs only if required. The content is defined at short notice.
<b>Literature</b>	Die Literatur wird kurzfristig festgelegt.

<b>Course L2413: Special topics of Civil- and Environmental Engineering 3LP</b>	
<b>Typ</b>	
<b>Hrs/wk</b>	3
<b>CP</b>	3
<b>Workload in Hours</b>	Independent Study Time 48, Study Time in Lecture 42
<b>Examination Form</b>	laut FSPO
<b>Examination duration and scale</b>	wird zu Beginn der Lehrveranstaltung festgelegt
<b>Lecturer</b>	Dozenten des SD B
<b>Language</b>	DE/EN
<b>Cycle</b>	WiSe/SoSe
<b>Content</b>	The course occurs only if required. The content is defined at short notice.
<b>Literature</b>	Die Literatur wird kurzfristig festgelegt.

<b>Course L0472: Fire Protection and Prevention</b>	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Examination Form</b>	Mündliche Prüfung
<b>Examination duration and scale</b>	20 min
<b>Lecturer</b>	Philipp Below
<b>Language</b>	DE
<b>Cycle</b>	SoSe
<b>Content</b>	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• fire in residential and office buildings</li> <li>• town planning: location of residential, office and industry areas, location of fire stations</li> <li>• design of roads and water pipes</li> <li>• explosions</li> </ul>
<b>Literature</b>	<ul style="list-style-type: none"> <li>• Schneider U. : Ingenieurmethoden im baulichen Brandschutz. Expert Verlag, 2. Aufl., 2002</li> </ul>

## Module M0829: Foundations of Management

### Courses

Title	Typ	Hrs/wk	CP
Management Tutorial (L0882)	Recitation (small)	Section 2	3
Introduction to Management (L0880)	Lecture	3	3

<b>Module Responsible</b>	Prof. Christoph Ihl
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<b>Admission Requirements</b>	None
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<b>Recommended Previous Knowledge</b>	Basic Knowledge of Mathematics and Business
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<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results
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<b>Professional Competence</b>	<p>After taking this module, students know the important basics of many different areas in Business and Management, from Planning and Organisation to Marketing and Innovation, and also to Investment and Controlling. In particular they are able to</p> <ul style="list-style-type: none"> <li>• explain the differences between Economics and Management and the sub-disciplines in Management and to name important definitions from the field of Management</li> <li>• explain the most important aspects of and goals in Management and name the most important aspects of entrepreneurial projects</li> <li>• describe and explain basic business functions as production, procurement and sourcing, supply chain management, organization and human resource management, information management, innovation management and marketing</li> <li>• explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain some basic methods from mathematical Finance</li> <li>• state basics from accounting and costing and selected controlling methods.</li> </ul>
<i>Knowledge</i>	
<i>Skills</i>	<p>Students are able to analyse business units with respect to different criteria (organization, objectives, strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to</p> <ul style="list-style-type: none"> <li>• analyse Management goals and structure them appropriately</li> <li>• analyse organisational and staff structures of companies</li> <li>• apply methods for decision making under multiple objectives, under uncertainty and under risk</li> <li>• analyse production and procurement systems and Business information systems</li> <li>• analyse and apply basic methods of marketing</li> <li>• select and apply basic methods from mathematical finance to predefined problems</li> <li>• apply basic methods from accounting, costing and controlling to predefined problems</li> </ul>
<b>Personal Competence</b>	<p>Students are able to</p> <ul style="list-style-type: none"> <li>• work successfully in a team of students</li> <li>• to apply their knowledge from the lecture to an entrepreneurship project and</li> </ul>





	Mechatronics: Core qualification: Compulsory Orientierungsstudium: Core qualification: Elective Compulsory Naval Architecture: Core qualification: Compulsory Technomathematics: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory
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<b>Course L0882: Management Tutorial</b>	
<b>Typ</b>	Recitation Section (small)
<b>Hrs/wk</b>	2
<b>CP</b>	3
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Christoph Ihl, Katharina Roedelius, Tobias Vlcek
<b>Language</b>	DE
<b>Cycle</b>	WiSe/SoSe
<b>Content</b>	<p>In the management tutorial, the contents of the lecture will be deepened by practical examples and the application of the discussed tools.</p> <p>If there is adequate demand, a problem-oriented tutorial will be offered in parallel, which students can choose alternatively. Here, students work in groups on self-selected projects that focus on the elaboration of an innovative business idea from the point of view of an established company or a startup. Again, the business knowledge from the lecture should come to practical use. The group projects are guided by a mentor.</p>
<b>Literature</b>	Relevante Literatur aus der korrespondierenden Vorlesung.

<b>Course L0880: Introduction to Management</b>	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	3
<b>CP</b>	3
<b>Workload in Hours</b>	Independent Study Time 48, Study Time in Lecture 42
<b>Lecturer</b>	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lühje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona
<b>Language</b>	DE
<b>Cycle</b>	WiSe/SoSe
<b>Content</b>	<ul style="list-style-type: none"> <li>• Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management</li> <li>• Important definitions from Management,</li> <li>• Developing Objectives for Business, and their relation to important Business functions</li> <li>• Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovation Management, Marketing and Sales</li> <li>• Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management</li> <li>• Definitions as information, information systems, aspects of data security and strategic information systems</li> <li>• Definition and Relevance of innovations, e.g. innovation opporunities, risks etc.</li> <li>• Relevance of marketing, B2B vs. B2C-Marketing</li> <li>• different techniques from the field of marketing (e.g. scenario technique), pricing strategies</li> <li>• important organizational structures</li> <li>• basics of human ressource management</li> <li>• Introduction to Business Planning and the steps of a planning process</li> <li>• Decision Analysis: Elements of decision problems and methods for solving decision problems</li> <li>• Selected Planning Tasks, e.g. Investment and Financial Decisions</li> <li>• Introduction to Accounting: Accounting, Balance-Sheets, Costing</li> <li>• Relevance of Controlling and selected Controlling methods</li> <li>• Important aspects of Entrepreneurship projects</li> </ul>
<b>Literature</b>	<p>Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008</p> <p>Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003</p> <p>Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006.</p> <p>Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001.</p> <p>Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgart 2008.</p> <p>Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005.</p> <p>Weber, J., Schäffer, U. : Einführung in das Controlling, 12. Auflage, Stuttgart 2008.</p> <p>Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.</p>

## Module M0613: Reinforced Concrete Structures I

### Courses

Title	Typ	Hrs/wk	CP			
Project Seminar Concrete I (L0896)	Seminar	1	1			
Reinforced Concrete Design I (L0303)	Lecture	2	3			
Reinforced Concrete Design I (L0305)	Recitation (large)	Section 2	2			
<b>Module Responsible</b>	Prof. Günter Rombach					
<b>Admission Requirements</b>	None					
<b>Recommended Previous Knowledge</b>	Basic knowledge in structural analysis and building materials. Modules: Structural Analysis I, Mechanics I+II					
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results					
<b>Professional Competence</b>	<p><i>Knowledge</i></p> <p>The students can outline the history of concrete construction and explain the basics of structural engineering, including usual load combinations and safety concepts. They are able to draft and dimension simple structures, as well as to evaluate and discuss the behaviour of the materials and of structural members.</p> <p><i>Skills</i></p> <p>The students are able to apply basic procedures of the conception and dimensioning to practical cases. They are capable to draft simple concrete structures and to design them for bending and bending with axial force, and to plan their detailing and execution. Moreover, they can make design and construction sketches and draw up technical descriptions.</p> <p><b>Personal Competence</b></p> <p><i>Social Competence</i></p> <p><i>Autonomy</i></p> <p>The students are able to carry out simple tasks in the conception and dimensioning of structures and to critically reflect the results.</p>					
<b>Workload in Hours</b>				Independent Study Time 110, Study Time in Lecture 70		
<b>Credit points</b>				6		
<b>Course achievement</b>				<b>Compulsory</b>	<b>Bonus</b>	<b>Form</b>
	Yes	None	Excercises			
<b>Examination</b>	Written exam					
<b>Examination duration and scale</b>	120 minutes					
<b>Assignment for the Following Curricula</b>	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory Civil- and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory					

<b>Course L0896: Project Seminar Concrete I</b>	
<b>Typ</b>	Seminar
<b>Hrs/wk</b>	1
<b>CP</b>	1
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
<b>Lecturer</b>	Björn Schütte
<b>Language</b>	DE
<b>Cycle</b>	SoSe
<b>Content</b>	In the course of the project seminar, a simple structure is drafted and dimensioned.
<b>Literature</b>	Download der Unterlagen zur Vorlesung über Stud.IP!

<b>Course L0303: Reinforced Concrete Design I</b>	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	3
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Günter Rombach
<b>Language</b>	DE
<b>Cycle</b>	SoSe
<b>Content</b>	<p>The following subjects/contents are treated:</p> <ul style="list-style-type: none"> <li>• history of concrete construction</li> <li>• building materials: mechanical and physical-chemical properties of concrete, steel, GFRP, CFRP</li> <li>• Introduction in safety concepts, ultimate limit states and safety coefficients</li> <li>• actions on structures</li> <li>• design of linear concrete members with arbitrary cross section for tension and bending with/without axial force</li> <li>• design of slender columns</li> </ul>
<b>Literature</b>	<p>Download der Unterlagen zur Vorlesung über Stud.IP!</p> <ul style="list-style-type: none"> <li>• Zilch K., Zehetmaier G.: Bemessung im konstruktiven Betonbau. Springer Verlag, 2010</li> <li>• König G., Tue N.: Grundlagen des Stahlbetonbaus, 3. Auflage, Teubner-Verlag, 2008</li> <li>• Deutscher Beton- und Bautechnikverein E.V.: Beispiele zur Bemessung von Betontragwerken nach Eurocode 2. Band 1: Hochbau, Bauverlag GmbH, Wiesbaden 2011</li> <li>• Fingerlos F., Hegger J., Zilch K.: Eurocode 2 für Deutschland. Berlin 2016</li> <li>• Dahms K.-H.: Rohbauzeichnungen, Bewehrungszeichnungen. Bauverlag, Wiesbaden 1997</li> <li>• Grasser E., Thielen G.: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen von Stahlbetontragwerken. Deutscher Ausschuss für Stahlbeton, Heft 240, Verlag Ernst &amp; Sohn, Berlin 1978</li> </ul>

<b>Course L0305: Reinforced Concrete Design I</b>	
<b>Typ</b>	Recitation Section (large)
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Günter Rombach
<b>Language</b>	DE
<b>Cycle</b>	SoSe
<b>Content</b>	See interlocking course
<b>Literature</b>	See interlocking course

## Module M0744: Structural Analysis II

### Courses

<b>Title</b>	<b>Typ</b>	<b>Hrs/wk</b>	<b>CP</b>
Structural Analysis II (L0673)	Lecture	2	3
Structural Analysis II (L0674)	Recitation (large)	Section 2	3
<b>Module Responsible</b>	Prof. Uwe Starossek		
<b>Admission Requirements</b>	None		
<b>Recommended Previous Knowledge</b>	<ul style="list-style-type: none"> <li>• Mechanics I/II</li> <li>• Mathematics I/II</li> <li>• Differential Equations I</li> <li>• Structural Analysis I</li> </ul>		
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results		
<b>Professional Competence</b>	<p>After successful completion of this module, students can express the basic aspects of linear frame analysis of statically indeterminate systems.</p>		
<i>Knowledge</i>			
<i>Skills</i>	<p>After successful completion of this module, the students are able to analyze state variables and to construct influence lines of statically indeterminate plane and spatial frame and truss structures.</p>		
<b>Personal Competence</b>	<p>Students can</p> <ul style="list-style-type: none"> <li>• participate in subject-specific and interdisciplinary discussions,</li> <li>• defend their own work results in front of others</li> <li>• promote the scientific development of colleagues</li> <li>• Furthermore, they can give and accept professional constructive criticism</li> </ul>		
<i>Social Competence</i>			
<i>Autonomy</i>	<p>The students are able to work in-term homework assignments. Due to the in-term feedback, they are enabled to self-assess their learning progress during the lecture period, already.</p>		
<b>Workload in Hours</b>	Independent Study Time 124, Study Time in Lecture 56		
<b>Credit points</b>	6		
	<b>Compulsor</b>	<b>Bonus</b>	<b>Description</b>

<b>Course achievement</b>	No	10 %	Written elaboration	Hausübungen mit Testat, betreut durch Studentische Tutoren (Tutorium)
<b>Examination</b>	Written exam			
<b>Examination duration and scale</b>	90 Minuten			
<b>Assignment for the Following Curricula</b>	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory Civil- and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory			

<b>Course L0673: Structural Analysis II</b>	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	3
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Uwe Starossek
<b>Language</b>	DE
<b>Cycle</b>	SoSe
<b>Content</b>	<ul style="list-style-type: none"> <li>• Linear structural analysis: statically indeterminate systems</li> <li>• force method</li> <li>• slope-deflection method for sway and non-sway frames</li> <li>• general displacement method and finite element method</li> </ul>
<b>Literature</b>	Krätzig, W. B.; Harte, R.; Meskouris, K.; Wittek, U.: Tragwerke 2 - Theorie und Berechnungsmethoden statisch unbestimmter Stabtragwerke, 4. Auflage, Berlin, 2004

<b>Course L0674: Structural Analysis II</b>	
<b>Typ</b>	Recitation Section (large)
<b>Hrs/wk</b>	2
<b>CP</b>	3
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Uwe Starossek
<b>Language</b>	DE
<b>Cycle</b>	SoSe
<b>Content</b>	See interlocking course
<b>Literature</b>	See interlocking course



## Module M0660: Construction Industry and Construction Management

### Courses

Title	Typ	Hrs/wk	CP
Construction Management (L0396)	Lecture	2	2
Construction Management (L0397)	Recitation (large)	Section 1	2
Law of Building Contracts (L0408)	Lecture	1	1
Environmental Law (L0346)	Lecture	1	1

<b>Module Responsible</b>	Prof. Jürgen Grabe
<b>Admission Requirements</b>	None
<b>Recommended Previous Knowledge</b>	none
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results
<b>Professional Competence</b>	<p>After successful completion of the module, students are able to</p> <ul style="list-style-type: none"> <li>• understand basic knowledge of construction management,</li> <li>• choose appropriate methods of construction project management to solve problems,</li> <li>• capture basic structures and antagonisms of European environmental legislation,</li> <li>• locate and apply relevant environmental regulations</li> <li>• implement any environmental regulation to the realisation of an construction project and to capture the significance for the civil engineer</li> <li>• recognize basic structures of general civil and construction law as well as standards for construction works</li> <li>• capture the content of contracts which are important for building design and execution.</li> </ul>
<i>Knowledge</i>	
<i>Skills</i>	
<b>Personal Competence</b>	
<i>Social Competence</i>	
<i>Autonomy</i>	
<b>Workload in Hours</b>	Independent Study Time 110, Study Time in Lecture 70
<b>Credit points</b>	6
<b>Course achievement</b>	None
<b>Examination</b>	Written exam
<b>Examination duration and scale</b>	100 minutes
<b>Assignment for the Following Curricula</b>	Civil- and Environmental Engineering: Core qualification: Compulsory Civil- and Environmental Engineering: Core qualification: Compulsory

<b>Course L0396: Construction Management</b>	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Jürgen Grabe
<b>Language</b>	DE
<b>Cycle</b>	SoSe
<b>Content</b>	<ul style="list-style-type: none"> <li>• Project development</li> <li>• Project management</li> <li>• Announcement</li> <li>• Order acquisition</li> <li>• Project execution</li> <li>• Project supervision</li> </ul>
<b>Literature</b>	<ul style="list-style-type: none"> <li>• Vorlesungsskript, s. <a href="http://www.tuhh.de/gbt">www.tuhh.de/gbt</a></li> <li>• Baugeräteliste BGL</li> <li>• Honorarordnung für Architekten und Ingenieure HOAI</li> <li>• Verdingungsordnung im Bauwesen VOB mit Kommentaren</li> </ul>

<b>Course L0397: Construction Management</b>	
<b>Typ</b>	Recitation Section (large)
<b>Hrs/wk</b>	1
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 46, Study Time in Lecture 14
<b>Lecturer</b>	Prof. Jürgen Grabe
<b>Language</b>	DE
<b>Cycle</b>	SoSe
<b>Content</b>	See interlocking course
<b>Literature</b>	See interlocking course

<b>Course L0408: Law of Building Contracts</b>	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	1
<b>CP</b>	1
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
<b>Lecturer</b>	Prof. Günter Schmeel
<b>Language</b>	DE
<b>Cycle</b>	SoSe
<b>Content</b>	<ul style="list-style-type: none"> <li>• Detecting the legal foundations and connections of construction law</li> <li>• Awareness of legal "Control points" in the construction contract and the construction process</li> <li>• Construction contract law according to the BGB and VOB</li> <li>• public procurement according to national and EU laws</li> <li>• Engineers law</li> </ul>
<b>Literature</b>	<ul style="list-style-type: none"> <li>• Axel Maser, Baurecht nach BGB und VOB/B Grundlagenwissen für Architekten und Ingenieure, Id Verlag 1., Auflage 2005, 28,00 €</li> <li>• Schmeel ATB Baurecht, Auflage 2002, 34,80 €</li> <li>• Werner / Pastor, Der Bauprozess 11. Auflage 2005, 149,00 €</li> </ul>

<b>Course L0346: Environmental Law</b>	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	1
<b>CP</b>	1
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
<b>Lecturer</b>	Dr. Friederike Mechel
<b>Language</b>	DE
<b>Cycle</b>	SoSe
<b>Content</b>	<p>The lecture focusses on:</p> <ul style="list-style-type: none"> <li>• Structure of Environmental Legislation in Europe and Germany</li> <li>• Important international, European and German laws/legal regulations (Water Framework Directive, IED, etc.)</li> <li>• Interactions between Environmental Laws and Technical Standards</li> </ul>
<b>Literature</b>	<ul style="list-style-type: none"> <li>• Erbguth, Wilfried; Schlacke, Sabine, Umweltrecht, 6. Auflage 2016</li> <li>• Gesetzessammlung Umweltrecht, 26. Auflage 2016 (Beck Texte im dtv)</li> </ul>

Module M0706: Geotechnics I				
<b>Courses</b>				
<b>Title</b>		<b>Typ</b>	<b>Hrs/wk</b>	<b>CP</b>
Soil Mechanics (L0550)		Lecture	2	2
Soil Mechanics (L0551)		Recitation (large)	Section 2	2
Soil Mechanics (L1493)		Recitation (small)	Section 2	2
<b>Module Responsible</b>	Prof. Jürgen Grabe			
<b>Admission Requirements</b>	None			
<b>Recommended Previous Knowledge</b>	Modules : <ul style="list-style-type: none"> <li>• Mechanics I-II</li> </ul>			
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results			
<b>Professional Competence</b>	The students know the basics of soil mechanics as the structure and characteristics of soil, stress distribution due to weight, water or structures, consolidation and settlement calculations, as well as failure of the soil due to ground- or slope failure. After the successful completion of the module the students should be able to describe the mechanical properties and to evaluate them with the help of geotechnical standard tests. They can calculate stresses and deformation in the soils due to weight or influence of structures. They are able to prove the usability (settlements) for shallow foundations.			
<i>Knowledge</i>				
<i>Skills</i>				
<b>Personal Competence</b>				
<i>Social Competence</i>				
<i>Autonomy</i>				
<b>Workload in Hours</b>	Independent Study Time 96, Study Time in Lecture 84			
<b>Credit points</b>	6			
<b>Course achievement</b>	<b>Compulsory</b>	<b>Bonus</b>	<b>Form</b>	<b>Description</b>
	No	20 %	Attestation	
<b>Examination</b>	Written exam			
<b>Examination duration and scale</b>	60 minutes			
<b>Assignment for the Following Curricula</b>	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory Civil- and Environmental Engineering: Core qualification: Compulsory Civil- and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory			

<b>Course L0550: Soil Mechanics</b>	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Jürgen Grabe
<b>Language</b>	DE
<b>Cycle</b>	WiSe/SoSe
<b>Content</b>	<ul style="list-style-type: none"> <li>• Structure of the soil</li> <li>• Ground surveying</li> <li>• Composition and properties of the soil</li> <li>• Groundwater</li> <li>• One-dimensional compression</li> <li>• Spreading of stresses</li> <li>• Settlement calculation</li> <li>• Consolidation</li> <li>• Shear strength</li> <li>• Earth pressure</li> <li>• Slope failure</li> <li>• Ground failure</li> <li>• Suspension based earth trenches</li> </ul>
<b>Literature</b>	<ul style="list-style-type: none"> <li>• Vorlesungsumdruck, s. <a href="http://ww.tu-harburg.de/gbt">ww.tu-harburg.de/gbt</a></li> <li>• Grabe, J. (2004): Bodenmechanik und Grundbau</li> <li>• Gudehus, G. (1981): Bodenmechanik</li> <li>• Kolymbas, D. (1998): Geotechnik - Bodenmechanik und Grundbau</li> <li>• Grundbau-Taschenbuch, Teil 1, aktuelle Auflage</li> </ul>

<b>Course L0551: Soil Mechanics</b>	
<b>Typ</b>	Recitation Section (large)
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Jürgen Grabe
<b>Language</b>	DE
<b>Cycle</b>	WiSe/SoSe
<b>Content</b>	See interlocking course
<b>Literature</b>	See interlocking course

<b>Course L1493: Soil Mechanics</b>	
<b>Typ</b>	Recitation Section (small)
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Jürgen Grabe
<b>Language</b>	DE
<b>Cycle</b>	WiSe/SoSe
<b>Content</b>	See interlocking course
<b>Literature</b>	See interlocking course

## Module M0869: Hydraulic Engineering

### Courses

<b>Title</b>	<b>Typ</b>	<b>Hrs/wk</b>	<b>CP</b>
Hydraulics (L0957)	Lecture	1	1
Hydraulics (L0958)	Project-/problem-based Learning	1	1
Hydraulic Engineering (L0959)	Lecture	2	2
Hydraulic Engineering (L0960)	Project-/problem-based Learning	1	2
<b>Module Responsible</b>	Prof. Peter Fröhle		
<b>Admission Requirements</b>	None		
<b>Recommended Previous Knowledge</b>	Hydraulic Engineering I		
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results		
<b>Professional Competence</b>			
<i>Knowledge</i>	Students are able to define the basic terms of hydraulic engineering and hydraulics. They are able to explain the application of basic hydrodynamic formulations (conservation laws) to practical hydraulic engineering problems. Besides this, the students can illustrate important tasks of hydraulic engineering and give an overview over river engineering, flood protection, hydraulic power engineering and waterways engineering.		
<i>Skills</i>	The students are able to apply hydraulic engineering methods and approaches to basic practical problems and design respective hydraulic engineering systems. Besides this, they are able to use and apply established approaches of hydraulics and determine water surfaces of channel flows, influences of constructions (weirs, etc.) on channel flows as well as flow conditions of pipe system. Furthermore, they are able to run, explain and document basic hydraulic experiments.		
<b>Personal Competence</b>			
<i>Social Competence</i>	The students are able to deploy their gained knowledge in applied problems. Additionally, they will be able to work in team with engineers of other disciplines in a goal-orientated, structured manner. They can explain their results by use of peer learning approaches.		
<i>Autonomy</i>	The students will be able to independently extend their knowledge and apply it to new problems. Furthermore, they are capable of organising their individual work flow to contribute to the conduct of experiments and to present discipline-specific knowledge.		
<b>Workload in Hours</b>	Independent Study Time 110, Study Time in Lecture 70		
<b>Credit points</b>	6		
<b>Course achievement</b>	None		
<b>Examination</b>	Written exam		
<b>Examination duration and scale</b>	The duration of the examination is 2 hours. The examination includes tasks with respect to the general understanding of the lecture contents and calculations tasks.		
<b>Assignment for the Following</b>	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Elective Compulsory Civil- and Environmental Engineering: Core qualification: Compulsory Civil- and Environmental Engineering: Core qualification: Compulsory		

<b>Curricula</b>	General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Elective Compulsory
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<b>Course L0957: Hydraulics</b>	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	1
<b>CP</b>	1
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
<b>Lecturer</b>	Prof. Peter Fröhle
<b>Language</b>	DE
<b>Cycle</b>	WiSe/SoSe
<b>Content</b>	<p>Flow of incompressible fluids in pipes and open channels</p> <ul style="list-style-type: none"> <li>• Hydraulics of pipes</li> <li>• Pumps in hydraulic systems</li> <li>• Open channel flow</li> <li>• Regulative construction in open channel flow                             <ul style="list-style-type: none"> <li>◦ Weirs</li> <li>◦ Sliding panels</li> <li>◦ Cross-section reduction by constructions</li> </ul> </li> </ul>
<b>Literature</b>	<p>Zanke, Ulrich C. , Hydraulik für den Wasserbau Ursprünglich erschienen unter: Schröder/Zanke "Technische Hydraulik", Springer-Verlag, 2003</p> <p>Naudascher, E.: Hydraulik der Gerinne und Gerinnebauwerke, Springer, 1992</p>

<b>Course L0958: Hydraulics</b>	
<b>Typ</b>	Project-/problem-based Learning
<b>Hrs/wk</b>	1
<b>CP</b>	1
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
<b>Lecturer</b>	Prof. Peter Fröhle
<b>Language</b>	DE
<b>Cycle</b>	WiSe/SoSe
<b>Content</b>	See interlocking course
<b>Literature</b>	See interlocking course

<b>Course L0959: Hydraulic Engineering</b>	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Peter Fröhle
<b>Language</b>	DE
<b>Cycle</b>	WiSe/SoSe
<b>Content</b>	<p>Fundamentals of hydraulic engineering</p> <ul style="list-style-type: none"> <li>• Introduction and hydrological cycle</li> <li>• River engineering <ul style="list-style-type: none"> <li>◦ Regime theory of natural rivers</li> <li>◦ Sediment transport</li> <li>◦ Regulation of rivers</li> <li>◦ Bank protection / protection of river bed</li> <li>◦ Tidal rivers</li> </ul> </li> <li>• Flood protection <ul style="list-style-type: none"> <li>◦ Dikes</li> <li>◦ Flood contraol basins</li> </ul> </li> <li>• Hydraulic power</li> <li>• Inland waterways engineering <ul style="list-style-type: none"> <li>◦ waterways</li> <li>◦ Locks and ship lifts</li> <li>◦ Fish passages</li> </ul> </li> <li>• Nature-oriented hydraulic engineering</li> </ul>
<b>Literature</b>	<p>Strobl, T. &amp; Zunic, F: Wasserbau, Springer 2006</p> <p>Patt, H. &amp; Gonsowski, P: Wasserbau, Springer 2011</p>

<b>Course L0960: Hydraulic Engineering</b>	
<b>Typ</b>	Project-/problem-based Learning
<b>Hrs/wk</b>	1
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 46, Study Time in Lecture 14
<b>Lecturer</b>	Prof. Peter Fröhle
<b>Language</b>	DE
<b>Cycle</b>	WiSe/SoSe
<b>Content</b>	See interlocking course
<b>Literature</b>	See interlocking course



<b>Module M0611: Steel Structures I</b>			
<b>Courses</b>			
<b>Title</b>	<b>Typ</b>	<b>Hrs/wk</b>	<b>CP</b>
Steel Structures I (L0299)	Lecture	2	3
Steel Structures I (L0300)	Recitation (large)	Section 2	3
<b>Module Responsible</b>	Prof. Marcus Rutner		
<b>Admission Requirements</b>	None		
<b>Recommended Previous Knowledge</b>	<ul style="list-style-type: none"> <li>• Structural analysis I, Structural analysis II</li> <li>• Mechanics I, Mechanics II</li> <li>• Building Materials and Building Chemistry</li> <li>• Principles of Building Materials and Building Physics</li> </ul>		
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results		
<b>Professional Competence</b>	<p>After passing this module students are able to</p> <ul style="list-style-type: none"> <li>• give a summary of the security concept</li> <li>• explain the principles of the design process</li> <li>• describe and illustrate the behaviour of members in tension, compression and bending</li> </ul> <p>Students can rate and apply the material steel appropriately with respect to its properties and usage.</p> <p>They can use the security concept with respect to loads, forces and resistances.</p> <p>They can check the ultimate limit state and the serviceability of simple members in tension, compression and bending.</p>		
<b>Personal Competence</b>	<p>After participation of an optional course (building of a simple truss) they are able to organize themselves in groups. They will be successful in guided building a truss with bolted connections according to design drawings.</p>		
<i>Social Competence</i>	--		
<i>Autonomy</i>	--		
<b>Workload in Hours</b>	Independent Study Time 124, Study Time in Lecture 56		
<b>Credit points</b>	6		
<b>Course achievement</b>	None		
<b>Examination</b>	Written exam		
<b>Examination duration and scale</b>	120 minutes		
<b>Assignment for the Following Curricula</b>	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory Civil- and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory		

<b>Course L0299: Steel Structures I</b>	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	3
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Marcus Rutner
<b>Language</b>	DE
<b>Cycle</b>	WiSe
<b>Content</b>	<ul style="list-style-type: none"> <li>• Introduction to steel constructions</li> <li>• Materials</li> <li>• Design and security model</li> <li>• Tension rods</li> <li>• Beams (elastic and plastic design)</li> <li>• Column design</li> <li>• Bolted connections</li> </ul>
<b>Literature</b>	<p>Petersen, C.: Stahlbau, 4. Auflage 2013, Springer-Vieweg Verlag</p> <p>Wagenknecht, G.: Stahlbau-Praxis nach Eurocode 3, Bauwerk-Verlag 2011</p> <ul style="list-style-type: none"> <li>• Band 1 Tragwerksplanung, Grundlagen</li> <li>• Band 2 Verbindungen und Konstruktionen</li> </ul>

<b>Course L0300: Steel Structures I</b>	
<b>Typ</b>	Recitation Section (large)
<b>Hrs/wk</b>	2
<b>CP</b>	3
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Marcus Rutner
<b>Language</b>	DE
<b>Cycle</b>	WiSe
<b>Content</b>	See interlocking course
<b>Literature</b>	See interlocking course

## Module M0755: Geotechnics II

### Courses

<b>Title</b>	<b>Typ</b>	<b>Hrs/wk</b>	<b>CP</b>
Foundation Engineering (L0552)	Lecture	2	2
Foundation Engineering (L0553)	Recitation (large)	Section 2	2
Foundation Engineering (L1494)	Recitation (small)	Section 2	2
<b>Module Responsible</b>	Prof. Jürgen Grabe		
<b>Admission Requirements</b>	None		
<b>Recommended Previous Knowledge</b>	Modules: <ul style="list-style-type: none"> <li>• Mechanics I-II</li> <li>• Geotechnics I</li> </ul>		
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results		
<b>Professional Competence</b>	The students know the basic principles and methods which are required to verificate the stability of geotechnical structures. After successful completion of the module the students are able to: <ul style="list-style-type: none"> <li>• verificate the stability and usability of foundations,</li> <li>• know individual methods of ground improvement and apply them in their range of application,</li> <li>• design retaining walls.</li> </ul>		
<i>Knowledge</i>			
<i>Skills</i>			
<b>Personal Competence</b>			
<i>Social Competence</i>			
<i>Autonomy</i>			
<b>Workload in Hours</b>	Independent Study Time 96, Study Time in Lecture 84		
<b>Credit points</b>	6		
<b>Course achievement</b>	<b>Compulsory</b> No	<b>Bonus</b> 20 %	<b>Form</b> Attestation
<b>Examination</b>	Written exam		
<b>Examination duration and scale</b>	60 minutes		
<b>Assignment for the Following Curricula</b>	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Elective Compulsory Civil- and Environmental Engineering: Core qualification: Compulsory Civil- and Environmental Engineering: Specialisation Civil Engineering: Compulsory Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Compulsory Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory		

<b>Course L0552: Foundation Engineering</b>	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Jürgen Grabe
<b>Language</b>	DE
<b>Cycle</b>	WiSe/SoSe
<b>Content</b>	<ul style="list-style-type: none"> <li>• Shallow foundations</li> <li>• Pile foundations</li> <li>• Ground improvement</li> <li>• Retaining walls</li> <li>• Underpinning</li> <li>• Groundwater Conservation</li> <li>• Cut-off Walls</li> </ul>
<b>Literature</b>	<ul style="list-style-type: none"> <li>• Vorlesung/Übung s. <a href="http://www.tu-harburg.de/gbt">www.tu-harburg.de/gbt</a></li> <li>• Grabe, J. (2004): Bodenmechanik und Grundbau</li> <li>• Kolymbas, D. (1998): Geotechnik - Bodenmechanik und Grundbau</li> <li>• Grundbau-Taschenbuch, neueste Auflage</li> </ul>

<b>Course L0553: Foundation Engineering</b>	
<b>Typ</b>	Recitation Section (large)
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Jürgen Grabe
<b>Language</b>	DE
<b>Cycle</b>	WiSe/SoSe
<b>Content</b>	See interlocking course
<b>Literature</b>	See interlocking course

<b>Course L1494: Foundation Engineering</b>	
<b>Typ</b>	Recitation Section (small)
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Jürgen Grabe
<b>Language</b>	DE
<b>Cycle</b>	WiSe/SoSe
<b>Content</b>	See interlocking course
<b>Literature</b>	See interlocking course

## Module M0631: Reinforced Concrete Structures II

### Courses

Title	Typ	Hrs/wk	CP
Project Concrete Structures II (L0894)	Project Seminar	1	1
Concrete Structures II (L0348)	Lecture	2	3
Concrete Structures II (L0349)	Recitation (large)	Section 2	2

<b>Module Responsible</b>	Prof. Günter Rombach
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<b>Admission Requirements</b>	None
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<b>Recommended Previous Knowledge</b>	<ul style="list-style-type: none"> <li>Knowledge of loads on structures and combination of actions</li> <li>Basics of safety format are required.</li> <li>Knowledge in design of beams and columns for ultimate limit state</li> <li>Modules: Reinforced Concrete Structures I, Structural Analysis I+II, Mechanics I+II</li> </ul>
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<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results
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<b>Professional Competence</b>	<p>The students know the basic principles which are required for design of reinforced concrete structures. They know the various methods to estimate the member forces in simple one and two-way slabs.</p> <ul style="list-style-type: none"> <li>The students can design reinforced concrete structure in the ultimate limit state (shear, bending, torsion) and in the serviceability limit state (crack and deflection control) including detailing (anchorage and links etc.).</li> <li>The students can estimate the member forces of simple slabs.</li> <li>The students know the content and the layout of a structural analysis</li> </ul>
<i>Knowledge</i>	
<i>Skills</i>	
<b>Personal Competence</b>	
<i>Social Competence</i>	Cooperation in a project work, where they design in a team a real concrete building and present the results at the end.
<i>Autonomy</i>	

<b>Workload in Hours</b>	Independent Study Time 110, Study Time in Lecture 70
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<b>Credit points</b>	6
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<b>Course achievement</b>	<table style="display: inline-table; border: none;"> <tr> <td style="text-align: center;"><b>Compulsory</b></td> <td style="text-align: center;"><b>Bonus</b></td> <td style="text-align: center;"><b>Form</b></td> <td style="text-align: center;"><b>Description</b></td> </tr> <tr> <td style="text-align: center;">Yes</td> <td style="text-align: center;">None</td> <td style="text-align: center;">Excercises</td> <td></td> </tr> </table>	<b>Compulsory</b>	<b>Bonus</b>	<b>Form</b>	<b>Description</b>	Yes	None	Excercises	
<b>Compulsory</b>	<b>Bonus</b>	<b>Form</b>	<b>Description</b>						
Yes	None	Excercises							

<b>Examination</b>	Written exam
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<b>Examination duration and scale</b>	120 minutes
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<b>Assignment for the Following</b>	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Elective Compulsory Civil- and Environmental Engineering: Core qualification: Compulsory Civil- and Environmental Engineering: Specialisation Civil Engineering: Compulsory
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<b>Curricula</b>	Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Compulsory Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Elective Compulsory
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<b>Course L0894: Project Concrete Structures II</b>	
<b>Typ</b>	Project Seminar
<b>Hrs/wk</b>	1
<b>CP</b>	1
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
<b>Lecturer</b>	Björn Schütte
<b>Language</b>	DE
<b>Cycle</b>	WiSe
<b>Content</b>	Design of a truss structure
<b>Literature</b>	Skript zur Lehrveranstaltung "Stahlbetonbau II"

<b>Course L0348: Concrete Structures II</b>	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	3
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Günter Rombach
<b>Language</b>	DE
<b>Cycle</b>	WiSe
<b>Content</b>	<ul style="list-style-type: none"> <li>• Design of concrete members for shear, punching and torsion</li> <li>• Design for serviceability limit state (durability): crack- and deflection control</li> <li>• Detailing</li> <li>• Design of discontinuity regions (e.g. corbels, frame corner)</li> <li>• design of footings</li> <li>• Introduction in the design of slabs</li> <li>• Layout and content of a structural design</li> </ul>
<b>Literature</b>	<ul style="list-style-type: none"> <li>• Vorlesungsumdrucke zum downloaden im STUDiP</li> <li>• Zilch K., Zehetmaier G.: Bemessung im konstruktiven Betonbau. Springer Verlag, 2010</li> <li>• König G., Tue N.: Grundlagen des Stahlbetonbaus. Teubner Verlag, Stuttgart 1998</li> <li>• Deutscher Beton- und Bautechnikverein E.V.: Beispiele zur Bemessung von Betontragwerken nach Eurocode 2. Band 1: Hochbau, Bauverlag GmbH, Wiesbaden 2011</li> <li>• Dahms K.-H.: Rohbauzeichnungen, Bewehrungszeichnungen. Bauverlag, Wiesbaden 1997</li> <li>• Grasser E., Thielen G.: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen von Stahlbetontragwerken. Deutscher Ausschuss für Stahlbeton, Heft 240, Verlag Ernst &amp; Sohn, Berlin 1978</li> <li>• DIN EN 1992-1-1:2011: Bemessung und Konstruktion von Stahlbeton- und Spannbetontragwerken - Teil 1: Allgemeine Bemessungsregeln für den Hochbau.</li> </ul>

<b>Course L0349: Concrete Structures II</b>	
<b>Typ</b>	Recitation Section (large)
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Günter Rombach
<b>Language</b>	DE
<b>Cycle</b>	WiSe
<b>Content</b>	See interlocking course
<b>Literature</b>	See interlocking course

## Module M0887: Transportation Planning and Traffic Engineering

### Courses

Title	Typ	Hrs/wk	CP
Transport Planning and Traffic Engineering (L0997)	Project-/problem-based Learning	4	6
<b>Module Responsible</b>	Prof. Carsten Gertz		
<b>Admission Requirements</b>	None		
<b>Recommended Previous Knowledge</b>	None		
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results		
<b>Professional Competence</b>			
<i>Knowledge</i>	Students are able to <ul style="list-style-type: none"> <li>• understand the facts, contexts and objectives of transport planning.</li> <li>• correctly apply definitions and concepts of transport planning.</li> <li>• reproduce basic concepts of transport modelling.</li> <li>• explain the fundamentals of traffic engineering and transport infrastructure construction.</li> </ul>		
<i>Skills</i>	Students are able to <ul style="list-style-type: none"> <li>• analyse transport supply based on key metrics.</li> <li>• estimate transport demand using key metrics.</li> <li>• design transport networks, links and junctions.</li> <li>• calculate traffic signal plans.</li> <li>• assess transport concepts.</li> </ul>		
<b>Personal Competence</b>			
<i>Social Competence</i>	Students are able to <ul style="list-style-type: none"> <li>• get together in groups and constructively discuss and analyse set problems.</li> <li>• in a group agree on solutions and document them.</li> </ul>		
<i>Autonomy</i>	Students are able to <ul style="list-style-type: none"> <li>• produce reports on group work.</li> <li>• structure the tasks and timing for working out a set problem.</li> </ul>		
<b>Workload in Hours</b>	Independent Study Time 124, Study Time in Lecture 56		
<b>Credit points</b>	6		
<b>Course achievement</b>	<b>Compulsor</b>	<b>Bonus</b>	<b>Form</b>
	Yes	None	Group discussion
	No	5 %	Excercises
<b>Examination</b>	Subject theoretical and practical work		



<b>Examination duration and scale</b>	Project report in four work packages, in small groups, during the semester; mandatory interim presentation
<b>Assignment for the Following Curricula</b>	Civil- and Environmental Engineering: Core qualification: Compulsory Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Compulsory Civil- and Environmental Engineering: Specialisation Water and Environment: Compulsory Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Compulsory Logistics and Mobility: Core qualification: Compulsory

<b>Course L0997: Transport Planning and Traffic Engineering</b>	
<b>Typ</b>	Project-/problem-based Learning
<b>Hrs/wk</b>	4
<b>CP</b>	6
<b>Workload in Hours</b>	Independent Study Time 124, Study Time in Lecture 56
<b>Lecturer</b>	Prof. Carsten Gertz
<b>Language</b>	DE
<b>Cycle</b>	WiSe
<b>Content</b>	<p>The course provides an introductory overview over the fundamentals of urban and regional transport planning, including the sub-topic traffic engineering. The following subject areas are covered:</p> <ul style="list-style-type: none"> <li>• objectives of transport planning,</li> <li>• key mobility metrics,</li> <li>• measuring and predicting demand,</li> <li>• designing and planning transport infrastructure,</li> <li>• fundamentals of traffic engineering and</li> <li>• an introduction to transport concepts and planning processes.</li> </ul>
<b>Literature</b>	<p>Steierwald, Gerd; Kühne, Hans Dieter; Vogt, Walter (Hrsg.) (2005) Stadtverkehrsplanung: Grundlagen, Methoden, Ziele. Springer Verlag. Berlin.</p> <p>Bosserhoff, Dietmar (2000) Integration von Verkehrsplanung und räumlicher Planung. Schriftenreihe der Hessischen Straßen- und Verkehrsverwaltung, Heft 42. Hessisches Landesamt für Straßen- und Verkehrswesen. Wiesbaden.</p> <p>Lohse, Dieter; Schnabel, Werner (2011) Grundlagen der Straßenverkehrstechnik und der Verkehrsplanung: Band 1; Straßenverkehrstechnik. Beuth Verlag. Berlin.</p> <p>Forschungsgesellschaft für Straßen- und Verkehrswesen (2007) Richtlinien für die Anlage von Stadtstraßen - RAST 06. FGSV-Verlag. Köln (FGSV, 200).</p>

## Module M0628: Water Management

### Courses

<b>Title</b>	<b>Typ</b>	<b>Hrs/wk</b>	<b>CP</b>
Groundwater Hydrology (L0251)	Lecture	1	1
Groundwater Hydrology (L0252)	Recitation (large)	Section 1	2
Water Management and Water Quality (L0366)	Lecture	2	3
<b>Module Responsible</b>	NN		
<b>Admission Requirements</b>	None		
<b>Recommended Previous Knowledge</b>	Mathematics I to III; Water Engineering I, Chemistry		
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results		
<b>Professional Competence</b>	<p><i>Knowledge</i> Students are able to define terms of the hydrologic cycle and also parameters to identify the water quality. Typical aquifer types and the occurring flow and storage processes can be explained technically. They are able to derive the Darcy law and the mathematical description of flow processes as well as their solution. They are in a position to explain the physical background of well hydraulics. Fundamentals of solute transport can be reflected.</p> <p><i>Skills</i> Students are able to use fundamental relationships of hydrology and water management for the solution of practical issues. They are in a position to rate water quality data and to set up hydrological water balances. They are able to construct ground water contour lines and streamlines on the basis of head data. They have the ability to analyse data of hydraulic field and lab tests to determine hydraulic conductivities and storage coefficients.</p>		
<b>Personal Competence</b>	<p><i>Social Competence</i> Students are able to help each other solving case studies.</p> <p><i>Autonomy</i> Are not imparted in this module.</p>		
<b>Workload in Hours</b>	Independent Study Time 124, Study Time in Lecture 56		
<b>Credit points</b>	6		
<b>Course achievement</b>	None		
<b>Examination</b>	Written exam		
<b>Examination duration and scale</b>	120 min		
<b>Assignment for the Following Curricula</b>	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Elective Compulsory Civil- and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Elective Compulsory		

<b>Course L0251: Groundwater Hydrology</b>	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	1
<b>CP</b>	1
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
<b>Lecturer</b>	Prof. Wilfried Schneider
<b>Language</b>	DE
<b>Cycle</b>	WiSe
<b>Content</b>	Hydrologic water balance, aquifertyps, groundwater velocities, Darcy law, groundwater contour lines, storage capacity, flow equation, pumping tests, method of Beyer, solute transport in groundwater
<b>Literature</b>	Todd; K. (2005): Groundwater Hydrology Fetter, C.W. (2001): Applied Hydrogeology Hörling & Coldewey (2005): Hydrogeologie Charbeneau, R.J. (2000): Groundwater Hydraulics and pollutant Transport

<b>Course L0252: Groundwater Hydrology</b>	
<b>Typ</b>	Recitation Section (large)
<b>Hrs/wk</b>	1
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 46, Study Time in Lecture 14
<b>Lecturer</b>	Prof. Wilfried Schneider
<b>Language</b>	DE
<b>Cycle</b>	WiSe
<b>Content</b>	See interlocking course
<b>Literature</b>	See interlocking course

<b>Course L0366: Water Management and Water Quality</b>	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	3
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Mathias Ernst
<b>Language</b>	DE
<b>Cycle</b>	WiSe
<b>Content</b>	The lecture water Management and water quality provides knowledge on the local and global water cycle. Content overview: <ul style="list-style-type: none"> <li>• Water balance, water availability , water scarcity, water recycling</li> <li>• Water quality parameter (organic, inorganic), assessment and decision support tools.</li> </ul>
<b>Literature</b>	Teil Wasserwirtschaft: <ul style="list-style-type: none"> <li>• Wasserwirtschaft, Maniak, Ulrich., Berlin [u.a.]: Springer, 2001</li> <li>• Wasser; Grohmann, Andreas N. . Berlin [u.a.]: de Gruyter, 2011</li> <li>• Pdf der Vorlesung</li> </ul>

## Module M0686: Sanitary Engineering I

### Courses

Title	Typ	Hrs/wk	CP
Wastewater Disposal (L0276)	Lecture	2	2
Wastewater Disposal (L0278)	Recitation (large)	Section 1	1
Drinking Water Supply (L0306)	Lecture	2	1
Drinking Water Supply (L0308)	Recitation (large)	Section 1	2

<b>Module Responsible</b>	Prof. Ralf Otterpohl
<b>Admission Requirements</b>	None
<b>Recommended Previous Knowledge</b>	<ul style="list-style-type: none"> <li>• Basic knowledge on Chemistry and Biology</li> <li>• Hydraulics of pipe systems and open channels</li> <li>• Basic knowledge on water management: water quantity and water quality</li> <li>• Basic knowledge on Environmental Legislation: Federal Water Act</li> </ul>
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results
<b>Professional Competence</b>	
<i>Knowledge</i>	The students can exemplify their expert knowledge on urban water infrastructures. They can present the derivation and detailed explanation of important standards for the design of drinking water supply and wastewater disposal systems in Germany and they are capable of reproducing the relevant empirical assumptions and scientific simplifications. The students are able to present and discuss sanitary engineering processes and the technologies used for drinking and wastewater treatment. They can also assess existing problems in the field of sanitary engineering by considering legal, risk and safety aspects. Furthermore, they know how to draft the features and effectiveness of important technologies of the future such as high- and low-pressure membrane filtration systems and techniques for the removal of trace pollutants.
<i>Skills</i>	The students are able to apply the relevant standards and guidelines for the design and operation of urban water infrastructures independently. Their expertise comprises expert skills to design drinking water supply and urban drainage systems as well as the associated treatment facilities. Besides the acquirement of technical skills the students are able to address and solve biochemical problems in the field of drinking water and wastewater treatment. The students are also able to develop ideas of their own to improve the existing water related infrastructures, systems and concepts.
<b>Personal Competence</b>	
<i>Social Competence</i>	Social skills are not targeted in this module.
<i>Autonomy</i>	Students are able to form concepts on their own to optimize urban water infrastructure processes. Therefore they can acquire appropriate knowledge when being given some clues or information with regard to the approach to problems (preparation and follow-up of the exercises).

<b>Workload in Hours</b>	Independent Study Time 96, Study Time in Lecture 84
<b>Credit points</b>	6
<b>Course achievement</b>	None
<b>Examination</b>	Written exam
<b>Examination duration and scale</b>	120 min
<b>Assignment for the Following Curricula</b>	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Elective Compulsory Civil- and Environmental Engineering: Core qualification: Compulsory Civil- and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Elective Compulsory

<b>Course L0276: Wastewater Disposal</b>	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Ralf Otterpohl
<b>Language</b>	DE
<b>Cycle</b>	SoSe
<b>Content</b>	<p>This lecture focusses on urban drainage and wastewater treatment.</p> <p>Urban Drainage</p> <ul style="list-style-type: none"> <li>• Design of urban drainage systems (combined and separate sewer systems)</li> <li>• Special structures</li> <li>• Rainwater management</li> </ul> <p>Wastewater treatment</p> <ul style="list-style-type: none"> <li>• Mechanical treatment (Screens, Grit chamber, Preliminary Sedimentation, Secondary Settlement Tanks, Membrane Filtration)</li> <li>• Biological Treatment (aerobic, anaerobic, anoxic)</li> <li>• Special Wastewater Treatment Processes (Ozonation, Adsorption)</li> </ul>
<b>Literature</b>	<p>Die hier aufgeführte Literatur ist in der Bibliothek der TUHH verfügbar.</p> <p>The literature listed below is available in the library of the TUHH.</p> <ul style="list-style-type: none"> <li>• Taschenbuch der Stadtentwässerung : mit 10 Tafeln und 67 Tabellen, Imhoff, K., &amp; . (2009). (31., verbesserte Aufl.). München: Oldenbourg Industrieverl.</li> <li>• Abwasser : Technik und Kontrolle. Neitzel, Volkmar, and. . Weinheim [u.a.]: Wiley-VCH, 1998.</li> <li>• Kommunale Kläranlagen : Bemessung, Erweiterung, Optimierung, Betrieb und Kosten, (2009). Günthert, F. Wolfgang: (3., völlig neu bearb. Aufl.). Renningen: expert-Verl.</li> <li>• Water and wastewater technology Hammer, M. J. 1., &amp; . (2012). (7. ed., internat. ed.). Boston [u.a.]: Pearson Education International.</li> <li>• Water and wastewater engineering : design principles and practice: Davis, M. L. 1. (2011). . New York, NY: McGraw-Hill.</li> <li>• Biological wastewater treatment: (2011). C. P. Leslie Grady, Jr. (3. ed.). London, Boca Raton, Fla. [u.a.]: IWA Publ.</li> </ul>

<b>Course L0278: Wastewater Disposal</b>	
<b>Typ</b>	Recitation Section (large)
<b>Hrs/wk</b>	1
<b>CP</b>	1
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
<b>Lecturer</b>	Prof. Ralf Otterpohl
<b>Language</b>	DE
<b>Cycle</b>	SoSe
<b>Content</b>	See interlocking course
<b>Literature</b>	See interlocking course

<b>Course L0306: Drinking Water Supply</b>	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	1
<b>Workload in Hours</b>	Independent Study Time 2, Study Time in Lecture 28
<b>Lecturer</b>	Dr. Klaus Johannsen, Prof. Mathias Ernst
<b>Language</b>	DE
<b>Cycle</b>	SoSe
<b>Content</b>	<p>The lecture on drinking water supply provides students with a basic understanding of the entire water supply system, encompassing water catchment, water treatment including pump systems, water storage, and the distribution system that carries water to the consumer.</p> <p>Initially, basics in hydraulics and pump systems are presented (system curve and pump curve). Students learn how the duty point of the pump is determined. Students learn about different water resources and will be able to design groundwater wells. Students learn how to determine water demand and derive planning values for designing the different elements of a water supply system (e.g. firefighting requirements). The functions of reservoirs, their design and arrangement in the water supply system are explained. Students will be able to design simple water distribution systems.</p> <p>A further part of the lecture deals with the processes involved in drinking water supply. This includes a presentation of the essential mechanisms and layout parameters for sedimentation, filtration, coagulation, membrane treatment, adsorption, water softening, gas exchange, ion exchange and disinfection. The basics of process treatment technology will be built on with parallel analysis of the impacts on chemical and physical water quality parameters.</p>
<b>Literature</b>	<p>Gujer, Willi (2007): Siedlungswasserwirtschaft. 3., bearb. Aufl., Springer-Verlag.</p> <p>Karger, R., Cord-Landwehr, K., Hoffmann, F. (2005): Wasserversorgung. 12., vollst. überarb. Aufl., Teubner Verlag</p> <p>Rautenberg, J. et al. (2014): Mutschmann/Stimmelmayer Taschenbuch der Wasserversorgung. 16. Aufl., Springer-Vieweg Verlag.</p> <p>DVGW Lehr- und Handbuch Wasserversorgung: Wasseraufbereitung - Grundlagen und Verfahren, m. CD-ROM: Band 6 (2003).</p>

<b>Course L0308: Drinking Water Supply</b>	
<b>Typ</b>	Recitation Section (large)
<b>Hrs/wk</b>	1
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 46, Study Time in Lecture 14
<b>Lecturer</b>	Dr. Klaus Johannsen, Prof. Mathias Ernst
<b>Language</b>	DE
<b>Cycle</b>	SoSe
<b>Content</b>	See interlocking course
<b>Literature</b>	See interlocking course

## Module M0612: Steel Structures II

### Courses

Title	Typ	Hrs/wk	CP
Steel Structures II (L0301)	Lecture	2	3
Steel Structures II (L0302)	Recitation (large)	Section 2	3
<b>Module Responsible</b>	Prof. Marcus Rutner		
<b>Admission Requirements</b>	None		
<b>Recommended Previous Knowledge</b>	Steel Structures I		
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results		
<b>Professional Competence</b>	<p>After successful completion students can</p> <ul style="list-style-type: none"> <li>describe and explain the behaviour of bolted and welded connections</li> <li>design and check simple halls and buildings</li> <li>calculate forces and stresses of simple structures (trusses, beams, frames)</li> <li>illustrate and dimension the main details (framework, column base, load application points)</li> </ul>		
<i>Knowledge</i>			
<i>Skills</i>	Students are able to design simple structures and connections, describe the load distribution and recognize the possible modes of failure. They can apply structural imperfections, calculate according to 2nd order theory and verify their results.		
<b>Personal Competence</b>			
<i>Social Competence</i>	--		
<i>Autonomy</i>	--		
<b>Workload in Hours</b>	Independent Study Time 124, Study Time in Lecture 56		
<b>Credit points</b>	6		
<b>Course achievement</b>	None		
<b>Examination</b>	Written exam		
<b>Examination duration and scale</b>	120 minutes		
<b>Assignment for the Following Curricula</b>	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Elective Compulsory Civil- and Environmental Engineering: Core qualification: Compulsory Civil- and Environmental Engineering: Specialisation Civil Engineering: Compulsory Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Compulsory Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Compulsory		



<b>Course L0301: Steel Structures II</b>	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	3
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Marcus Rutner
<b>Language</b>	DE
<b>Cycle</b>	SoSe
<b>Content</b>	<ul style="list-style-type: none"> <li>• Welded connections</li> <li>• Simple constructions                             <ul style="list-style-type: none"> <li>◦ Trusses</li> <li>◦ Plate girders</li> <li>◦ Frames</li> <li>◦ Columns</li> </ul> </li> <li>• Buildings with several storeys</li> <li>• Halls</li> </ul>
<b>Literature</b>	Petersen, C.: Stahlbau, 4. Auflage 2013, Springer-Vieweg Verlag Wagenknecht, G.: Stahlbau-Praxis nach Eurocode 3, Bauwerk-Verlag 2011 <ul style="list-style-type: none"> <li>• Band 1 Tragwerksplanung, Grundlagen</li> <li>• Band 2 Verbindungen und Konstruktionen</li> </ul>

<b>Course L0302: Steel Structures II</b>	
<b>Typ</b>	Recitation Section (large)
<b>Hrs/wk</b>	2
<b>CP</b>	3
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Marcus Rutner
<b>Language</b>	DE
<b>Cycle</b>	SoSe
<b>Content</b>	See interlocking course
<b>Literature</b>	See interlocking course

## Thesis

### Module M-001: Bachelor Thesis

**Courses**

Title	Typ	Hrs/wk	CP
<b>Module Responsible</b>	Professoren der TUHH		
<b>Admission Requirements</b>	<ul style="list-style-type: none"> <li>According to General Regulations §21 (1):</li> </ul> <p>At least 126 ECTS credit points have to be achieved in study programme. The examinations board decides on exceptions.</p>		
<b>Recommended Previous Knowledge</b>			
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results		
<b>Professional Competence</b>			
<i>Knowledge</i>	<ul style="list-style-type: none"> <li>The students can select, outline and, if need be, critically discuss the most important scientific fundamentals of their course of study (facts, theories, and methods).</li> <li>On the basis of their fundamental knowledge of their subject the students are capable in relation to a specific issue of opening up and establishing links with extended specialized expertise.</li> <li>The students are able to outline the state of research on a selected issue in their subject area.</li> </ul>		
<i>Skills</i>	<ul style="list-style-type: none"> <li>The students can make targeted use of the basic knowledge of their subject that they have acquired in their studies to solve subject-related problems.</li> <li>With the aid of the methods they have learnt during their studies the students can analyze problems, make decisions on technical issues, and develop solutions.</li> <li>The students can take up a critical position on the findings of their own research work from a specialized perspective.</li> </ul>		
<b>Personal Competence</b>			
<i>Social Competence</i>	<ul style="list-style-type: none"> <li>Both in writing and orally the students can outline a scientific issue for an expert audience accurately, understandably and in a structured way.</li> <li>The students can deal with issues in an expert discussion and answer them in a manner that is appropriate to the addressees. In doing so they can uphold their own assessments and viewpoints convincingly.</li> </ul>		
<i>Autonomy</i>	<ul style="list-style-type: none"> <li>The students are capable of structuring an extensive work process in terms of time and of dealing with an issue within a specified time frame.</li> <li>The students are able to identify, open up, and connect knowledge and material necessary for working on a scientific problem.</li> <li>The students can apply the essential techniques of scientific work to research of their own.</li> </ul>		

<b>Workload in Hours</b>	Independent Study Time 360, Study Time in Lecture 0
<b>Credit points</b>	12
<b>Course achievement</b>	None
<b>Examination</b>	Thesis
<b>Examination duration and scale</b>	According to General Regulations
<b>Assignment for the Following Curricula</b>	<p>General Engineering Science (German program, 7 semester): Thesis: Compulsory</p> <p>Civil- and Environmental Engineering: Thesis: Compulsory</p> <p>Bioprocess Engineering: Thesis: Compulsory</p> <p>Computer Science: Thesis: Compulsory</p> <p>Data Science: Thesis: Compulsory</p> <p>Digital Mechanical Engineering: Thesis: Compulsory</p> <p>Electrical Engineering: Thesis: Compulsory</p> <p>Energy and Environmental Engineering: Thesis: Compulsory</p> <p>Engineering Science: Thesis: Compulsory</p> <p>General Engineering Science (English program, 7 semester): Thesis: Compulsory</p> <p>Computational Science and Engineering: Thesis: Compulsory</p> <p>Logistics and Mobility: Thesis: Compulsory</p> <p>Mechanical Engineering: Thesis: Compulsory</p> <p>Mechatronics: Thesis: Compulsory</p> <p>Naval Architecture: Thesis: Compulsory</p> <p>Technomathematics: Thesis: Compulsory</p> <p>Teilstudiengang Lehramt Elektrotechnik-Informationstechnik: Thesis: Compulsory</p> <p>Teilstudiengang Lehramt Metalltechnik: Thesis: Compulsory</p> <p>Process Engineering: Thesis: Compulsory</p>