Karlsruhe Institute of Technology

Module Handbook
Civil Engineering (M.Sc.)

Summer Term 2013
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Department of Civil Engineering, Geo- and Environmental Sciences

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1.1 All Modules

Module: Design and Construction of Components in Reinforced Concrete [bauiM1P1-BEMISTB]

Coordination: L. Stempniewski
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6211701	(p. 154)	2/2	W	6	L. Stempniewski

Learning Control / Examinations
graded:
written examination, 90 minutes

Conditions
None.

Recommendations
Basics of Reinforced Concrete

Learning Outcomes
Achieving a higher level of insight into complex subjects of reinforced concrete

Content
Design and Construction of Components, Design for bending and Torsion, Biaxial Bending, Punching, Truss Analogy

Remarks
Literature: Vorlesungsskriptum

Module: Steel and Composite Structures [bauiM1P2-STAHLBAU]

Coordination: T. Ummenhofer
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6212801	Steel and Composite Structures (p. 302)	2/2	S	6	T. Ummenhofer

Learning Control / Examinations
graded:
written exam, 90 minutes

Conditions
None.

Recommendations
Basics in steel structures

Learning Outcomes
The students have knowledge in calculation of composite structures, in construction and design calculation of structures and building components made of thin-walled, cold formed steelwork components as well as basics in fire protection in steel constructions and basics in torsion of any cross section.

Content
Basics of steel composite structures, composite girders and composite columns designed for structural engineering and bridge construction, fire protection in steel constructions, the theory of torsion, light-weight steel construction

Remarks
Literature: lecture accompanying documents DIN EN 1993 Bemessung und Konstruktion von Stahlbauten DIN EN 1994 Bemessung und Konstruktion von Verbundbauten

Module: Surface Structures and Dynamics of Structures [bauiM1P3-FTW-BD]

Coordination: W. Wagner
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6214701	Surface Structures (p. 199)	2	W	3	W. Wagner
6215701	Dynamics of Structures (p. 142)	2	W	3	T. Seelig

Learning Control / Examinations
graded:
written examination

Conditions
Technical Mechanics of BSc, Advanced Mathematics

Recommendations
Structural Analysis 1+2

Learning Outcomes
Sub-module Surface Structures:
The students will learn the essential principles for surface structures (Theory, models, analytical and numerical solution procedures and error analysis). This is used as the basis for the design and construction of surface structures.
Sub-module Dynamics of Structures:
Analysis of structural vibrations of civil structures - reasons, concepts to reduce vibrations, mathematical models. The technical background will be illustrated by practical examples.

Content
Sub-module Surface Structures:
Panel structures Models and basic equations, PDE and BCs, analytical solutions, FE for rot. symmetry, FE-application to general panel structures, practical related solutions with truss models Plate structures Models and basic equations, PDE and simplifications, analytical solutions, serial solutions, FE for rot.symmetry, FE-application to general plate structures, practical related solution strategies, elastic foundation and temperature, influence surfaces Introduction to shell structures
Sub-module Dynamics of Structures:
Kinematics -Harmonic vibrations -Periodic vibrations (harmonic analysis) -Representation in the frequency range -Non-periodic vibrations (spectra) Vibrations with one degree of freedom -Mechanical model for real structures -Non-damped and damped free oscillations -Transient oscillations (impacts) -Harmonic excitation, transfer function -Isolation -Filter effect -Periodical excitation (frequency range) Vibrations with 2 degrees of freedom -Free vibrations -Harmonic excitation -Passive mass-damper Vibrations with finite degrees of freedom -Equations of motion -Mode decomposition, natural frequencies -Different kind of excitation -Participation factor -Damping

Remarks
Literature:
Sub-module Surface Structures:
Script Flächentragwerke
Hake, E. , Meskouris, K. (2001): Statik der Flächentragwerke, Springer.
Altenbach, H., Altenbach, J., Naumenko, K. (1998): Ebene Flächentragwerke, Grundlagen der Modellierung und Berechnung von Scheiben und Platten, Springer.
Sub-module Dynamics of Structures:
Script: P. Vielsack: Grundlagen der Baudynamik

Module: Bracing and Stability in Reinforced Concrete [bauiM1S01-STABISTB]

Coordination: L. Stempniewski
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6211801	(p. 139)	2/2	S	6	L. Stempniewski

Learning Control / Examinations
graded:
written examination, 90 minutes

Conditions
None.

Recommendations
Design and Construction of Components in Reinforced Concrete

Learning Outcomes
Design of Buildings regarding Bracing and Stability

Content
Theoretical Basics, Theory of Second Order, Design of Slender Columns, Bracing and Stability of Buildings

Remarks
Literature: Vorlesungsskriptum

Module: Basics of Prestressed Concrete [bauiM1S02-GDLSPANNB]

Coordination: L. Stempniewski
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6211803	(p. 216)	2/2	S	6	L. Stempniewski

Learning Control / Examinations
graded:
written examination, 90 minutes

Conditions
None.

Recommendations
Design and Construction of Components in Reinforced Concrete

Learning Outcomes
Understanding the basics and Functionality of Prestressed Concrete.

Content
Types and Systems for Prestressing, Loss of Prestressing Forces caused by friction, Creep, Shrinkage and Relaxation

Remarks
Literature: Vorlesungsskriptum

Module: Solid Construction Bridges [bauiM1S03-MASSBRUE]

Coordination: L. Stempniewski
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6211901	(p. 243)	2/2	W	6	L. Stempniewski

Learning Control / Examinations
graded: examination Solid Construction Bridges, weighting acc. CP, written exam, 90 minutes

Conditions
None.

Recommendations
Basics of Prestressed Concrete

Learning Outcomes
Understanding how to design and build bridges regarding span, architecture and environment

Content
Equipment of Bridges, Load Assumptions, Construction Methods, Types of Supports

Remarks
Literature: Vorlesungsskriptum

Module: [bauiM1S04-BAUDYN]

Coordination: L. Stempniewski
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	2

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6211805	(p. 268)	1/1	S	3	L. Stempniewski
6211903	(p. 185)	1/1	W	3	L. Stempniewski

Learning Control / Examinations
graded:
oral examination, 30 minutes

Conditions
None.

Learning Outcomes

Content

Remarks
Literature:
Stempniewski, L.; Haag, B. (2010): Baudynamik-Praxis, Beuth

Module: Anchorage in Concrete [bauiM1S05-BEFTECH]

Coordination: L. Stempniewski
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	2

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6211807	(p. 152)	1/1	S	3	L. Stempniewski
6211905	(p. 153)	1/1	W	3	L. Stempniewski

Learning Control / Examinations
graded:
oral examination

Conditions
None.

Recommendations
Dynamics

Learning Outcomes
Comprehension of the Importance of using the right Anchorage System in a specific case and in the right Way

Content
Anchorage Systems, Basics, Load Bearing Behavior of different Systems, Construction

Remarks
Literature: Eligehausen, Mallée: “Befestigungstechnik im Beton- und Mauerwerksbau”

Module: Material science, welding and fatigue [bauiM1S06-SCHWEISSEN]

Coordination: T. Ummenhofer
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6212803	Material science, welding and fatigue (p. 304)	3/1	S	6	T. Ummenhofer

Learning Control / Examinations
graded:
written examination, 90 minutes

Conditions
quisites: Recommendations

Learning Outcomes

Content

Remarks
Literature:

Module: Construction of steel and composite bridges [bauiM1S07- STAHLBRÜ]

Coordination: T. Ummenhofer
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6212901	Construction of steel and composite bridges (p. 303)	2/2	W	6	T. Ummenhofer

Learning Control / Examinations
graded:
written examination, 60 minutes

Conditions
None.

Recommendations
Grundlagen des Stahlbaus, Steel Structures

Learning Outcomes
The students have knowledge in design, construction, design calculation and assembly of steel and steel composite bridges.

Content
Historical development, design basics, pavement constructions, 3d-bearing capacity of steel-bridges, main beams in solid-webbed constructions, main beams in composite constructions, main beams in framework construction, bridge bearings, assembly process

Remarks
Literature: lecture accompanying documents DIN Fachbericht 101: Einwirkungen auf Brücken DIN Fachbericht 103: Stahlbrücken DIN Fachbericht 104: Verbundbrücken

Module: Hollow section structures [bauiM1S08-HOHLPROFIL]

Coordination: S. Herion
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6212903	Hollow section structures (p. 222)	2/2	W	6	S. Herion

Learning Control / Examinations
graded:
oral examination, 30 minutes

Conditions
None.

Recommendations
Basics in steel structures

Learning Outcomes
The students have knowledge in construction and dimensioning of predominantly static and of non predominantly static stressed constructions made of hollow sections as well as their connections.

Content
Appliance in steel- and bridge engineering, welded joints, cast joints, fatigue behavior, calculation examples

Remarks
Literature:
Manuscript: “Hollow section structures”, Karlsruher Institut für Technologie (KIT), Versuchsanstalt für Stahl, Holz und Steine

Module: Glass, plastic and cable structures [bauiM1S09- GlaKunSe]

Coordination: D. Ruff
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6212905	Glass, plastic and cable structures (p. 211)	3/1	W	6	D. Ruff

Learning Control / Examinations
graded:
written examination, 90 minutes

Conditions
None.

Recommendations
Grundlagen des Stahlbaus

Learning Outcomes
The students have knowledge in material characteristics of glass construction materials, in glass-steel constructions, their structural behaviour and the check of load-carrying capacity; The students have knowledge in manufacturing, characteristics and processing capacities of plastics, as well as types of constructions and design rules; The students have knowledge of assembly and the characteristics of cables, high-strength tension members as well as types of constructions and design rules of cable structures.

Content
Glass in civil engineering, glass structures, construction details, design calculation, plastics in civil engineering, construction details, design of wires, cables, cords, end-connections, clampings, buffles, static and dynamic structural behaviour, construction and design calculation

Remarks
Literature: lecture accompanying documents Technische Regeln für die Verwendung von linienförmig gelagerten Verglasungen, DIBt, Berlin Technische Regeln für die Verwendung von absturzsichernden Verglasungen, DIBt, Berlin DIN EN 1993 Bemessung und Konstruktion von Stahlbauten DIN 18008 Glas im Bauwesen

Module: Structures in steel and timber [bauiM1S10-BAUING-TSH]

Coordination: T. Ummenhofer
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6212907	Supporting steel structures (p. 317)	1/1	W	3	T. Ummenhofer
6213901	(p. 316)	1/1	W	3	Frese

Learning Control / Examinations
graded:
oral examination, 60 minutes

Conditions
None.

Recommendations
Prerequisites: mandatory participation in Timber structures
Basics in steel structures, Steel Structures

Learning Outcomes
Structures in steel: The students have knowledge in the design of structures, regarding the necessary boundary conditions. Structures in timber: Timber bridges Nail plate connections Timber structures for halls Learning from failures Dome structures
Structures in timber:
The lecture gives an overview about damages to timber structures and their reasons and highlights the topic „timber structures“ from pathological perspective. In doing so the aims are achieving awareness of damages and learning strategies to avoid damages and failures.

Content
Structures in steel: Structure design and constructive detail design in structural- and bridge engineering Structures in timber: Timber bridges Nail plate connections Timber structures for halls Learning from failures Dome structures Structures in timber: Classification of damages; definitions of the sphere, in which damages and failures occur; damages and failures that are typical for timber structures

Remarks
Literature:
Structures in steel: lecture accompanying documents Structures in timber: Blaß, H.J.; Görlacher, R.; Steck, G. (Ed.) Holzbauwerke STEP 1 - Bemessung und Baustoffe. Fachverlag Holz, Düsseldorf, 1995 (ISSN-Nr. 04462114)
Structures in timber: lecture accompanying documents

Module: Preservation of steel and timber structures [bauiM1S11-BAUING-BSH]

Coordination: R. Görlacher
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6212909	Preservation of steel structures (p. 150)	2	W	3	T. Ummenhofer
6213903	(p. 149)	1/1	W	3	R. Görlacher

Learning Control / Examinations
graded:
written examination, 90 minutes

Conditions
None.

Recommendations
participation in Timber structures (bauiM1S12-BAUING-HB)

Learning Outcomes
Preservation of steel structures:
The students have knowledge in investigation of old building fabric, in character- istics of old steel and cast productions made of iron materials, in typical defects, to load bearing evaluation and for elimination of damages or for reinforcement as well as investigation of remaining service life of predominantly static- and non-predominantly static stressed constructions.
Preservation of timber structures:
The students know the historical development of timber structures as well as load and force distribution in historical timber constructions. They are aware of techniques of inspection and evaluation of timber constructions. The students are able to detect decay and damage as well as determine timber qualities (in-situ strength grading of timber). They are aware of calculation of carpentry joints. They know particularities in designing a historical timber roof structure. The students know methods for repairing and strengthening for the conservation of cultural heritage taking into consideration carpentry and engineered solutions.

Content
Preservation of steel structures: Old steels, cast materials, investigation of constructions and building parts, damage-mechanisms, investigation of bearing capacity, maintenance procedures
Preservation of timber Structures: History of timber constructions: Simple timber constructions, development of timber-frame construction and timber roof structures, history of timber bridges. Inspection and evaluation of an existing timber construction: Limit state design, strength of timber used in historical constructions, inspection of built-in timber. Calculation of carpentry joints. Design of historical timber constructions: Consideration of ductility of the joints, modelling (plane - spatial systems). Methods of repair and strengthening: Concepts for the conservation of cultural heritage, repair, strengthening, additional load bearing structures

Remarks
Literature:
Preservation in steel structures: lecture accompanying documents
Preservation of Timber Structures: Blaß, H.J.; Görlacher, R.; Steck, G. (Ed.) Holzbauwerke STEP 1 - Bemessung und Baustoffe. Fachverlag Holz, Düsseldorf, 1995 (ISSN-Nr. 04462114) Görlacher, R.: Historische Holzbauwerke. Untersuchen, Berechnen und Instandsetzen. Karlsruhe 1999. ISBN 3-934540-01-5 Manuscript „Bauwerkserhaltung im Holzbau“, Lehrstuhl für Ingenieurholzbau und Baukonstruktionen, Universität Karlsruhe (TH)

Module: Timber structures [bauiM1S12-BAUING-HB]

Coordination: H. Blaß
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6213801	(p. 224)	2/2	S	6	H. Blaß

Learning Control / Examinations
graded:
written examination, 90 minutes

Conditions
None.

Learning Outcomes
The students are able to design composite glued or mechanically jointed components as well as special connection details. They have knowledge about detailing for durability and fire resistance of timber. The students are qualified to design timber structures.

Content
Elements: Mechanically jointed beams, stressed skin panels, purlins Joints: Moment resisting connections, multiple-shear joints with dowel-type fasteners, joist hangers and framing anchors, reinforced connections Details: Tension perpendicular to the grain in joints, notched beam and holes in glulam beams, fire resistance, detailing for durability, durability - preservative treatment

Remarks
Literature: Blaß, H.J.; Görlacher, R.; Steck, G. (Ed.) Holzbauwerke STEP 1 - Bemessung und Baustoffe. Fachverlag Holz, Düsseldorf, 1995 (ISSN-Nr. 04462114)

Module: Timber and wood-based materials [bauiM1S13-BAUING-HHW]

Coordination: H. Blaß
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6213803	(p. 223)	2/2	S	6	Sandhaas

Learning Control / Examinations
graded:
oral examination, 30 minutes

Conditions
None.

Learning Outcomes
The students understand basically wood as natural raw material and its physical properties. They know the natural influences on the structure and the mechanical properties of wood as building material. They are aware of the growth and biological structure of trees as supplier of wood. The students know the processing of timber from tree-felling to ready-made building materials. Apart from solid timber products they get to know the production and use of wood based products like glulam, plywood, particle boards and fibre boards. They are aware about the basic properties of timber and wood-based materials. At different excursions the students gain insight into sustainable forest management and the production of wood-based building materials.

Content
Wood anatomy Influence on the creation of wood Wood failures Wood physics Timber drying Solid timber Wood based products Glued laminated timber Wood based panels

Remarks
Literature: Blaß, H.J.; Görlacher, R.; Steck, G. (Ed.) Holzbauwerke STEP 1 - Bemessung und Baustoffe. Fachverlag Holz, Düsseldorf, 1995 (ISSN-Nr. 04462114) Manuscript „Holz und Holzwerkstoffe“, Lehrstuhl für Ingenieurholzbau und Baukonstruktionen, Universität Karlsruhe (TH)

Module: Non-linear Analysis of Beam Structures [bauiM1S14-NILI-STAB]

Coordination: W. Wagner
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6214702	Non-linear Analysis of Beam Structures (p. 259)	2/2	W	6	I. Münch

Learning Control / Examinations
graded:
written examination, 90 minutes

Conditions
None.

Recommendations
Structural Analysis 1+2

Learning Outcomes
Students will learn the main essential principles of the nonlinear analysis of beam structures (ultimate load design, II. Order theory, extensions and error analysis). This is used as the basis for the design and construction of structures.

Content
Material Nonlinearity:
Basics of ultimate load design,
plastic hinge theory I. O.,
incremental and direct calculation of the ultimate load,
limit value theorems
Geometrical Nonlinearity:
PDE of II. O. theory , VV,
imperfections,
iteration procedures,
stability problems
Geometrical and Material Nonlinearity:
Plastic hinge theory of II. O.

Remarks
Literature:
Script Nichtlineare Modellierung von Stabtragwerken

Module: Computational Analysis of Structures [bauiM1S15-CTWM]

Coordination: W. Wagner
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6214801	Computational Analysis of Structures (p. 171)	2/2	S	6	W. Wagner

Learning Control / Examinations
graded:
oral exam, 30 minutes
attested:
term paper

Conditions
None.

Recommendations
Surface Structures and Dynamics of Structures

Learning Outcomes
Students will learn the essential principles for the computational modeling of structures (FE-Models for Beam and Surface Structures, Modeling of practical problems, error analysis). This allows the computer aided design and construction of structures.

Content
Numerical Modeling of 2D/3D beams, surface structures
Application to 2D/3D beams, surface structures
Further Problems
Exactness and improvement of the solutions, folded plates, rotational shells, adaptive mesh generation, stationary heat conduction 2D/3D, further problems of building physics, commercial software for design and construction

Remarks
Literature:
Script Computergestützte Tragwerksmodellierung
Krätzig, W.B., Basar, Y. (1997): Tragwerke 3 - Theorie und Anwendung der Methode der Finiten Elemente, Springer.
Werkle, H. (2001): Finite Elemente in der Baustatik, Statik und Dynamik der Stab- und Flächentragwerke, Vieweg.

Module: FE-Applications in Practical Engineering [bauiM1S16-FE-PRAXIS]

Coordination: W. Wagner
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6214803	FE-Applications in Practical Engineering (p. 193)	2/2	S	6	W. Wagner

Learning Control / Examinations
graded:
oral examination, 30 minutes

Conditions
None.

Recommendations
Computational Analysis of Structures

Learning Outcomes
Students will enhance their skills in computer aided modeling of structures by using commercial FE-codes for practical civil engineering projects.

Content
Use of different commercial software for the modeling of beam- and surface structures, structural analysis and design, discussion of approximation behaviour at examples, analytical comparative calculations, software comparisons, control options.

Remarks
Literature: Script Computergestützte Tragwerksmodellierung

Module: Shell Structures and Stability of Structures [bauiM1S17-STABISHELL]

Coordination: W. Wagner
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6214805	Shell Structures (p. 283)	1/1	S	3	I. Münch
6214807	Stability of Structures (p. 298)	1/1	S	3	I. Münch

Learning Control / Examinations
graded:
oral examination, 30 minutes
attested: term paper

Conditions
None.

Recommendations
Surface Structures

Learning Outcomes
Students will learn the theory and analytical and computational modeling of shell structures and of stability problems.

Content
Shell Structures:
Examples in nature and technique,
membrane- and bending theory of rotational shells,
analytical solutions,
KV for rotational shells,
FE-modeling of shells,
stability of shell structures
Stability of Structures:
math., stat. and physical basics of stability theory,
sensitivity, imperfections,
analytical solutions,
calculations for 2D/3D-beam-, plate- and shell structures,
numerical models,
path following, bifurcation, practical examples

Remarks
Literature:
Script Schalentragwerke
Script Stabilität der Tragwerke

Module: Numerical Methods in Structural Analysis [bauiM1S18-FEM-BS]

Coordination: W. Wagner
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6214901	Numerical Methods in Structural Analysis (p. 262)	2/2	W	6	I. Münch

Learning Control / Examinations
graded:
oral examination, 30 minutes

Conditions
None.

Recommendations
Computational Analysis of Structures

Learning Outcomes
Students will develop main parts of a finite element program for beam and surface structures on the basis of the lectures in Structural Analysis

Content
Development of a program for truss structures with VBA, input and output of data, element stiffness matrices, transformation, solving of equations, calculation of stress resultants, design, visualisation, extension to beam structures, shear stresses for Q in arbitrary cross-sections, 2D-heat-conduction (temperature distribution in structural components), surface structuresl, model-calculations for practical problems

Remarks
Literature:
Script Computergestützte Tragwerksmodellierung

Module: Non-linear Analysis of Surface Structures [bauiM1S19-NILI-FTW]

Coordination: W. Wagner
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6214903	Non-linear Analysis of Surface Structures (p. 258)	2/2	W	6	W. Wagner

Learning Control / Examinations
graded:
oral examination, 30 minutes

Conditions
None.

Learning Outcomes
Students will learn the essential principles of nonlinear analysis of surface structures.

Content
Geometric nonlinear models of surface structures,
nonlinear material models for thin structures,
analytical and numerical surface structure analysis,
introduction to the modelling of shell structures,
application of stability and dynamic problems,
modelling of laminated structures,
practial examples

Remarks
Literature:
Script

Module: Basis of Finite Elements [bauiM1S20-GRUNDFE]

Coordination: P. Betsch
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6215901	(p. 218)	2/2	W	6	P. Betsch

Learning Control / Examinations
graded:
oral examination, 20 minutes

Conditions
Technical Mechanics of BSc, Advanced Mathematics, Introduction to Continuum Mechanics

Learning Outcomes
The basic mathematical and mechanical concepts of finite element methods are demonstrated on the basis of structural-mechanical problems. In this context, the whole range of the necessary steps and methods will be described and some parts will also be programmed in classroom exercises and homework. Afterwards the students must be able: 1) to perform structural analyses independently using finite elements, 2) to perform modifications in a finite element program and to add own elements.

Content
-Overview - general applications - general approach -Finite elements for one-dimensional boundary value problems -Differential formulation - weak form/variational forms, discretisation with Ritz and Galerkin's methods, global - local approaches, assembly of global matrices and vectors -Introduction of boundary conditions -Numerical error - accuracy of analysis -Possibilities for ansatz functions, Lagrangian, Hermitian polynomials -accuracy of the results - optimal stress points -Ansatz functions for 2nd order DE problems, continua beams problems with 4th order DE -FE-approaches for 2- and 3-dimensional elasticity problems -Weak form, requirements, concerning ansatz functions, Lagrangian ansatz functions for triangular and quadrilateral elements, volume elements (tetrahedron, hexahedron) -Isoparametric elements -Numerical integration, area and volume integral, required order of integration -Preconditions for convergence for 2-dimensional problems -Discretisation and discretisation error - a-priori and a-posteriori error estimation - approximation - convergence of error -Instationary problems, elasto-dynamics, mass and damping matrix -Introduction into time integration schemes

Remarks
Literature:
[1] Cook, Malkus, Plesha: Concept and Applictaions of Finite Element Analysis, 1989.
[2] Hughes: The Finite Element Method, 1987.
[3] Zienkiewicz, Taylor: The Finite Element Method, Volume 1,2 & 3, 2000.
[4] Bathe: Finite-Elemente-Methoden, 2001.

Module: Fracture and Damage Mechanics [bauiM1S21-BRUCHMECH]

Coordination: T. Seelig
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6215903	(p. 170)	2/2	W	6	T. Seelig

Learning Control / Examinations
graded:
oral examination, 45 minutes

Conditions
Technical Mechanics of BSc, Advanced Mathematics, Introduction to Continuum Mechanics

Recommendations
Continuum Mechanics

Learning Outcomes
Fundamental concepts and methods of fracture mechanics and damage mechanics are presented which are used in the analysis of structures containing cracks as well as in the modelling of complex material behaviour. Besides the continuum mechanical description, material specific aspects are also discussed

Content
- phenomenology and mechanisms of fracture - linear elastic fracture mechanics (crack tip fields, K-concept, energy balance, J-integral, small scale yielding) - elastic plastic fracture mechanics (Dugdale model, HRR-field, J-controlled crack growth) - dynamic fracture mechanics (dynamic loading, fast running cracks) - micromechanics of heterogeneous solids (defects and eigenstrain, RVE-concept, homogenization) - damage mechanics (mechanisms of brittle and ductile damage, micromechanical and phenomenological models, softening and localization)

Remarks
Literature: [1] Anderson, T.L.: Fracture Mechanics - Fundamentals and Application. CRC Press, 1995 [2] Gdoutos, E.E.: Fracture Mechanics - An Introduction. Kluwer Acad. Publ., 1993 [3] Gross, D., Seelig, Th: Bruchmechanik - mit einer Einführung in die Mikromechanik, Springer, 2007 [4] Knott, J.F.: Fundamentals of Fracture Mechanics. Butterworth, 1973 [5] Krajcinovic, D.: Damage Mechanics. Elsevier, 1996 [6] Mura, T.: Micromechanics of Defects in Solids. Martinus Nijhoff Publishers, 1982 [7] Nemat-Nasser, S., Hori, M.: Micromechanics - Overall Properties of Heterogeneous Materials. North-Holland, 1993

Module: Material Models in Solid Mechanics [bauiM1S22-MATTHEO]

Coordination: T. Seelig
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6215801	(p. 137)	2/2	S	6	T. Seelig

Learning Control / Examinations
graded:
oral examination, 45 minutes

Conditions
Technical Mechanics of BSc, Advanced Mathematics, Introduction to Continuum Mechanics

Recommendations
Continuum Mechanics

Learning Outcomes
Numerous tasks in engineering require a theoretical description of a material's response beyond the elastic range. The course focuses on the continuum mechanical description of various kinds of inelastic material behavior. Besides the different phenomena their physical origins are also discussed.

Content
- general purpose of material theories and constitutive laws - elasticity (isotropic / anisotropic material models) - phenomenology of inelastic material behavior (residual deformation, rate-dependence / creep, plastic incompressibility / dilatancy, pressure-dependence / independence, damage) - concepts of constitutive modeling (internal variables, yield condition, flow rule, hardening laws, incremental constitutive equations) - material theories: viscoelasticity, plasticity, viscoplasticity - applications (metals, geomaterials, concrete, thermoplastic polymers, wood)

Remarks
Literature: [1] Chen, W.F., Hahn, D.J.: Plasticity for Structural Engineers. Springer, 1988 [2] de Souza Neto, E.A., Peric, D., Owen, D.R.J.: Computational Methods for Plasticity. Wiley, 2008 [3] Doghri, I.: Mechanics of Deformable Solids. Springer, 2000 [4] Khan, A.S., Huang, S.: Continuum Theory of Plasticity. Wiley,1995 [5] Lemaitre, J., Chaboche, J.L.: Mechanics of Solid Materials. Cambridge University Press, 1990 [6] Lubliner, J.: Plasticity Theory. Macmillan, 1990; Dover, 2008 [7] Seelig, Th.: Anwendungsorientierte Materialtheorien. Skript zur Vorlesung

Module: Contact Mechanics I - Statics [bauiM1S23-KONTMECH-I]

Coordination: A. Konyukhov
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6215803	(p. 232)	2/2	S	6	A. Konyukhov

Learning Control / Examinations
graded:
oral examination, 30 minutes

Conditions
Technical Mechanics of BSc, Advanced Mathematics, Introduction to Continuum Mechanics, Finite Elements

Recommendations
Continuum Mechanics

Learning Outcomes
Contact problems appear within a large number of engineering problems. The main difficulty in the solution of contact problems is the nonlinearity of the governing equilibrium equations even for small displacement problems. This nonlinearity is arising from a lack of a-priori knowledge about a contact area and contact stresses. Thus, an advanced mathematical modeling should be applied. Several contact approaches for modeling contact conditions within the Finite Element method are described during the course. Particular problems arising during the modeling are discussed and illustrated by numerical examples using also commercial F.E. programs. Numerical implementations for the FEAP code (Finite Element Analysis Program, version FEAP-MeKa) are done for 2d examples.

Content
-Introduction into contact mechanics: equilibrium equations, boundary conditions, nonlinearities appearing in contact modeling. -Non-frictional contact. Contact with a rigid obstacle. SIGNORINI's problem. Variational formulation. -Contact kinematics for an arbitrary two body contact problem. Variational formulation. KUHN-TUCKER conditions. -Analytical solutions for simple contact problems: HERTZ contact problems. -General description of NEWTON's iterative solution method for nonlinear equations. Convergence. Consistent linearization. -Various solution methods: merits and drawbacks within the Finite Element formulation. Method of LAGRANGE multipliers. Penalty method. Augmented LAGRANGE method. -Small displacement problems. Simple Finite Element formulation based on the penalty approach: node-to-ground contact element for SIGNORINI's problem, node-to-node contact element for the arbitrary two body contact problem. -Large displacement contact problems. Concept of global and local searching algorithms. Closest point projection procedure. -Master-slave algorithm. Node-to-segment contact element. Formulation for various approaches (Penalty, Augmented LAGRANGE method). -Continuous transfer of contact stresses through the contact surface. Patch test. -Various approaches to satisfy a patch test: Mortar method and segment-to-segment contact element. -Basis of frictional contact problems. Coulomb friction law. Variational formulation. KUHN-TUCKER conditions. Return-mapping algorithm. -Small displacement friction problem: node-to-node contact element. Patch sliding test for the sticking-sliding zone.

Remarks
Literature: [1] Johnson: Contact Mechanics [2] Laurson: Computational Contact and Impact Mechanics [3] Wriggers: Computational Contact Mechanics

Module: Concrete Construction Technology [bauiM1S24-BETONTECH]

Coordination: M. Haist
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6211809	(p. 159)	2	S	3	M. Haist, V. Kvitsel
6211810	(p. 331)	2	S	3	H. Müller, E. Kotan

Learning Control / Examinations
graded:
oral examination, 30 minutes

Conditions
None.

Learning Outcomes

Content

Remarks
Literature:

Module: Durability and Service Life Design [bauiM1S25-DAUERLEB]

Coordination: J. Eckhardt
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6211907	(p. 236)	3	W	4,5	J. Eckhardt, M. Haist, M. Vogel
6211908	(p. 132)	1	W	1,5	J. Eckhardt, M. Vogel

Learning Control / Examinations
graded:
oral examination, 30 minutes

Conditions
quisites: Recommendations

Learning Outcomes

Content

Remarks
Literature:

Module: Preservation and Rehabilitation of Concrete and Masonry Constructions [bauiM1S26-BBM]

Coordination: E. Kotan
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6211811	(p. 284)	2/1	W	4,5	E. Kotan, H. Müller
6211813	(p. 148)	1	W	1,5	H. Müller, E. Kotan, M. Vogel

Learning Control / Examinations
graded:
oral examination, 30 minutes

Conditions
None.

Learning Outcomes
After successful completion of the module, the students have detailed knowledge about the relevant causes and processes of degradation in concrete and masonry constructions. Thus they are able to take appropriate measures to enhance the durability of solid buildings and to plan and execute effective measures to repair damaged concrete and masonry constructions. Moreover the students have also the knowledge about the main aspects and basic techniques of building reinforcement.

Content
This course provides fundamental knowledge of the possibilities to preserve concrete and masonry constructions. Besides an introduction into the characteristics of masonry, plaster, concrete and reinforced concrete structures, various damage patterns and their origins are discussed. Based on the knowledge of the essential damage processes, efficient measures for the increase of the durability are described, which include material and constructional precautions as well as additional preventive measures. Furthermore the course focuses on the repair of already damaged concrete and masonry constructions. In this connection different research methods for the analysis of damages are presented and various possibilities are shown to predict the time-development of these damages. Finally repair materials as well as procedures are described which are necessary for the realization of a durable repair measure. A further main part of the course covers the different possibilities of an additional reinforcement of concrete and masonry constructions. Applicable materials and their characteristics in design and construction are introduced and discussed. In the accompanying exercises the subject matter shall independently be developed and the practical realization will be practised by means of several design problems.

Remarks
Literature: hand-out as well as (selection): [1] Blaich, J.: Bauschäden - Analyse und Vermeidung; EMPA; Stuttgart, 1999 [2] Pfefferkorn, W.: Rißschäden an Mauerwerk, Ursachen erkennen - Rißschäden vermeiden; Stuttgart, IRB Verlag, 1994 [3] Reichert, H.: Konstruktiver Mauerwerksbau, Bildkommentar zur DIN 1053-1, Rudolf Müller Verlag, Köln, 1999 [4] Ruffert, G.: Ausbessern und Verstärken von Betonbauteilen; 2. Aufl.; Beton Verlag, 1982 [5] SIVV - Handbuch: Schützen, Instandsetzen, Verbinden und Verstärken von Betonbauteilen; Verarbeiten von Kunststoffen im Betonbau beim Deutschen Beton- und Bautechnik-Verein E.V.; IRB Verlag, Stuttgart, 2008 [6] Stark, J.; Wicht, B.: Dauerhaftigkeit von Beton - Der Baustoff als Werkstoff, Hrsg.: Bauhaus-Univ. Weimar, F.A. Finger- Institut für Baustoffkunde -FIB-; 2001 [7] Tausky, R.: Betontragwerke mit Außenbewehrung; Birkhäuser Verlag, Basel, 1993

Module: Building Physics I [bauiM1S27-BAUPH-I]

Coordination: E. Kotan
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6211909	Applied Building Physics (p. 134)	2	W	3	E. Kotan, Heiß
6211910	Building Technology (p. 205)	2	W	3	S. Wirth

Learning Control / Examinations
graded:
oral partial examination Applied Building Physics, 20 minutes
oral partial examination Building Technology, 20 minutes

Conditions
None.

Learning Outcomes

Content

Remarks
Literature:

Module: Building Physics II [bauiM1S28-BAUPH-II]

Coordination: E. Kotan
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6211814	Practical Noise Control (p. 270)	2	S	3	R. Grigo
6211815	Practical Fire Protection (p. 269)	2	S	3	H. Schröder

Learning Control / Examinations
graded:
oral partial examination Practical Fire Protection, 20 minutes
oral partial examination Practical Noise Control, 20 minutes

Conditions
None.

Learning Outcomes

Content

Remarks
Literature:

Module: Materials Testing and Measuring Techniques [bauiM1S29-MATPRÜF]

Coordination: N. Herrmann
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6211911	Measuring Techniques in Civil Engineering (p. 250)	1/1	W	3	N. Herrmann
6211913	Materials Testing in the Field of Concrete (p. 244)	2	W	3	N. Herrmann

Learning Control / Examinations
graded:
oral examination, 30 minutes

Conditions
None.

Learning Outcomes
The basic knowledge of materials testing in the field of construction materials and concrete structures connected with the application in engineering constructions (e.g. bridges, power plants, etc.) will be imparted. As the main focus of high quality materials testing lies on the registration of the relevant measuring parameters, approximately half of the module will deal with the basics of measuring techniques and tasks. A part of the lesson is laboratory training. In these sessions the students will create own measuring concepts for a simple test, perform the test and evaluate the gained data.

Content

-
- Concrete testing according to standards
- Cement and aggregates
- Testing of natural stones
- Bearings and expansion joint for bridges
- Anchors
- Pre-stressing systems
- Testing of structural members
- Vibration measurement
- Monitoring
- Special testing and nuclear safety
- Chemical and physical analyzing methods
- Electronic measurement of mechanical parameters – basics
- Strain measurement

- Stress and pressure measurement
- Temperature measurement
- Humidity measurement
- Displacement measurement
- Force measurement
- Acceleration measurement
- Vibration measurement
- Data evaluation and visualization
- Transient measurement
- Trigger

Module: Finite Elements for Field and Time Dependent Problems [bauiM1S30-FE2]

Coordination: P. Betsch
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6215905	(p. 198)	2/2	S	6	P. Betsch

Learning Control / Examinations
graded: examination Finite Elements, oral exam, 20 minutes

Conditions
Technical Mechanics of BSc, Advanced Mathematics, Introduction to Continuum Mechanics, Finite Elements

Learning Outcomes
Students will get insight into analysis of general field problems. Also, time integrationfor the solution of structural problems will be discussed in detail to enable the participants to choose the proper algorithms and parameters in applications. The students will also work on program for 2 dim heat transport problems, as well as time integration schemes. In addition, the formulation of mixed elements is introduced.

Content
Field problems -Finite elements for general field problems and heat transport problems, simple fluids quasi-harmonic equation -Heat conduction, elastic torsion of prismatic bars - FE discretisation Time dependent problems -Time integration of semi-discrete equations - first order equations -Simple time integration algorithms: finite elements, collocation, stability of algorithms, accuracy and error -Newmark family of algorithms, generalized algorithms, modifications -Stability, numerical dissipation and dispersion -Judgement of algorithms, numerical examples; modification of parameters Mixed elements elastostatics -Problems in the application of elements with pure displacement approximation, locking problems -Basic concepts of functional analysis, mixed functionals, Hu-Washizu, Hellinger -Reissner functionals, solvability, stability -Discretisation with finite elements, detection of locking effects -Plane stress elements based on Hellinger-Reissner's functional stress approximation, enhanced assumed strain approach (EAS), assumed natural strain approach (ANS) -Outlook on three-dimensional plate- and shell problems

Remarks
Literature:
[1] Zienkiewicz, Taylor: The Finite Element Method, Volume 1,2 & 3, 2000.
[2] Hughes: The Finite Element Method, 1987.
[3] Belytschko, Liu, Moran: Nonlinear Finite Element for Continua and Structures, 2000.
[4] Wriggers: Nichtlineare Finite-Element-Methoden, 2001.

Module: Contact Mechanics II - Dynamics [bauiM1S31-KONTMECH-II]

Coordination: A. Konyukhov
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6215907	(p. 233)	2/2	W	6	A. Konyukhov

Learning Control / Examinations
graded: examination Contact Mechanics II, oral exam, 30 minutes

Conditions
Technical Mechanics of BSc, Advanced Mathematics, Introduction to Continuum Mechanics, Finite Elements, Contact Mechanics I

Recommendations
Continuum Mechanics

Learning Outcomes
-Understand modern contact algorithms for structures subjected to large deformations and dynamic loading. -Understand specific FE-issues related to different contact approaches. -Perform partially own implementation.

Content
-Advanced studies in mathematics necessary to define 3D contact of surfaces - Differential geometry of surfaces -Contact kinematics for arbitrary two bodies contact problem. -Linearization of various parameters in covariant form. -Variational formulation of contact. -Regularization of contact conditions in covariant form. Coulomb friction law in covariant form. -Kuhn-Tucker conditions for non-frictional and frictional contact. -Return-mapping algorithm. -Linearization of a virtual work in covariant form. Sticking and sliding cases. Geometrical interpretation. -Finite element implementation within the node-to-segment approach. -Continuous transfer of contact stresses through the contact surface. Non-frictional and frictional patch tests. -Various approaches to satisfy the patch test: Mortar method and segment-to-segment contact element. -Dynamic contact problems. Explicit and implicit numerical integration scheme. Stability and tolerance of time integration schemes: selection of a time step. -Deformable and rigid bodies. Various approaches to satisfy contact conditions: integration of non-holonomic constraints, force method (penalty). -Fully elastic and plastic impact: different regularizations. Aspects of finite element modeling. -Momentum and energy conservation properties of the time integration scheme.

Remarks
Literature: [1] Synge: Tensor calculus [2] Gerretsen: Lectures on tensor calculus and differential geometry [3] Johnson: Contact Mechanics [4] Laurson: Computational Contact and Impact Mechanics [5] Wriggers: Computational Contact Mechanics

Module: [bauiM1S32-KONTIMECH]

Coordination: T. Seelig
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	2

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6215702	(p. 234)	2	W	3	T. Seelig, I. Schmidt
6215805	(p. 245)	2	S	3	T. Seelig

Learning Control / Examinations
graded:
oral examination

Conditions
None.

Learning Outcomes

Content

Remarks
Literature:

Module: Laboratory Course on Structural Vibrations [bauiM1S33-MESSPRAK]

Coordination: T. Seelig
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	2

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6215703	(p. 248)	2	W	3	T. Seelig, C. Ruck
6215806	(p. 249)	2	S	3	T. Seelig, C. Ruck

Learning Control / Examinations
graded:
oral examination

Conditions
Technical Mechanics of BSc, Advanced Mathematics, Dynamics of Structures

Learning Outcomes
PART I - BASICS: The knowledge acquired in the lectures “Structural Dynamics” and “Dynamics” will be applied to real practical structures. Theoretical computations and experimentally gained results will be compared and interpreted. More complicated phenomena of theory, e.g. natural modes, anti-resonance etc., will be visualised. Students will carry out experiments, if possible, by themselves.
PART II - TIME DOMAIN AND MODAL ANALYSIS, PARAMETER IDENTIFICATION: The goal is the consideration and experimental investigation of vibrational behavior of lab structures by modal analysis. In addition, the estimation of structural parameters as resonance frequencies and modal damping is discussed and shown by experiments. All lab tests will be performed on lab examples showing similar properties as real-world civil structures.

Content
PART I - BASICS: Measuring of the dynamics behaviour of small-scale structure models (linear, discrete single- and multiple degree-of-freedom systems) in the laboratory and of real structures on site. Information about sensors, i.e. internal design, function limits as well as about electronic conditioning and processing of the signals is given within the course. Strains, forces, moments, displacements, velocities and accelerations will be measured. Different kinds of excitation, e.g. by a ground-motion, unbalances or hammer are considered. Furthermore the required measuring devices, their properties and limits will be presented.
PART II - TIME DOMAIN AND MODAL ANALYSIS, PARAMETER IDENTIFICATION: -Time Domain Analysis (Sampling Theory, Transformations, etc.) - Modal Anlysis (Exitation, Mass Load Effects) - Parameter Estimation

Remarks
Literature:
[1] Haug, A.: Elektronisches Messen mechanischer Größen, Hauser, 1969
[2] Müller, R. et al.: Mechanische Größen elektrisch gemessen, Expert Verlag, 1984
[3] Heymann, J. (Hrsg.): Messverfahren der experimentellen Mechanik, Springer, 1986

Module: Model Formation in Strength of Materials and Theory of Kinetic Stability for Structures [bauiM1S34-MOFEKIST]

Coordination: P. Betsch
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6215807	(p. 252)	2	S	3	P. Betsch
6215910	(p. 231)	2	W	3	P. Betsch

Learning Control / Examinations
graded:
oral examination

Conditions
Technical Mechanics of BSc, Advanced Mathematics

Learning Outcomes
MODELING TECHNIQUES IN STRENGTH OF MATERIALS: Mechanical Models of Strength of Materials (beams, plates or a shells) are based on special kinematics of the cross-section during deformation. In such a way the general continuum-mechanical problem can be considerably reduced from partial boundary value problems to ordinary ones. On the other hand, as a result of this simplification, all the models have limitations, concerning their range of application. The limits of the customary models in the Strength of Materials will be revealed and the transitions between different models will be discussed.
THEORY OF KINETIC STABILITY OF STRUCTURES: A mathematical based theory of stability of equilibrium is presented based on the two methods of Liapunov.

Content
MODELING TECHNIQUES IN STRENGTH OF MATERIALS: Mathematic tools -Regular perturbation techniques -Singular perturbation techniques One-dimensional continuum -Plane elastica (linear and non-linear theories) -Stress concentration due to shear deformation -Elastic foundation theories -Areas and cables -Local bending effects in cables -Spatial elastica Two-dimensional continuum -Stress and deformation concentration in different plate theories -Corner singularity as boundary layer problem -Non-linear plate theory (Membrane influence) -Non-linear theory of slightly curved shells
THEORY OF KINETIC STABILITY OF STRUCTURES: Definition of stability by Lyapunov -Demonstrative definition of stability -Lyapunov's definition of stability -Asymptotic stability First Method -Imperfection and disturbed bifurcation -Method of small vibrations -Imperfection sensitivity of symmetric, non-symmetric and oblique bifurcation -Stability degree and practical instability -Unilateral constraints -Alternating constraints -Direction dependent force laws -Bifurcation from the non-trivial state -Interaction Second Method -Energy integral -Principle of minimum of potential energy -Inner and outer potential (examples) -Analogy to the motion of a sphere -Zero natural values -Non-linear constraints -Sensitivity of equilibrium states -Local and global instability -Transition from stress problems to stability problems

Remarks
Literature:
[1] Timoshenko, S., Goodier, J.: Theory of Elasticity, McGraw-Hill, 1951
[2] Reismann, H., Pawlik, P.: Elasticity: theory and applications, Wiley, 1980
[3] Hahn, W.: Stability of Motion, Springer, 1967

Module: Advanced fluid mechanics [bauiM2P1-AFM]

Coordination: M. Uhlmann
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6221701	Advanced Fluid Mechanics (p. 202)	2	W	3	N.N.
6221702	Numerical Fluid Mechanics I (p. 263)	1/1	W	3	M. Uhlmann

Learning Control / Examinations
written exam in each course, 90 minutes

Conditions
Hydromechanics, advanced mathematic

Recommendations
Numerical treatment of partial differential equations

Learning Outcomes
Theoretical background for a quantitative description of fluid flow phenomena in technical systems and the environment. Introduction to the numerical computation of fluid flow problems; techniques for the analysis of numerical methods applicable to the fundamental flow equations; design of solution strategies; practical realization of the algorithms through independent programming exercises.

Content
Advanced Fluid Mechanics: Budgets and flow equations, vortex dynamics, gravity waves, mixing, heat transfer, buoyancy, flow stability Numerical Fluid Mechanics I: General introduction to CFD, Conservation laws, Mathematical properties of the equations, Fundamentals of numerical discretization: finite-differences, Finite-volume method, Numerical stability & error analysis, Temporal integration, Solution of algebraic systems of equations

Remarks
Literature:
P.Kundu & I.Cohen, “Fluid Mechanics”, Academic Press, 2010
C. Hirsch, “Numerical computation of internal and external flows”, Butterworth-Heinemann, 2nd edition; 2007
C.A.J. Fletcher, “Computational techniques for fluid dynamics”; 2nd edition, 1991
R.J. LeVeque, “Finite difference methods for ordinary and partial differential equations” Society for Industrial and Applied Mathematics, 2007
R.J. LeVeque “Finite volume methods for hyperbolic problems” Cambridge Univ. Press, 2002
W.H. Press et al. “Numerical recipes in Fortran/C/C++” Cambridge U. Press, second edition, 1986
P.J. Tritton, “Physical fluid dynamics”, 2 ed., Claredon Press, Oxford, 1992

Module: Dynamics of water and mass transport in river basins [bauiM2P2-WSF]

Coordination: F. Nestmann
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6222701	Multi-Phase Flow (p. 247)	2	W	3	F. Nestmann
6224701	Terrestrial Water Flows and Mass Transport (p. 340)	2	W	3	E. Zehe

Learning Control / Examinations
graded:
written exam in each course

Conditions
None.

Learning Outcomes
Students gain in-depth knowledge of the processes of water and solute transport in rivers and river basins, and they gain the basis for water quality modelling. The focus is on current and future challenges in terrestrial ecosystems, such as water and groundwater protection, water quality predictions, and the risk management of extremes in times of global change. Students know the physical principles of soil water movement and evaporation in catchments. They can assess the impact of important control variables and are familiar with the advection-dispersion solute transport theory. They understand the relationships and interactions between hydraulic and morphological phenomena in rivers and water bodies, and they can apply the related concepts and modelling approaches. In addition, they learn about phenomena associated with water-air mixtures and they can take this into account in the technical design of hydraulic structures.

Content
Part of "Water and solute dynamics in environmental systems" • Water dynamics in the unsaturated and saturated zone: Richards equation, soil hydraulic functions • Infiltration in natural soils • Energy balance • Evaporation and evapotranspiration regime, approaches to quantify evaporation • Biotic and abiotic interactions • Advection, dispersion, advective-dispersive transport and analytical solutions • Process-based and conceptual models Part of "multiphase flow": • Basics of River-Morphodynamics: classification, bedload and suspendedload • Interaction between solids and flow: Methods of modelling and calculation of bedload rates • Suspendedload: diffusion theory of Schmidt • Bed forms: structure, flow resistance, methods of modelling • Water-Air-mixtures: Basics, characteristics, technical applications

Remarks
Literature: Plate, E. J.,Zehe, E. (2008): Hydrologie und Stoffdynamik kleiner Einzugsgebiete. Prozesse und Modelle, Schweizerbart, Stuttgart, 2008.

Module: Mass Fluxes and Cycles [bauiM2P3-STK]

Coordination: J. Winter
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6223701	Mass Fluxes (p. 308)	2	W	3	S. Fuchs
6225701	Bioprocess Engineering (p. 165)	2	W	3	J. Winter

Learning Control / Examinations
written exam in each course

Conditions
None.

Learning Outcomes
Students gain in depth understanding of mass fluxes in natural and technical systems. They will be able to recognize needs for the management and to derive efficient measures / technologies. Beyond the given physical and physic-chemical options the performance of microbial metabolic processes for waste, waste water and contaminated air will be discussed.

Content
Fundamentals of bacterial metabolism: energy yield and growth. Biological reactions of nitrogen and phosphorous removal and utilization in technical processes.

Remarks
Literature:
Wastewater Treatment. M. Henze, P. Harremoes, J. la Cour Jansen, E. Arvin, Springer Verlag, Heidelberg, 1997
Wastewater Engineering, Treatment and Reuse.Metcalf & Eddy, McGraw-Hill, 2003

Module: Water ressources and river basin management [bauiM2S01-HY1]

Coordination: U. Ehret
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6224801	Water Resources and River Basin Management (p. 344)	2/2	S	6	J. Ihringer, U. Ehret
geök-WB2-2a	(p. 343)	2+2	S	6	J. Ihringer

Learning Control / Examinations
Take home exam

Conditions
None.

Recommendations
Module “Water resources management and engineering hydrology” (6th semester BSc Civil Engineering)

Learning Outcomes
Students can independently apply the state of the art application-specific methods and tools for river basin management. They have extensive knowledge of hydrological processes and possess expertise on the use of water balance models. By setting up their own hydrological model the students got to know the basic data needs of hydrological models, its potential applications and they can assess the reliability of the model results.

Content
Water balance modelling: • Operation, process description and applications of conceptual hydrological models used in a water management practice model (LARSIM). • Building an own hydrological model (necessary basic data, model parameters and adjustment, calibration strategies) • High water, and low water predictions • Sensitivity analysis of model parameters • Visualization and analysis of results • Performance measures for validation of model results and uncertainty ranges Selected problems of water management: • Water resources management principles and design of water management systems (design and management of dams) • Regionalization of hydrological parameters and runoff characteristics

Remarks
Literature: Larsim: Ludwig, K. and Bremicker, M., 2006. The Water Balance Model LARSIM - Design, Content and Applications. Freiburger Schriften zur Hydrologie, 22. Institut für Hydrologie, Uni Freiburg i. Br. Good modelling practice: Van Waveren, R. H., S. Groot, H. Scholten, F. van Geer, H. Wösten, R. Koeze and J. Noort. 1999: Handbook Good Modelling Practice. STOWA/RWS-RIZA, Utrecht/Lelystad, the Netherlands. Download: http://harmoniqua.wau.nl/public/Reports/Existing Guidelines/GMP111.pdf Calibration: Gupta, H.V., Sorooshian, S. and Yapo, P.O., 1998. Toward improved calibration of hydrologic models: Multiple and noncommensurable measures of information. Water Resources Research, 34(4): 751-763.

Module: Thermodynamics in environmental systems [bauiM2S02-HY2]

Coordination: E. Zehe
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6224901	Thermodynamics in Environmental Systems (p. 314)	2/2	W	6	E. Zehe, U. Ehret

Learning Control / Examinations
Take home exam

Conditions
None.

Learning Outcomes
Students will become familiar with the basics of environmental systems theory and thermodynamics. They will get to know the global components of global energy and entropy flows as well as the main global mass cycles (using the example of the water cycle) and will learn how to quantify them. Based on the principles of thermodynamics students will gain insight in the mechanics of formation and conservation of complex structures, as for example of ecosystems.

Content
Fundamentals of environmental systems theory: • System states and characteristics • Fundamental processes in environmental systems (diffusion, advection, advection-dispersion) and types of differential partial equations to represent these processes Fundamentals of thermodynamics: • 1.+2. principle of thermodynamics • Thermodynamic gradients • Ideal gas equation Thermodynamics in Environmental systems: • Thermodynamics both, near and far from the thermodynamic equilibrium • The earth as open, hierarchical, thermodynamic system far from the des thermodynamic equilibrium • Formation and conservation of structures, evolution and irreversibility in environmental systems in the light of thermodynamics • The water cycle as a closed mass cycle in the light of thermodynamics - Mass and energy flows in the atmosphere - Mass and energy flows in the soil-vegetation-water-system • Optimality and self-organization principles in environmental systems - Maximizing power - Maximizing entropy production - Minimizing the time to achieve equilibrium states

Remarks
Literature: Prigogine, I. (1989): What is entropy? Naturwissenschaften, 76, 1-8, 10.1007/bf00368303. Kleidon, A. (2010): Life, hierarchy, and the thermodynamic machinery of planet Earth, Physics of Life Reviews, 7, 424-460.

Module: Dynamics of water and mass transport in watersheds [bauiM2S03-HY3]

Coordination: E. Zehe
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6224803	Dynamics of Water and Mass Transport in Catchments (p. 339)	2/2	S	6	E. Zehe, U. Scherer
geök-WB2-2b	(p. 338)	2+2	S	6	E. Zehe, U. Scherer

Learning Control / Examinations
Take home exam

Conditions
compulsory module Dynamics of Water and Mass transport in river basins, bauiM2P2-WSFWSF

Recommendations
take core elective course "Experimental hydrology and process monitoring in natural systems" bauiM2S33-HY8HY8 in parallel

Learning Outcomes
Students will be familiar with the transport processes of nutrients and contaminants in surface runoff and in the unsaturated zone of rural catchments. This includes the processes of infiltration, overland flow, soil water flow, advective and dispersive transport of solutes, particulate transport via erosion as well as reaction and degradation of substances. Students will independently apply analytical and process based modelling instruments and will thus be able to estimate model parameters from field experiments, balance the fluxes of water and substances in the critical zone and perform risk assessments on the travel distances of contaminants. In addition, students will be capable of assessing the limits of applicability of the models in natural structured soils.

Content
Transport in the unsaturated zone: • Advective-dispersive transport in homogeneous and heterogeneous soils • Adsorption isotherms, microbiological degradation, reaction processes • Modelling of solute transport in soils (i.e. of pesticides) using analytical models: - Risk analysis for pesticides in the soil (transport, residence time, adsorption, degradation) - Estimation of model parameters from field experiments - Parameterisation of adsorption isotherms, break through curves Transport at the surface: • Surface runoff generation • Detachment, transport and deposition of sediment particles • Particulate transport Application of process based models: • Introduction into process based modelling (processes, data need and management, time step controls) using a hydrological model (i.e. CATFLOW) • Simulation of soil water fluxes, overland flow, erosion and associated transport processes at various scales • Sensitivity analysis, goodness of fit measures

Remarks
Literature: Jury, W. and Horton, R. (2004): Soil physics. John Wiley Hillel, D. (1995): Environmental Soil Physics. Academic Press Fritsche, W. (1998) Umweltmikrobiologie, Grundlagen und Anwendungen. Gustav Fischer Verlag, 248pp. Roth, K. (1994): Lecture notes in soil physics. www.uphys.uni-heidelberg.de Plate, E. und Zehe, E. (2008): Hydrologie und Stoffdynamik kleiner Einzugsgebiete: Prozesse und Modelle. Schweizerbart

Module: Data analysis and environmental monitoring [bauiM2S04-HY4]

Coordination: J. Ihringer
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6224805	Data Analysis and Environmental Monitoring (p. 173)	2/2	S	6	E. Zehe, J. Ihringer

Learning Control / Examinations
Take home exam

Conditions
None.

Recommendations
Basic knowledge of statistics, take course “experimental hydrology and process monitoring in natural systems” in parallel

Learning Outcomes
Students will become familiar with advanced analysis methods of spatial and temporal environmental data sets. In addition they will gain knowledge on the planning of experimental designs for field campaigns. Special emphasis will be put on the regionalization of point measurements. Students will learn the application and suitability of various kriging methods and will be able to evaluate interpolated maps critically.

Content
Time series analysis: • Test procedures: homogeneity, stationarity, outliers • Analysis and assessment of correlation functions and spectra, multiple regressions and correlations • Components of time series and their determination (trend, period, remainder) • Approaches for the description of the remainder • Data generation: generation of yearly, monthly and daily values Geostatistics: • Experimental variogram, directional variograms, indicator variogram, fitting of theoretical variogram functions, anisotropy • Ordinary Kriging, Kriging equations • Screening property of Kriging weights, BLUE, pure nugget effect • Cross validation, RMSE • Estimation of spatial patterns in case of non-stationary data: External Drift Kriging, Simple Updating • Estimation of spatial patterns by simulations: Smoothing problem of interpolation methods, Turning Band Simulations • Field campaign for measuring soil moisture: planning of the measuring design, measurement of soil moisture and data analysis

Remarks
Literature: Bárdossy, A. (2001): Introduction into Geostatistics. Inst. f. Wasserbau, Universität Stuttgart. Kitanidis, P. K. (1999): Introduction into Geostatistics. Applications in Hydrogeology. Cambridge University Press. Bras, R. L. and Rodriguez-Iturbe, I. (1985): Random Functions and Hydrology. Addison-Wesley Massachusetts. Brooker, I. (1982): Two-dimensional simulation by turning bands. Math. Geology 17 (1).

Module: Experimental hydrology and process monitoring in environmental systems [bauiM2S05-HY5]

Coordination: U. Scherer
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6224807	Experimental Hydrology and Process Monitoring in Environmental Systems (p. 226)	0/4	S	6	U. Scherer, U. Ehret

Learning Control / Examinations
Take home exam

Conditions
er and mass transport in environmental system

Learning Outcomes
Students will gain in-depth knowledge of the water cycle and understand watersheds as integral phenomenon of morphological processes shaping the landscape. They are familiar with measuring principles and can independently handle measuring instruments for the monitoring of state variables and water fluxes at various scales (soil column, plot scale, hillslope scale, watershed scale). They will gain fundamental understanding of the problems associated with field measurements and will be able to estimate measurement errors as well as to evaluate field data using statistic methods.

Content
Literature Seminar and Tutorial: • Literature on experimental designs in the field, scaling and measurement uncertainties • Plausibility check and correction of measurement data Hydrologic field course in an alpine catchment (Ebnit, Vorarlberg): • Introduction to the geology, geomorphology and pedology of the catchment • Characterisation of soil profiles • Monitoring of hydrologic state variables in the soil (soil moisture, hydraulic conductivity, soil temperature) • Infiltration and tracer experiments • Ground water levels • Monitoring of discharge using various methods • Meteorology

Remarks
Literature: Script avaible, hydrologic journal papers

Module: Aquatic Ecosystems [bauiM2S06-HY6]

Coordination: C. Kämpf
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6224903	Aquatic Ecosystems (p. 210)	2/2	W	6	C. Kämpf

Learning Control / Examinations
graded:
study paper, critical literature review, introductory note

Conditions
None.

Learning Outcomes
To familiarize students with
- ecological theory, microbial ecology, chemical cycles, and
- renaturation strategies

Content
- riverine landscapes: rivers and flood plains as biotopes
- function of natural and cultivated landscape
- assessment and evaluation: structural quality, bio-indicators, saprobial System, dose-effect-correlation, and value-functions - construction measures and their impact on biocoenoses: changes in flow dynamics and nutrient availability - sustainable river and landscape management: principles and objectives for the protection of nature, species and habitats + excursion to Rhine floodplains

Remarks
Literature:
semester reader & session handouts

Module: Environmental Communication [bauiM2S07-HY7]

Coordination: C. Kämpf
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6224905	Environmental Communication (p. 324)	2/2	W	6	C. Kämpf

Learning Control / Examinations
graded:
study paper, group-edit, introductory note

Conditions
None.

Learning Outcomes
Knowledge: students will know various communication concepts, procedural steps, and actors of effective communication for appropriate social action in environmental protection and nature conservation. Skills: students choose relevant modes of communication for scientific research and project management respectively. Competence: students will act appropriatetly within transdisciplinary contexts such as in risk communication for flood protection.

Content
Inter- and transdisciplinarity within the complex society-technology-ecosystems in academic research and in public relations - various forms of knowledge; theories of decision making; - various document types: proposals, reports, studies, visualization, online information; - risk communication for flood protection; environmental information law (UIG) - text production

Remarks
Literature: course pack (actual papers of various relevant journals, news clippings)

Module: Groundwater management [bauiM2S08-HY8]

Coordination: U. Mohrlok
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	2

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6221801	Groundwater Management (p. 220)	2	S	3	U. Mohrlok
6221901	Groundwater Modelling (p. 261)	1/1	W	3	U. Mohrlok

Learning Control / Examinations
oral

Conditions
None.

Recommendations
fundamental knowledge in fluid mechanics, hydrology, solute transport and numerical methods

Learning Outcomes
groundwater management: Participants receive the basic knowledge and definitions in hydrogeology, investigation methods for quantitative analysis of flow and transport processes in the subsurface. The application of assessment and management tools are discussed by means of examples such as irrigation, groundwater remediation and salt water intrusion. groundwater modelling: Participants receive an introduction to the application of numerical modelling of flow and transport processes in groundwater. They are capable of applying these models to simple examples of groundwater management by means of a project work.

Content
groundwater management: Basics for the characterization of the development of groundwater quantity and quality are introduced. Particularly, the interaction of flow and transport processes in the heterogeneous subsurface environment as well as the reliability and uncertainty in measured data are discussed. groundwater modelling: The approximate description of numerical models is considered. The accuracy and reliability of numerical results are discussed.

Remarks
Literature: Anderson, M.P. and W.W. Woessner (1992). Applied Groundwater Modelling Simulation of Flow and advective Transport. San Diego, CA, U.S.A.: Academic Press, Inc. Harcourt Brace Jovanovich Publisher. Bear, J. (1979). Hydraulics of Groundwater. McGraw Hill. Chiang, W.-H., Kinzelbach, W. & R. Rausch (1998). Aquifer simulation model for Windows - Groundwater flow and transport modeling, an integrated program. Berlin, D.:Gebrüder Borntraeger. Fetter, C.W. (1999). Contaminant Hydrogeology , 2/e. Upper Saddle River, NJ, U.S.A.: Prentice Hall. Hiscock, K.M. (2005). Hydrogeology: principles and practice. Malden, MA, U.S.A.: Blackwell. Kruseman, G.P. and N.A. de Ridder (1991). Analysis and Evaluation of Pumping Test Data. NL: ILRI public 47. Nielsen, D.M. and A.J. Johnson (1990). Ground Water and Vadose Zone Monitoring. Albuquerque, NM, USA: ASTM. Schwartz, F. and H. Zhang (2003). Fundamentals of Ground Water. New York, NY, U.S.A.: John Wiley & Sons. Zheng, Ch. and G.D. Bennett (2002). Applied Contaminant Transport Modeling. New York, NY, U.S.A.: John Wiley.

Module: Studies of Development Projects in Water Resources Management [geök-WB1-4]

Coordination: F. Nestmann
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6222901	Studies of Development Projects in Water Resources Management (p. 346)	2/2	W	6	F. Nestmann

Learning Control / Examinations
graded - oral exam - 20 minutes

Conditions
None.

Learning Outcomes
Students gain insight into planning and operation / maintenance of national and international research & development projects in the field of water resources management.

Content
University members and external lecturers will provide insight into actual projects. An excursion shall allow the students to gain an authetic impression about the procedural steps of a real water management project.

Remarks
Literature:

Module: Practical use of numerical methods in fluid mechanics [bauiM2S10-WB2]

Coordination: P. Oberle
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6222903	Practical use of numerical methods in fluid mechanics (p. 251)	2/2	W	6	P. Oberle

Learning Control / Examinations
graded: examination, written exam, 40 minutes

Conditions
None.

Recommendations
fundamental knowledge in hydrology, hydraulic engineering, water resources management and fluvial hydraulics

Learning Outcomes
Knowledge: Student shall gain a solid understanding of the method applied. Skills: students will be firm handling numerical models developed for the simulation of flow.

Content
The course introduces to physical and numerical basics as well as to areas of application and examples of use of different hydrodynamic-numerical (HN-) procedures. Furthermore, the related use of Geographical Information Systems (GIS) in pre- and post-processing as well as their coupling with HN-procedures are presented. Other aspects covered are the coupling of elements of automation with HN-procedures and the implementation of morphodynamic models.

Remarks
Literature: course accompanying papers

Module: Hydro Power Engineering [bauiM2S11-WB3]

Coordination: P. Oberle
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6222801	Hydro Power Engineering (p. 181)	2/2	S	6	P. Oberle

Learning Control / Examinations
graded:
oral exam

Conditions
None.

Learning Outcomes
Knowledge: students shall gain a practice-oriented basic understanding of the planning, operation and maintenance of hydropower plants. Competence: students will view the current political and legal framework as major context factor.

Content
The course explains the technical background for planning and designing waterpower plants. Among others, it covers the constructional characteristics of river and high-pressure power plants, the operating modes and selection criteria of different types of turbines as well as electro-technical aspects of the plants' operation. In addition, ecological aspects and energy policy are considered as frame conditions. The lecture sessions are complemented by the presentation of current projects and excursions.

Remarks
Literature: presentation slides; Giesecke J., Mosonyi E., 2005, Wasserkraftanlagen, Planung, Bau und Betrieb, Springer Verlag, Berlin

Module: Waterway Engineering [bauiM2S12-WB4]

Coordination: A. Kron
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6222803	Waterway Engineering (p. 334)	2/2	S	6	A. Kron

Learning Control / Examinations
graded: oral exam, 20 min

Conditions
None.

Learning Outcomes
Students are knowledgeable about the various types of navigable waterways and their hydraulic structures. Skills: They know the hydraulic basics for the design of these hydraulic structures and the interaction of ship and waterway Competence: students will consider the administrative structure of the waterways and shipping authorities in navigation projects.

Content
Inland waterways, navigation locks, ship lifts, Interaction ship-waterway

Remarks
Literature: course notes, course pack

Module: River dynamics [bauiM2S13-WB5]

Coordination: B. Lehmann
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6222805	Morphodynamics (p. 254)	1/1	S	3	B. Lehmann
6222807	Flow Behavior (p. 312)	1/1	S	3	F. Seidel

Learning Control / Examinations
graded - oral exam

Conditions
None.

Learning Outcomes
Knowledge: Student shall gain a solid understanding of the method applied.

Content
The modul reports the interaction effects between flow-structures, flow-resistance and river-morphodynamics.

Remarks
Literature: course pack

Module: Nature-orientated river Engineering [bauiM2S14-WB6]

Coordination: B. Lehmann
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6222809	River Engineering (p. 209)	2	S	3	B. Lehmann
6222810	Ethohydraulics (p. 189)	2	S	3	B. Lehmann

Learning Control / Examinations
graded - oral exam, 30 minutes

Conditions
None.

Learning Outcomes
The modul reports the basics and methods for nature-orientated river-engineering.

Content
Habitat of rivers, ecologocal passability, bioengineering applications, ethohydraulic methods, examples

Remarks
Literature: course pack, handouts

Module: Experimental Techniques I: Small Scale Experiments [bauiM2S15-SM1]

Coordination: C. Lang
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	2

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6221802	Experimental Methods (p. 190)	1/2	S	4,5	Lang
6220901	Hydraulic Engineering Project (p. 342)	0/1	W	1,5	Lang, B. Lehmann, F. Seidel

Learning Control / Examinations
graded: - oral exam (40 min) - test protocol and report

Conditions
None.

Recommendations
Hydromechanics, Hydraulic Modelling Methods

Learning Outcomes
Students have the subject-related knowledge and skills for the comparative analysis of basic flow situations in physical models, using various measurement technologies. They are able to assess and evaluate the results. In addition, students will be able to compare the results of their measurements with theoretical deductions and evaluate them with regard to practical applications in the technical hydraulics. Competence: students will present the results of the comparative analysis to a chosen audience.

Content
Lecture: - Typical set-up of hydraulic and aerodynamic models - Measurement instrumentation for basic and applied research - Dimensional analysis - Dimensionsless fluid parameters: ratio of forces - Experimental techniques: analogy numerical/physical modeling, aerodynamic models, model distortion Exercises in the students lab: - Pipe flow with orifice plate - Open channel flow with gate and hydraulic jump - Venturi pipe flow with cavitation - Settling velocities of spheres - Diffusion of a turbulent air jet Engineering application: - Small-scale experiment in the context of a authentic engineering project

Remarks
Literature: Kobus, H. 1984, Wasserbauliches Versuchswesen, DVWK-Schrift Heft 39, Verlag Paul Parey Berlin Zierep, J.,1991, Ähnlichkeitsgesetze und Modellregeln der Strömungslehre, Verlag Braun, Karlsruhe Tropea, C. et.al., 2007, Springer Handbook of Experimental Fluid Mechanics, Springer Verlag Berlin

Module: Interaction Flow - Building Structure [bauiM2S16-SM2]

Coordination: B. Ruck
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6221903	Interaction Flow-Building Structure (p. 347)	1/1	W	3	Lang
6221905	Building- and Environmental Aerodynamics (p. 203)	1/1	W	3	B. Ruck

Learning Control / Examinations
graded:
2 oral examinations, 60 minutes

Conditions
None.

Recommendations
Hydromechanics, course Advanced Fluid Mechanics, bauiM2P1-AFMAFM, course Technical Hydraulics, bauiM2S17-SM3

Learning Outcomes
The students have the competence to analyse and calculate steady and unsteady flow loading on hydro-engineering and aerodynamic structures as well as natural structures. They characterize flow induced vibrations and can categorize and pre-estimate them. With typical applications the connection between theory and practice is given.

Content
Building- and Environmental Aerodynamics: The lecture gives an introduction to the field of buidling- and environmental aerodynamics. Part 1 is dedicated to building aerodynamics and to the assessment of wind loads, whereas part 2 deals with aspects of flows in natural environments. Topics: Atmospheric boundary layer and natural wind, Wind loads on technical and natural structures, Wind induced vibrations, Wind shelter, Wind tunnel modelling Gates in Hydraulic Engineering: Particularities of gates in hydraulic steel engineering will be presented, their construction and calculation of their loading will be discussed. - determination of hydrostatic and hydrodynamic flow forces - principles of calculation - overview gates: lock gates, weir gates, submerged gate leafs - flow dependent building vibrations - cavitation - packings, sealings - corrosion protection

Remarks
Literature:
Wickert, G., Schmaußer, G.,1971, Stahlwasserbau, Springer Verlag, Berlin,
Schmaußer, G., Nölke, H., Herz, E., 2000, Stahlwasserbauten - Kommentar zur DIN 19704, Ernst und Sohn Verlag, Berlin
Naudascher, E., 1991, Hydrodynamic Forces, Balkema Pub., Rotterdam
Naudascher, E., Rockwell, D., 2005, Flow-Induced Vibrations, Dover Publ., N.Y.
Erbisti, P.C.F., 2004, Design of Hydraulic Gates, Balkema Pub., Tokyo
Lewin, J., 1995, Hydraulic Gates and Valves in free surface flow and submerged outlets, Th. Telford Pub., London
Hucho, W., 2002: “Aerodynamik der stumpfen Körper”, Vieweg-Verlag, ISBN 3-528-06870-1
Holmes, J.D., 2007: “Wind Loading on Structures”, Taylor & Francis, ISBN 978-0-415-40946-9
Oertel, H., Ruck, S.: 2012: “Bioströmungsmechanik”, Vieweg - Teubner, ISBN: 978-3-8348-1765-5
Oertel, H. jr. (Hrsg.), 2008: “Prandtl - Führer durch die Strömungslehre”, Vieweg-Teubner, ISBN 978-3-8348-0430-3

Module: Technical Hydraulics [bauiM2S17-SM3]

Coordination: C. Lang
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6221804	Steady and Unsteady-state Operation of Hydraulic Systems (p. 306)	2/2	S	6	Lang, N.N.

Learning Control / Examinations
graded: oral examination, 40 minutes

Conditions
Hydromechanics

Recommendations
course Advanced Fluid Mechanics, bauiM2P1-AFMAFM

Learning Outcomes
The students have the competence to analyze, calculate and evaluate a complex fluid mechanics problem. This ability will be practiced by means of many practical applications

Content
Part 1: Pipe flow systems - Dimensioning of pipe flow systems - Calculation of pipe networks - Unsteady flow in pipe lines Part 2: Control structures - Discharge characterisitcs - Energy dissipation - Spillway chute - Unsteady operating Part 3: Particular examples for hydraulic problems e.g. cavitation, diffusors, density stratification

Remarks
Literature: Vorlesungsskript Rohrhydraulik, 2009 Naudascher, E., 1992, Hydraulik der Gerinne und Gerinnebauwerke, Springer Verlag Berlin

Module: Experimental techniques II: measurement techniques [bauiM2S18-SM4]

Coordination: B. Ruck
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	2

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6221703	Flow Measuring Technique (p. 311)	1/1	W	3	B. Ruck
6221812	Signal Processing in Fluid Mechanics (p. 290)	1/1	S	3	B. Ruck

Learning Control / Examinations
graded:
2 oral examinations, 30 minutes each

Conditions
None.

Learning Outcomes
Signal detection and processing in fluid mechanics: The lecture deals with the fundamentals of signal detection and processing in fluid mechanics. Both, processing in the time and frequency domain will be explained.Typical processing procedures of existing measuring systems will be demonstrated. Flow Measuring Technique: The lecture gives an introduction to existing flow measuring techniques. Measuring techniques based on electrical, acoustical and optical signal detection and processing are presented.

Content
Signal detection and processing in fluid mechanics (SS): Introduction to signal detection and processing, fundamentals and definitions, flow measuring techniques and their specific signal detection and processing, processing in time and frequency domain, image analysis Flow measuring techniques (WS): Pressure-based and mechanical probes, electrical measuring systems, acoustical measuring devices, laser-based flow measuring systens

Remarks
Literature:
Profos, P., Pfeifer, T., 1993: “Grundlagen der Messtechnik”, Oldenburg-Verlag, ISBN 3-486-22537-5
Ruck, B., 1987: “Laser-Doppler-Anemometrie”, AT-Fachverlag Stuttgart, ISBN 3-921 681-00-6
Ruck, B. (Hrsg.), 1990: “Lasermethoden in der Strömungsmesstechnik”, AT-Fachverlag Stuttgart, ISBN 3-921681-01-4
Schlichting, H., Gersten, K., 2006: “Grenzschichttheorie”, Springer-Verlag, ISBN: 978-3-540-23004-5

Module: Environmental Fluid Mechanics [bauiM2S19-SM5]

Coordination: N.N.
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6221907	Environmental Fluid Mechanics (p. 183)	2/2	W	6	N.N.

Learning Control / Examinations
graded: oral eamination, 30 minutes

Conditions
None.

Recommendations
compulsory module Advanced Fluid Mechanics, bauiM2P1-AFMAFM

Learning Outcomes
The students gain understanding of physical processes that define mass transport (e.g. pollutants), energy transport (e.g. cooling water), and momentum transport (e.g. flows and waves) in surface water and atmosphere. They learn about method for quantifying these processes.

Content
Mixing and transport processes in turbulent and stratified flows, exchange processes at interfaces, flows and transport processes in estuaries, lakes, rivers and canals, atmospheric flows as well as experimental and numerical methods; application examples for contaminant transport, mixing processes in reservoirs and lakes, density driven flows, inflows into water bodies amongst others are dicussed.

Remarks
Literature:
Acheson, D.J. (1990), Elementary Fluid Dynamics, Oxford Applied Mathematics and Computing Science Series, Clarendon Press, Oxford, England.
Batchelor, G.K. (1967), An Introduction to Fluid Dynamics, Cambridge University Press, Cambridge, England.
Turner, J.S. (1973), Buoyancy Effects in Fluids, Cambridge University Press, Cambridge, England.
Csanady, G.T. (1973), Turbulent Diffusion in the Environment, D. Reidel Publishing Comany, Dordrecht, Holland.
Fischer, H.B., List, E.G., Koh, R.C.Y., Imberger, J. & Brooks, N.H. (1979), Mixing in Inland and Coastal Waters, Academic Press, New York, NY.
Kundu, P.K. & Cohen, I.M. (2002), Fluid Mechanics, 2nd Edition, Academic Press, San Diego, CA.
Mei, C.C. (1997), Mathematical Analysis in Engineering, Cambridge University Press, Cambridge, England.
Rutherford, J.C. (1994), River Mixing, John Wiley & Sons, Chichester, England.
van Dyke, M. (1982), An Album of Fluid Motion, The Parabolic Press, Stanford, California.
Wetzel, R.G. (1983), Limnology, Saunders Press, Philadelphia, PA.

Module: Turbulent Flows [bauiM2S20-NS1]

Coordination: M. Uhlmann
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	2

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6221806	Fluid Mechanics of Turbulent Flows (p. 201)	2	S	3	M. Uhlmann
6221913	Modelling of Turbulent Flows - RANS and LES (p. 320)	2	W	3	M. Uhlmann

Learning Control / Examinations
graded:
oral examination, 30 minutes in each course

Conditions
Hydromechanics, mathematics

Learning Outcomes
Introduction to the physics of turbulent flows and the problem of computing them, statistical analysis of turbulent field data, detailed description of currently used statistical turbulence models (Reynolds-averaging as well as spatial filtering), discussion of model performance and range of applicability

Content
Fluid Mechanics of Turbulent Flows: General introduction to turbulent flows, Equations of fluid motion, Statistical description of turbulence, Free shear flows, The scales of turbulent motion, Wall-bounded shear flows, DNS as numerical experiments; Turbulence Models RANS - LES: Introduction to RANS modelling, k-epsilon and other eddy viscosity models, Reynolds-stress transport models, The concept of Large-Eddy Simulation (LES), Spatial filtering, Current Subgrid-stress models, Boundary conditions and wall treatment

Remarks
Literature: S.B. Pope “Turbulent flows”, Cambridge University Press, 2000. U. Frisch “Turbulence: The legacy of A.N. Kolmogorov”, Cambridge U. Press, 1995. P.A. Durbin and P.A. Petterson Reif. “Statistical theory and modeling for turbulent flows”, Wiley, 2001. D.C. Wilcox “Turbulence Modeling for CFD”, DCW Industries, second edition, 1998.

Module: Advanced Computational Fluid Dynamics [bauiM2S21-NS2]

Coordination: M. Uhlmann
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6221807	Parallel programming techniques for engineering problems (p. 265)	1/1	S	3	M. Uhlmann
6221809	Numerical fluid mechanics II (p. 264)	1/1	S	3	M. Uhlmann

Learning Control / Examinations
graded: exam Parallel Programming Techniques, written, 60min, exam Numerical Fluid Mechanics II, oral, 30min

Conditions
Module Advanced Fluid Mechnics;

Recommendations
Numerical treatment of partial differential equations, programming skills

Learning Outcomes
Numerical Fluid Mechanics II: Advanced skills in numerical simulation of fluid flow problems, Realisation of computations based upon the Navier-Stokes equations, Analysis, design and implementation of algorithms, Introduction to a program package for the simulation of complex fluid flow; Parallel programming techniques: To acquire the basic knowledge about parallel computing possibilities and its limitations, To enable the student to analyze a given problem from CFD (and beyond) and assess the potential for an efficient solution using parallel computing techniques, To transmit the scope, syntax and practical application of the message passing paradigm, using the standard "MPI"

Content
Numerical Fluid Mechanics II: Efficient solution of the incompressible Navier-Stokes equations, grid generation, utilization of a commercial CFD package, extension of the existing software package with user-defined modules; Parallel programming techniques: Architectures of parallel computers, General considerations and limits of parallel efficiency (speedup, scaling, latency, load-balancing, Amdahl's law), Parallel programming paradigms, Design of a parallel program, General strategies for algorithm parallelization, Introduction to the message passing standard MPI, Parallelization of some select algorithms (hands-on sessions)

Remarks
Literature: C. Hirsch "Numerical computation of internal and external flows" Butterworth-Heinemann, 2nd edition, 2007. J.H. Ferziger and M. Peric "Computational Methods for Fluid Dynamics", Springer, 3rd edition, 2001. N. Carriero "How to Write Parallel Programs: A First Course", MIT Press, 1990. T.G. Mattson, B.A. Sanders, B.L. Massingill "Patterns for Parallel Programming" Addison-Wesley, 2004. M. Snir, S. Otto, S. Huss-Lederman, D. Walker, J. Dongarra "MPI: The Complete Reference", MIT Press, 1995.

Module: Wastewater Analyses in Practice [bauiM2S22-IB1]

Coordination: J. Winter
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6225801	Wastewater analyses and application (p. 267)	4	S	6	C. Gallert, J. Winter

Learning Control / Examinations
graded:
Report

Conditions
Module Mass Fluxes and Cycles, bauiM2P3-STKSTK

Learning Outcomes
Practical experience in analytical methods for determing sum parameters in wastewater treatment plants and comparison of different analytical methods (standard methods and rapid tests)

Content
-Analysis of sum parameters (COD, DOC, TKN, NH4+, NO3-, PO43-, heavy metals(, toxicity test, methane production, potential of single treatement processes in a wastewater treatment plant. Comparison of different analytical methods (standard methods and test kits).

Remarks
Literature: Script of the Institute

Module: Technologies for solid waste management [bauiM2S23-IB2]

Coordination: J. Winter
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6225802	Processing of wastes, excursions (p. 328)	2/2	S	6	J. Winter, C. Gallert

Learning Control / Examinations
oral presentation and oral examination

Conditions
None.

Learning Outcomes
Legal requirements and different technologies of solid waste management in Germany and Europe. The theoretical background will be supplemented with field trips.

Content
Technical processes of solid waste treatment and recycling of renewables (landfill, composting, digestion, MBT, incineration)
Field trips to different waste treatment plants in Karlsruhe and nearby cities

Remarks
Literature:
Abfallwirtschaft B. Bilitewski, G. Härdtle, K. Marek Springer-Verlag, Heidelberg, 1993
Abfallwirtschaft, Abfalltechnik O. Tabasaran Ernst & Sohn Verlag Berlin, 1994
Mechanische und biologische Verfahren der Abfallbehandlung ATV-Handbuch Ernst & Sohn Verlag Berlin, 2002
Biologische Abfallverwertung W. Bidlingmaier Eugen Ulmer GmbH, Stuttgart, 2000

Module: Water Treatment Technologies [bauiM2S24-SW1]

Coordination: E. Hoffmann
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6223801	Process Technologies in Storm Water Treatment (p. 307)	1/1	S	3	S. Fuchs, E. Hoffmann
6223803	Process Technologies in Water Supply and Wastewater Disposal (p. 330)	1/1	S	3	E. Hoffmann

Learning Control / Examinations
graded: homework (2cp), presentation and written report (4 cp)

Conditions
None.

Learning Outcomes
Based on the lecture transformation and degradation processes the students will gain knowledge in planing, deminsioning and operation of different plant for water of water treatment. Requirements and limitation will be derived having a closer look on natural and anthopogenic substance cycles.

Content
Taylor made solutions for water and waste water treatment: Sedimentation, Oxidation, Flocculation and Flotation, Adsorption

Remarks
Literature: Gujer, W.: “Siedlungswasserwirtschaft”, Springer, Berlin (3. Aufl., 2007)

Module: Urban Water Management [bauiM2S25-SW2]

Coordination: S. Fuchs
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6220902	Urban Water Management (p. 326)	2/2	W	6	S. Fuchs, P. Klingel, U. Mohrlok

Learning Control / Examinations
graded:
presentation, report

Conditions
None.

Recommendations
module Technical Hydraulics, module Plant Operation and Optimization

Learning Outcomes
The students have knowledge in integrated water ressource management focusing on urban areas. That covers fundamental knowledge in water and linked substance transports on surfaces, in surface water, water distribution and sewer systems and groundwater bodies.

Content
Amount and quality of different runoff components; indicators of pollution; tools for urban water management (water distribution, urban drainage, surface and ground waters ; characteristics of urban surface waters)

Remarks
Literature: lecture accompanying documents

Module: Water Quality of Surface Water Bodies and Groundwater [bauiM2S26-SW3]

Coordination: S. Fuchs
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6223805	Surface Water Quality (p. 200)	1/2	S	4,5	S. Fuchs
6221811	Groundwater Quality (p. 219)	1/0	S	1,5	U. Mohrlok

Learning Control / Examinations
graded:
oral presentation, report and oral interview

Conditions
None.

Learning Outcomes
Students will learn the theoretical background of surface and groundwater evaluation. They will further learn the priciples of physical, chemical and ecological analysis. Considering almost undisturbed and deteroriated systems they will practice their knowledges in a field course.

Content
surface waters: Oxygen household, sediment/water interactions, biological water quality, hydromorphological quality groundwater: sampling methods, measurement of pysical and chemical paramters and data analysis.

Remarks
Literature:
Schwörbel, Einführung in die Limnologie, 7. Aufl., UTB-Verlag Gustav Fischer (1993)
Lampert und Sommer, Limnoökologie, Thieme Verlag (1993)
Schwörbel, Methoden der Hydrobiologie, Süßwasserbiologie, 3. Aufl., UTB-Verlag Gustav Fischer (1986)
DIN 38410 (2004): Deutsche Einheitsverfahren zur Wasser-, Abwasser- und Schlammuntersuchung - Biologisch-ökologische Gewässeruntersuchung . DIN Deutsches Institut für Normung e.V., Beuth Verlag Berlin
DVWK (Deutscher Verband für Wasserwirtschaft und Kulturbau), Schriften 107, "Grundwassermessgeräte", Verlag Paul Parey, 1994
DVWK (Deutscher Verband für Wasserwirtschaft und Kulturbau), Schriften 125, "Methoden für die Beschreibung der Grundwasserbeschaffenheit", Verlag Paul Parey, 1999
Wechselnde aktuelle Literatur

Module: Applied Ecology [bauiM2S27-SW4]

Coordination: S. Fuchs
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	2

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6223807	Principles of Applied Ecology (p. 177)	2	S	3	S. Fuchs
6223901	Seminar: Ecological Management of Water Bodies (p. 286)	2	W	3	S. Fuchs

Learning Control / Examinations
graded: oral exam, presentation

Conditions
None.

Learning Outcomes
Based on case studies students will gain knowledge about the relevance and realisation of measures related to ecological theories and principles. Requirements and limitation will be derived having a closer look on several projects. The knowledge will be deepend by student's presentations in the course of the subsequent seminar.

Content
Ecological principles will be studied and appropriated measures will be discussed

Remarks
Literature: Limnology, 3rd Edition, Wetzel, Academic Press 2001, kursbegleitende Materialien

Module: Water Supply and Sanitation Systems and Plants [bauiM2S28-SW5]

Coordination: E. Hoffmann
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	2

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6223808	Water Treatment (p. 341)	1/1	S	3	E. Hoffmann
6222905	Water Distribution (p. 345)	1/1	W	3	P. Klingel

Learning Control / Examinations
graded:
oral exam. presentation or report

Conditions
None.

Recommendations
module Technical Hydraulics, module Urban Water Management

Learning Outcomes
Knowledge in operation and optimization of water distribution drainage and treatment systems

Content
Water infrastructure: operation, design of system components, operational planning, optimization in regard to effiziency ressources and energy consumption, case studies

Remarks
Literature: Fachbücher, Fachartikel, Schrifttum zur Vorlesung

Module: Industrial Water Management [bauiM2S29-SW6]

Coordination: E. Hoffmann
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	2

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6223810	Cleaner Production – Closing the Loop (p. 238)	1/1	S	3	E. Hoffmann
6223902	Appropriated Technologies (p. 133)	1/1	W	3	E. Hoffmann

Learning Control / Examinations
graded:
oral exam
ungraded:
report on lab work

Conditions
None.

Learning Outcomes
Students will gain knowledge in industrial production processes, emissons and evaluation of waste water compounds. In addition on legal requirements they will learn appropriated methods for emission reduction and substance recycling.

Content
This module will discuss different types of waste waters (e.g. leather, paper, metal industries) and appropriate physico-chemical as well as biological treatment technologies.

Remarks
Literature: vorlesungsbegleitende Materialien

Module: River Basin Modeling [bauiM2S30-SW7]

Coordination: S. Fuchs
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	2

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6223812	Mass Fluxes in River Basins (p. 309)	2/0	S	3	S. Fuchs
6223904	Modelling Mass Fluxes in River Basins (p. 253)	0/2	W	3	S. Fuchs

Learning Control / Examinations
graded: oral exam, 3 CP, report on model work 3CP

Conditions
None.

Learning Outcomes
Students will gain knowledge in water driven massfluxes and the alteration of those by human activities. A model for quantifying the emissions into surface waters will be introduced. In practical excercises the student will develop model apadtion and scenarios.

Content
The module will present system theories, modeling tools and management strategies

Remarks
Literature: Modellwerkzeuge, vorlesungsbegleitende aktuelle Literatur

Module: Urban and Regional Planning [bauiM3P1-PLSTAREG]

Coordination: W. Jung
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6231701	Urban Planning (p. 300)	1/1	W	3	B. Brester
6231703	Regional Planning (p. 282)	2	W	3	W. Jung

Learning Control / Examinations
graded:
oral examination, 30 minutes

Conditions
BSc-modul mobility and infrastructure

Learning Outcomes
The aim is to provide an overview of important tasks for spatial planning, of the legal principles, methods and strategies for solving spatial problems on urban and regional level. The students shall be able to develop planning strategies, particularly in the field of planning on a supra-local level.

Content
In the lectures basic goals and tasks of planning of different levels, procedures and instruments, the relationship between governmental and private planning are taught. The scientific contexts are developed systematically to strengthen the various methodological approaches to understand and evaluate them. Particular attention will be paid inter alia to changing conditions, such as demographic and economic developments.

Remarks
Literature: Literaturliste zum Modul

Module: Models and Methods in Traffic Engineering and Transportation Planning [bauiM3P2-VERMODELL]

Coordination: P. Vortisch
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6232701	Methods and Models in Transportation Planning (p. 156)	1/1	W	3	P. Vortisch, M. Kagerbauer
6232703	Traffic Engineering (p. 310)	1/1	W	3	P. Vortisch

Learning Control / Examinations
Oral examination (40 minutes)

Conditions
None.

Recommendations
BSc-modul mobility and infrastructure

Learning Outcomes
Knowledge about methods and approaches in transport planning and traffic engineering

Content
Methods and models in transport planning as well as the relevant tools and methods for the traffic engineer. Transport Planning: Four-Step-Algorithm, aggregate versus indivdiual models, choice modeling. Traffic Engineering: Measuring traffic flow data, description of traffic conditions / fundamental diagram, capacity of roads and intersections with and without traffic signals

Remarks
Literature: Skriptum mit weiterführenden Literaturangaben / Übungsblätter

Module: Infrastructure Management [bauiM3P3-STRINFRA]

Coordination: R. Roos
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6233801	Design and Construction of Highways (p. 182)	1/1	S	3	R. Roos
6233802	Operation and Maintenance of Highways (p. 161)	2	S	3	R. Roos

Learning Control / Examinations
graded:
oral examination

Conditions
BSc-modul mobility and infrastructure

Learning Outcomes
Main goal is the gain of methods in further tasks of highway design and road construction and leraning the steps of practical design of a real road

Content
The course is about junction layouts of roads and testing of highway designs as well as road construction materials and road construction types in theory and a practical design.

Remarks
Literature:

Module: Track guided transport systems - technical design & components [bauiM3P4-EBTECHNIK]

Coordination: E. Hohnecker
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6234701 / 6234702	Track Guided Transport Systems - Technical Design and Components (p. 297)	3/1	W	6	E. Hohnecker

Learning Control / Examinations
written examination, 90 min

Conditions
None.

Learning Outcomes
to know the complexity of the profession "track guided systems"

Content
basics in all fields; layout and dimensioning of lines

Remarks
Literature: Zilch, Diederichs, Katzenbach: Handbuch f. Bauingenieure, Springer-Verlag

Module: Laws and Proceedings concerning Traffic and Roads [bauiM3P5-VERFRECHT]

Coordination: R. Roos
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6233804	Environmental Impact Assessment (p. 325)	1	S	1,5	R. Roos
6233803	Laws concerning Traffic and Roads (p. 332)	2/0	S	3	D. Hönig
6232801	Assessment and Evaluation Techniques (p. 164)	1/0	S	1,5	P. Vortisch, B. Chlond

Learning Control / Examinations
graded: oral exams (40 minutes)

Conditions
None.

Learning Outcomes
Understanding of the laws concerning construction and operating of roads, gaining of basic knowledge concerning the environmental impact of roads and financing in public privat partnership Basic knowledge about the assessment and evaluation techniques for the planning of infrastructure projects

Content
Constitutional framework, envirnmental impact of roads, changeing topics concerning mainly proceedures in highway engineering Methodologies and application of standardized assessment and decisison techniques (Cost-Benefit-Analyses, Value Benefit Analyis etc.) in transport planning

Remarks
Literature:

Module: Urban Renewal [bauiM3S01-PLSTUMB]

Coordination: W. Jung
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6231801	Urban Management (p. 299)	1/1	S	3	W. Jung
6231803	History of Urban Planning and the Built Environment (p. 301)	1	S	1,5	J. Vogt
6231804	Building Theory (p. 204)	1	S	1,5	Everts

Learning Control / Examinations
graded:
oral examination, 30 minutes

Conditions
Basic modul Urban and Regional Planning

Learning Outcomes
The aim is to convey the principles and methods of urban renewal. In the module adaptation strategies are taught, by which cities and city regions react to changing conditions. These changes -such as climate change, demographics or changing economic practices- are encountered by urban concepts city-wide, on the level of city quarters or on the building level. In addition to the urban redevelopment in Germany selected references from Europe are examinated.

Content
Based on the core module “Urban and Regional Planning” this lecture is focused on adaptation strategies of cities and urban regions. In addition to a classification in the current discussions on urban redevelopment basic methods and tools are taught. The students of the module Urban Renewal shall be able to elaborate strategies of urban renewal and redevelopment. The basic methodological framework is the discussion of projects as examples for good practice. The module will be supplemented by courses such as “History of Urban Planning and the Built Environment” to consider the historical development and cultural heritage. In addition, in the course “Building Theory” urban qualities and implementation on the building level are taught.

Remarks
Literature: Literaturliste zum Modul

Module: Space and Infrastructure [bauiM3S02-PLRAUMINF]

Coordination: W. Jung
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6231805	Logistics, Supply and Disposal (p. 188)	1/1	S	3	M. Jehling
6231807	Planning Techniques and Planning Methods (p. 266)	1/1	S	3	S. Keller

Learning Control / Examinations
graded:
oral examination, 30 minutes

Conditions
Basic modul Urban and Regional Planning

Learning Outcomes
Transport infrastructure, water and energy, and telecommunications are fundamental prerequisites for the development of an area. However, the conditions of the area, its topography, resources, environment, population and characteristics have to be considered in order to design not only an effective, but also a sustainable plan. This relationship between spatial planning and infrastructure development are mediated. This content will be supplemented by learning the skills to analyse and display spatial data. The aim is to show the importance of coupling between planning task and use of computer-based tools in spatial planning. A link between theoretical background and reality on the one hand and instruments on the other is necessary.

Content
Logistics, Supply and Disposal: After a introduction to the terms infrastructure and development the lecture examines the most important infrastructures in detail: Traffic systems, railway planning, air traffic, watercourses, water supply and drainage, power supply, telecommunications, recycling and waste management systems. Also the calculation and distribution of development costs are shown. Techniques and Methods: Foundations of information and communication theory, spatial information on the Internet, project presentation, planning information systems, technical information systems, Cartographic Principles

Remarks
Literature:
Literaturliste zum Modul

Module: Traffic Management und Simulation Methods [bauiM3S03-VERMANAGE]

Coordination: P. Vortisch
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6232802	Traffic Management and Transport Telematics (p. 333)	1/1	S	3	P. Vortisch
6232804	Traffic Flow Simulation (p. 291)	1/1	S	3	P. Vortisch

Learning Control / Examinations
oral examination (40 minutes)

Conditions
Module Model Approaches and Methodologies in transportation

Learning Outcomes
Acquisition of the specific and advanced knowledge and the relevant methodologies in the field of traffic engineering. Basic considerations in the development and the application of simulation models in transport planning and traffic engineering.

Content
In excess of the basic module "Model approaches and methods in transportation" more advanced methods of traffic engineering will be dealt with (advanced signalisation, control of routes and networks). Furthermore methods for the development of simulation models as well as their application will be in the focus (application of professional software tools for transport planning and traffic engineering). Another issue are transport telemtics and intelligent transportation system.

Remarks
Literature: Skripten, Richtlinienwerke (Handbuch zur Bemessung von Straßen, Richtlinien für Lichtsignalanlagen), Software-Handbücher

Module: Planning of Transportation Systems [bauiM3S04-VERPLAN]

Coordination: P. Vortisch
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6232806	Characteristics of Transportation Systems (p. 176)	2/0	S	3	P. Vortisch
6232807	Tendering, Planning and Financing in Public Transport (p. 348)	2/0	S	3	W. Weißkopf

Learning Control / Examinations
Oral examination

Conditions
None.

Learning Outcomes
Understanding the complexity of the transport field in its disciplinarity between engineering science, politics, society, economy. Acquisition of the relevant knowledge and the methodologies for the evaluation of projects and measures. The module is rather transport planning than traffic engineering oriented.

Content
The module deals with the fundamentals which are necessary to understand the travel demand process and for the evaluation of measures. Furthermore knowledge will be presented, which is necessary to develop measures for influencing travel behaviour and the analyses of their efficiency. External effects of transportation and traffic. The emphasis in the second part is in Public Transport: Here the specific and systemic characteristics of Public Transport modes and their particularities in planning and operation will be considered.

Remarks
Literature: Skripten und Vorlesungsumdrucke stehen zum Download zur Verfügung.

Module: Highway Design [bauiM3S05-STRENTW]

Coordination: M. Zimmermann
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6233903	Highway design project study (p. 275)	2	W	3	M. Zimmermann, R. Roos
6233901	IT-based Road Design (p. 175)	1/1	W	3	M. Zimmermann

Learning Control / Examinations
graded:
oral examination
attested:
Design of a rural road

Conditions
None.

Learning Outcomes
Gaining the basics of practical working with the elements of highway design in horizontal alignment, vertical alignment and cross section, gaining the basics of data processed road design

Content
The method of data processed road design is theoretically and in practical examples aquired.

Remarks
Literature:

Module: Road Construction [bauiM3S06-STRBAUT]

Coordination: R. Roos
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6233904	Practical Laboratory Training in Road Construction (p. 239)	2	W	3	C. Karcher
6233905	Pavement Structural Design and Failure Analysis (p. 155)	2	W	3	C. Karcher

Learning Control / Examinations
graded:
Oral examination

Conditions
None.

Learning Outcomes
Gaining theoretical structural design basics of road constructions as well as carrying out of failure analysis including the concerning laboratory tests

Content
Theoretical design methods for pavement structures, failure analysis of different road construction types and typical laboratory tests for earthwork, binder an asphalt mixes

Module: Track guided transport systems - basics of operating systems [bauiM3S07-EBBETRIEB]

Coordination: E. Hohnecker
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6234801	Operation (p. 160)	2	S	3	E. Hohnecker
6234802 / 6234803	Facilities and Rolling Stock (p. 136)	1/1	S	3	E. Hohnecker

Learning Control / Examinations
Written examination (120 min)

Conditions
None.

Recommendations
module bauiM3P4-EBTECHNIK

Learning Outcomes
to have basic knowledges of operation planning, of the construction of stations and railway vehicles

Content
vehicles, stations, operation modi, timetable

Remarks
Literature: Fiedler: Grundlagen der Bahntechnik, Werner-Verlag, Düsseldorf

Module: Track guided transport systems - operational logistics & management [bauiM3S08-EBLOGISTIK]

Coordination: E. Hohnecker
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6234804	Operation Systems and Track Guided Infrastructure Capacity (p. 163)	2	S	3	E. Hohnecker
6234805	Management in Public Transport (p. 242)	2	S	3	E. Hohnecker

Learning Control / Examinations
graded:
oral examination “Management in Public Transport”
ungraded:
home work “Operation Systems and Track Guided Infrastructure Capacity” (ca. 10 pages)

Conditions
None.

Recommendations
module bauiM3P4-EBTECHNIK

Learning Outcomes
to know how to plan and operate a public transport system

Content
capacities of lines and stations; new operration modi; managment in public transport; special transport systems

Remarks
Literature: Pachl: Systemtechnik des Schienenverkehrs, Teubner-Verlag, Stuttgart

Module: Project “Integrated Planning” [bauiM3S09-PROJEKTIP]

Coordination: R. Roos
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6230901	(p. 271)	4	W	6	Assistenten

Learning Control / Examinations
graded:
oral examination in 2 of 4 subjects, 40 minutes
(integrated term paper of the whole group and 2 presentations of the results; internal attest)

Conditions
None.

Learning Outcomes
With this project, the participating institutions offer students the possibility of practical application of their acquired expertise. The claim of the “integrated” planning is comprehensive planning considering various demands.

Content
In this course students work on a given, real example for a characteristic problem of spatial and infrastructure development. The central task is the development of integrated planning drafts in the field of spatial and infrastructure planning. The development of a convincing vision as the basis for a sustainable development leads to different demands on spatial planning, traffic engineering, highway engineering and public transport. To create a viable draft, the various requirements must be balanced against each other.

Remarks
Literature:

Module: Data Analysis and Transportation Modelling [bauiM3S10-VERDATAMOD]

Coordination: P. Vortisch
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6232901	Transportation Data Analysis (p. 178)	1/1	W	3	M. Kagerbauer, T. Streit
6232903	Seminar in Transportation (p. 288)	2	W/S	3	P. Vortisch, B. Chlond

Learning Control / Examinations
graded:
oral examination “Transportation Data Analysis” (20 minutes)
ungraded:
term paper and presentation

Conditions
None.

Learning Outcomes
The objective of this module is the generation of data (surveys in transport) and its scientific use in the sense of statistical modelling or the quantitative analysis by means of statistical Software (SAS/R). Application of this basic knowledge.

Content
In a first course advanced methods of survey methodologies in transportation, data generation, the processing and the analysis of data as well as statistical modelling with such data will be dealt with by using statistical analysis software (e.g. SAS/ R). The second part of the module will deal with the elaboration of a small scientific task by using the competences in the form of a seminar. The emphasis of this seminar will be based on the analyses of data by means of the software.

Remarks
Literature: Vorlesungsbegleitende Umdrucke Übungen am PC

Module: Intermodality in Long-distance, Freight and Air Transport [bauiM3S11-VERINTER]

Coordination: B. Chlond
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	2

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6232808	Freight Transport (p. 221)	1/1	S	3	B. Chlond
6232904	Long-distance and Air Traffic (p. 196)	2/0	W	3	B. Chlond, N.N., Wilko Manz

Learning Control / Examinations
Graded:
Written examination

Conditions
None.

Learning Outcomes
Knowledges about the characteristics of freight transportation, long distance travel and air travel against the background of the globalization and and EU-integration Knowledge about the challenges and the design and of intermodal transport services.

Content
Relevant factors for the demand in freight transport. Methods for demand forecasts and planning in freight transport. Measures for influencing the demand in freight transport as well as their efficiency. Particularities of the airline industry in a global market shown in case studies. Organisation of the airline industry. Particularities of Long Distance Travel. Methodology of the Federal Transport Master Plan. Evolution of Long Distance Transport Systems.

Remarks
Literature:

Module: Road Safety [bauiM3S12-STRVSICH]

Coordination: M. Zimmermann
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6233908	Seminar in Highway Engineering (p. 287)	2	W	3	M. Zimmermann
6233906	Safety Management in Highway Engineering (p. 289)	1/1	W	3	M. Zimmermann

Learning Control / Examinations
graded:
oral exam, 20 minutes
attested:
integrated term paper, public presentation of the results

Conditions
None.

Learning Outcomes
Gaining the procedures to increase infrastructural road safety and appliance at regional accident black spots

Content
In this course the theoretical basics of road safety are repeated and fundamental improvements are discussed. During the following seminar in highway engineering changing regional accident black spots are analysed and improvements for the road authorities are worked out and will be presented.

Remarks
Literature:

Module: Special Topics in Highway Engineering [bauiM3S13-STRSPEZ]

Coordination: R. Roos
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	2

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6233805	Technical and economical management tools in Highway Engineering (p. 313)	2	S	3	H. Rethage
6233806	Simulations and analysis methods in Highway Engineering (p. 292)	1	S	1,5	R. Roos, Mitarbeiter
6233807	Special Topics in Highway Engineering (p. 157)	1	S	1,5	R. Roos

Learning Control / Examinations
graded:
oral examination Technical and economical management tools in Highway Engineering (20 minutes)
oral examination Special Chapters in Highway Engineering (20 minutes)

Conditions
None.

Learning Outcomes
Learning the methodology of organisation and carrying out the road operation and maintenance

Content
In this course the duties of the management of existing roads are aquiered and the technical and commercial control from the point of view of the road authorities are explained.

Remarks
Literature:

Module: Dimensioning and construction of railway lines [bauiM3S14-EBBAU]

Coordination: E. Hohnecker
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6234806	examination Infrastructure Dimensioning and Railway Traffic (p. 228)	1/1	S	3	E. Hohnecker, Mitarbeiter
6234808	Infrastructure Equipment of Railway Tracks (p. 227)	1	S	1,5	E. Hohnecker, Mitarbeiter
6234809	Construction and Maintenance of Track Infrastructure (p. 140)	1	S	1,5	E. Hohnecker, Mitarbeiter

Learning Control / Examinations
graded:
written examination Infrastructure Dimensioning and Railway Traffic, 45 min
oral examination Equipment, Construction and Maintenance of Railway Tracks, 20 min

Conditions
None.

Recommendations
module bauiM3P4-EBTECHNIK

Learning Outcomes
to know the methods of planning, dimensioning, construction and maintenance of railway lines

Content
dimensioning of railway tracks; planning and construction of railway lines; operation and maintenance; mechanic and planing models; power supply; electric elements in signalling/operation

Remarks
Literature:
Fiedler: Grundlagen der Bahntechnik, Werner-Verlag, Düsseldorf

Module: Economics, law and environmental aspects in railway transportation [bauiM3S15-EBUMWELT]

Coordination: E. Hohnecker
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6234901	Environmental Aspects of Guided Transport Systems (p. 323)	2	W	3	E. Hohnecker
6234902	Economic Efficiency of Guided Transport Systems (p. 349)	1	W	1,5	E. Hohnecker
6234903	Law Aspects of Guided Transport Systems (p. 281)	1	W	1,5	E. Hohnecker

Learning Control / Examinations
oral examination (45 min)

Conditions
None.

Learning Outcomes
to know the economic, judicial and environmental problems of track guided transport systems

Content
basics of economy; evalutation of planing; economic and law in public transport; customer orientation; noise and vibration; ecology

Remarks
Literature: Aberle: Transportwirtschaft, Oldenbourg-Verlag Kunz: Eisenbahnrecht, Nomos, Baden-Baden

Module: Traffic infrastructure [bauiM3S16-EBVERKEHR]

Coordination: E. Hohnecker
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6234810 / 6234811	Determination of Demand, Timetable Construction and Alignment (p. 151)	2/1	S	4,5	E. Hohnecker
6234904	Standard Valuation in Public Transport. Using an Example (p. 305)	0/1	W	1,5	E. Hohnecker

Learning Control / Examinations
speech, 30 min, term paper, max 4 pages

Conditions
None.

Recommendations
1. module bauiM3S07-EBBETRIEB
2. module bauiM3S08-EBLOGISTIK

Learning Outcomes
to know how to plan and evaluate a public transport project

Content
determination of demand, alignment, construction of timetable, cost estimate, evaluation of track guided public transport projects

Remarks
Literature:

Module: Construction Management and Work Planning [bauiM4P1-]

Coordination: N. N.*
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6241701	(p. 138)	2	W	3	N. N.*, Mitarbeiter
6241702	(p. 141)	2	W	3	N. N.*, Mitarbeiter

Learning Control / Examinations
wE, 90 min

Conditions
quisites: none Recommendations

Learning Outcomes

Content

Module: Construction Equipment and Machinery [bauiM4P2-]

Coordination: S. Gentes
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6241703	(p. 214)	1	W	1,5	S. Gentes, Mitarbeiter
6241704	(p. 145)	2/1	W	4,5	H. Schlick, H. Schneider

Learning Control / Examinations
wE, 90 min

Conditions
quisites: none Recommendations

Learning Outcomes
The students are able to assemble suitable machinery and equipment (method selection) for the selected construction method. They realise optimisation potential with the help of appropriate process engineering methods und will learn about the performance values and operation conditions of those methods.

Content
Within the frame of this module, various devices will be presented with the help of BGL. Moreover, an on-site induction with practical examples and performance calculations as well as practical workshops at the Institut's own test site with machine deployment will take place.

Remarks
Literature: 1) Baugeräteliste, Band 2007, 1. Aufl., 2007. 2) Hüster, Felix, Leistungsberechnung der Baumaschinen, Shaker, 5. Aufl., Aachen, 2005. 3) Girmscheid, Gerhard: Leistungsermittlungshandbuch für Baumaschinen und Bauprozesse, Springer, 3., überarb. Aufl., Berlin, Heidelberg, Zürich, 2005. 4) Drees, Gerhard; Krauß, Siri: Baumaschinen und Bauverfahren - Einsatzgebiete und Einsatzplanung, expert-Verlag, 3., völlig neu bearb. Aufl., Renningen, 2002.

Module: Economics and Management in Construction [bauiM4P3-]

Coordination: K. Lennerts
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6241801	(p. 230)	1/1	S	3	S. Gentes
6241803	(p. 197)	1	S	1,5	K. Lennerts
6241804	(p. 147)	1	S	1,5	N. N.*, S. Gentes

Learning Control / Examinations
wE, 90 min

Conditions
quisites: none Recommendations

Learning Outcomes
The students are able to independently create offers and standard pricing and will gain extensive knowledge of an appropriate software. module. Furthermore the students are able to make strategic investment decisions and to make a successful corporate controlling. They have a detailed knowledge in forms of organisations.

Content
This module covers the calculation of various factors (Mittellohn, EKT, BGK, AGK and W&G). After a manual example for tendering, the result will be transferred to currently applied software. Furthermore following topics are discussed within the lectures: • financing • investing • basics of contolling • forms of organisation

Remarks
Literature: 1) Bronner, Albert: Angebots- und Projektkalkulation - Leitfaden für Praktiker, Springer, 3., aktualisierte Aufl., Berlin, Heidelberg, 2008. 2) Drees, Gerhard u. Paul, Wolfgang: Kalkulation von Baupreisen - Hochbau, Tiefbau, Schlüsselfertiges Bauen, Bauwerk, 10., erw. und aktualisierte Aufl., Berlin, 2008. 3) Leimböck, Egon; Klaus, Ulf Rüdiger u. Hölkermann Oliver: Baukalkulation und Projektcontrolling unter Berücksichtigung der KLR Bau und der VOB, Vieweg, 11., überarb. Aufl., Wiesbaden, 2007. 4) Girmscheid, Gerhard, Motzko, Christoph: Kalkulation und Preisbildung in Bauunternehmen - Grundlagen, Methodik und Organisation, Springer, Berlin, Heidelberg, 2007. 5) Handwörterbuch der Betriebswirtschaft (HWB), Herausgegeben von: Prof. Dr. Dr. h.c. Richard Köhler, Prof. Dr. Dr. h.c. Hans-Ulrich Küpper, Prof. Dr. Andreas Pfingsten, Schäffer Pöeschel, 6. Auflage, 2007 Weitere Literatur wird zu Beginn der Vorlesung bekannt gegeben. Lernmaterialien bzw. Unterlagen zur Veranstaltung werden zu Beginn des Semesters über einen virtuellen Projektraum zur Verfügung gestellt.

Module: Sustainability in Real Estate Management [bauiM4P4-]

Coordination: K. Lennerts
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6241805	(p. 255)	1/1	S	3	K. Lennerts
6241807	(p. 241)	1	S	1,5	K. Lennerts, Mitarbeiter
6241808	(p. 192)	1	S	1,5	K. Lennerts

Learning Control / Examinations
wE, 90 minutes

Conditions
quisites: Recommendations

Learning Outcomes

Content

Module: Business and Human Resource Management [bauiM4S01-]

Coordination: N. N.*
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6241809	(p. 162)	2	S	3	N. N.*
6241810	(p. 225)	1	S	1,5	K. Lennerts, K. Janowski
6241811	(p. 336)	1	S	1,5	R. Kohlhammer

Learning Control / Examinations
oE, 40 min

Conditions
quisites: none Recommendations

Learning Outcomes

Content

Module: Innovation in Construction Process Engineering - Case Studies [bauiM4S02-]

Coordination: N. N.*
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6241812	(p. 229)	2	S	3	N. N.*, S. Gentes
6241813	(p. 285)	2	S	3	N. N.*, H. Schneider

Learning Control / Examinations
oE

Conditions
None.

Learning Outcomes

Content

Module: Environmental Engineering and Strategies for Energy Supply [bauiM4S03-]

Coordination: N. N.*
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6241814	Construction Methods in Environmental Engineering (p. 327)	1/1	S	3	H. Schneider
6241816	(p. 180)	1/1	S	3	N. N.*, Mitarbeiter

Learning Control / Examinations
oE

Conditions
quisites: Recommendations

Learning Outcomes

Content

Module: Construction Process Engineering and Quality Management [bauiM4S04-]

Coordination: N. N.*
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6241818	(p. 294)	1	S	1	N. N.*, F. Kohlbecker
6241819	(p. 158)	1	S	2	N. N.*, F. Kohlbecker
6241820	(p. 280)	1	S	2	N. N.*, Mitarbeiter
6241821	(p. 277)	1	S	1	N. N.*, G. Schlick

Learning Control / Examinations
oE

Conditions
None.

Learning Outcomes

Content

Module: Advanced Project Management [bauiM4S05-]

Coordination: N. N.*
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6241822	(p. 256)	1	S	1,5	S. Gentes
6241823	(p. 274)	1	S	1,5	G. Schlick
6241824	(p. 273)	1/1	S	3	N. N.*, Mitarbeiter

Learning Control / Examinations
oE, 40 min

Conditions
quisites: none Recommendations

Learning Outcomes
The students have deepened knowledge in Project Management an Control. They know how to create, check, and avoid claims.

Content
In this module the knowledge in Project Management is deepened (e.g. commitment, new trends, ...) Examples out of practice facilitates the comprehension of difficult situations. Furthermore the students learn how to establish, reason, and calculate claims based on VOB. In addition to practical examples, claims will be checked with the help of the base calculation.

Remarks
Literature: ELWERT, Ulrich, Flassak, Alexander: Nachtragsmanagement in der Baupraxis - Grundlagen, Beispiele, Anwendung, Vieweg, 2., erw. und aktualisierte Aufl., Wiesbaden, 2008. WÜRFELE, Falk [Hrsg.]: Nachtragsmanagement - Leistungsbeschreibung, Leistungsabweichung, Bauzeitverzögerung, Werner, Neuwied, 2006. SCHERER, Holger: Integriertes Nachtragsmanagement - Verfahrenshandbuch für die Dokumentation von Behinderungen, Störungen und Nachtragssachverhalten auf der Grundlage der VOB, Zeittechnik-Verlag, Neu-Isenburg, 2001. HELLER, Jörg: Sicherung der Nachtragsvergütung nach VOB und BGB, Zeittechnik-Verlag, Neu-Isenburg, 2000. DIETHELM, G.: Projektmanagement, Band 1: Grundlagen, Verlag Neue Wirtschafts-Briefe, Herne, 2000 DIETHELM, G.: Projektmanagement, Band 2: Sonderfragen, Verlag Neue Wirtschafts-Briefe, Herne, 2001 ESCHENBRUCH, K.: Recht der Projektsteuerung, Werner Verlag, München, 2003 HAHN, R.: Projektmanagement für Ingenieure, Wiley-VCH Verlag, Weinheim, 2002 KERZNER, H.: Project Management - A Systems Approach to Planning, Scheduling and Controlling, Wiley & Sons, 2006 KOCHENDÖRFER, B., LIEBCHEN, J.: Bau-Projekt-Management, Verlag B. G. Teubner, Stuttgart, 2001 Project Management Institute: A Guide to the Project Management Body of Knowledge: PMBOK Guide, 2008 ROSENAU, M:, W.: Succesful Project Management, Van Norstrand Reinhold, New York, 1992 VOLKMANN, W.: Projektabwicklung, Verlag für Wirtschaft und Verwaltung Hubert Wingen, Essen, 2002

Module: Environmentally-friendly Recycling and Disassembly of Buildings [bauiM4S06-]

Coordination: S. Gentes
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6241826	(p. 276)	1/1	S	3	S. Gentes
6241828	(p. 329)	1/1	S	3	S. Gentes

Learning Control / Examinations
oE, 40 min

Conditions
quisites: none Recommendations

Learning Outcomes
The students are able to choose a disassembly procedure considering current case-law and guidelines and to select appropriate methods for different materials, e.g. concrete, bricking, wood, etc.

Content
This module gives an overview of statutory provisions and guidelines, current demolition and recycling methods, as well as disassembly machines. Current projects will be visited and a dismantling plan for selected practical cases will be developed within the frame of this module.

Remarks
Literature: 1) Seemann, Axel: Entwicklung integrierter Rückbau- und Recyclingkonzepte für Gebäude - ein Ansatz zur Kopplung von Demontage, Sortierung und Aufbereitung, Shaker, Aachen, 2003. 2) RAL, Deutsches Institut für Gütesicherung und Kennzeichnung e.V.: Ausbau und Entsorgung von Gefahrstoffen in Bauwerken - Gütesicherung, Beuth, Ausg. Juni 2004, Berlin, 2004. 3) Lippok, Jürgen [Red.]: Abbrucharbeiten - Grundlagen, Vorbereitung, Durchführung, Müller, 2., aktualisierte und erw. Aufl., Köln, 2007. 4) Zeiher, Marco: Ein Entscheidungsunterstützungsmodell für den Rückbau massiver Betonstrukturen in kerntechnischen Anlagen, Karlsruhe, Univ., Diss., 2009

Module: Upgrading of Existing Buildings and Energetic Refurbishment [bauiM4S07-]

Coordination: K. Lennerts
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6241901	(p. 143)	2/1	W	4,5	K. Lennerts, Mitarbeiter
6241903	(p. 179)	1	W	1,5	K. Lennerts, Mitarbeiter

Learning Control / Examinations
oE

Conditions
quisites: Recommendations

Learning Outcomes

Content

Module: Real Estate Management [bauiM4S08-]

Coordination: K. Lennerts
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6241904	(p. 279)	1	W	1,5	K. Lennerts, Mitarbeiter
6241905	(p. 278)	1	W	1,5	K. Lennerts, Mitarbeiter
6241906	(p. 272)	1	W	1,5	K. Lennerts, Mitarbeiter
6241907	(p. 172)	1	W	1,5	K. Lennerts, S. Beretitsch

Learning Control / Examinations
oE

Conditions
quisites: Recommendations

Learning Outcomes

Content

Module: Lean Construction [bauiM4S09-]

Coordination: N. N.*
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6241908	(p. 240)	2/2	W	6	N. N.*, Mitarbeiter

Learning Control / Examinations
oE, 40 min

Conditions
quisites: none Recommendations

Learning Outcomes
Development of basic Knowledge and understanding for the newest methods in planning and executing construction projects

Content
Basic philosophy and concepts of Lean Construction are presented. The understanding of those principles is facilitated through role plays and games. The most important methods of Lean Construction are presented and used. Lean Construction requires adapted and new forms of contracting. These are presented and explained. Case studies from all over the world will conclude the course.

Remarks
Literature: 1) A lot of literature can be found on the website: www.leanconstruction.org; 2) Collaborative Relationships in Construction by Hedley Smyth and Stephen Pryke, Wiley-Blackwell, 2008; 3) International Group for Lean Construction (IGLC) publishes the proceedings of the Annual Conference on the website: www.iglc.net

Module: Advanced Studies in Construction Engineering [bauiM4S10-]

Coordination: N. N.*
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6241910	(p. 319)	2	W	3	N. N.*, H. Schlick
6241911	(p. 315)	1	W	1,5	N. N.*, H. Schneider
6241913	(p. 184)	1	W	1,5	N. N.*, H. Schlick

Learning Control / Examinations
oE, 40 min

Conditions
quisites: none Recommendations

Learning Outcomes

Content

Module: Advanced Construction Equipment Technology [bauiM4S11-]

Coordination: S. Gentes
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6241914	(p. 246)	1/1	W	3	S. Gentes, Mitarbeiter
6241916	(p. 146)	2	W	3	S. Gentes, H. Schneider

Learning Control / Examinations
oE

Conditions
quisites: Recommendations

Learning Outcomes

Content

Module: Decommissioning of Nuclear Facilities [bauiM4S12-]

Coordination: S. Gentes
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6241917	(p. 174)	1/1	W	3	S. Gentes, Mitarbeiter
6241919	(p. 257)	1/1	W	3	S. Gentes, Mitarbeiter

Learning Control / Examinations
oE

Conditions
quisites: Recommendations

Learning Outcomes

Content

Module: Facility Management in Hospitals and Hospital Management [bauiM4S13-]

Coordination: K. Lennerts
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	2

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6241921	Facility Management in Hospitals (p. 191)	2/1	W	4,5	K. Lennerts, Mitarbeiter
	Hospital Management (p. 237)	1	S	1,5	S. Nickel

Learning Control / Examinations
graded:
Facility Management in Hospitals: term paper
Hospital Management: oral examination

Conditions
None.

Learning Outcomes

Content

Module: Building Preservation in Concrete and Masonry Constructions [bauiM4S14-]

Coordination: H. Müller, E. Kotan, G. Herold
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6211811	(p. 284)	2/1	W	4,5	E. Kotan, H. Müller
6211813	(p. 148)	1	W	1,5	H. Müller, E. Kotan, M. Vogel

Learning Control / Examinations
graded:
oral examination, 30 minutes

Conditions
None.

Learning Outcomes
After successful completion of the module, the students have detailed knowledge about the relevant causes and processes of degradation in concrete and masonry constructions. Thus they are able to take appropriate measures to enhance the durability of solid buildings and to plan and execute effective measures to repair damaged concrete and masonry constructions. Moreover the students have also the knowledge about the main aspects and basic techniques of building reinforcement.

Content
This course provides fundamental knowledge of the possibilities to preserve concrete and masonry constructions. Besides an introduction into the characteristics of masonry, plaster, concrete and reinforced concrete structures, various damage patterns and their origins are discussed. Based on the knowledge of the essential damage processes, efficient measures for the increase of the durability are described, which include material and constructional precautions as well as additional preventive measures. Furthermore the course focuses on the repair of already damaged concrete and masonry constructions. In this connection different research methods for the analysis of damages are presented and various possibilities are shown to predict the time-development of these damages. Finally repair materials as well as procedures are described which are necessary for the realization of a durable repair measure. A further main part of the course covers the different possibilities of an additional reinforcement of concrete and masonry constructions. Applicable materials and their characteristics in design and construction are introduced and discussed. In the accompanying exercises the subject matter shall independently be developed and the practical realization will be practised by means of several design problems.

Remarks
Literature: hand-out as well as (selection): [1] Blaich, J.: Bauschäden - Analyse und Vermeidung; EMPA; Stuttgart, 1999 [2] Pfefferkorn, W.: Rißschäden an Mauerwerk, Ursachen erkennen - Rißschäden vermeiden; Stuttgart, IRB Verlag, 1994 [3] Reichert, H.: Konstruktiver Mauerwerksbau, Bildkommentar zur DIN 1053-1, Rudolf Müller Verlag, Köln, 1999 [4] Ruffert, G.: Ausbessern und Verstärken von Betonbauteilen; 2. Aufl.; Beton Verlag, 1982 [5] SIVV - Handbuch: Schützen, Instandsetzen, Verbinden und Verstärken von Betonbauteilen; Verarbeiten von Kunststoffen im Betonbau beim Deutschen Beton- und Bautechnik-Verein E.V.; IRB Verlag, Stuttgart, 2008 [6] Stark, J.; Wicht, B.: Dauerhaftigkeit von Beton - Der Baustoff als Werkstoff, Hrsg.: Bauhaus-Univ. Weimar, F.A. Finger- Institut für Baustoffkunde -FIB-; 2001 [7] Tausky, R.: Betontragwerke mit Außenbewehrung; Birkhäuser Verlag, Basel, 1993

Module: Theoretical Soil Mechanics [bauiM5P1-THEOBM]

Coordination: T. Triantafyllidis
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6251801	Stress, Strain and Limit States in Soils (p. 295)	2/1	S	4,5	A. Niemunis
6251803	Triaxial Testing in Soil Mechanics (p. 167)	1	S	1,5	T. Wichtmann

Learning Control / Examinations
graded: examination “Theoretical Soil Mechanics”, written exam, 90 minutes, 6 CP

Conditions
None.

Recommendations
Module “Basics of Numerical Modelling”

Learning Outcomes
Understanding of the essential behaviour of soil under monotonic and cyclic load with and without effects of time regarding large and small deformations. Ability to describe mathematically and physically correct ralations in soil mechanics. Ability to understand the tensorial terminology of modern geotechnical literature. Self-dependent recognition of controlling mechanisms and limitations of simple engineering models. Decision, preparation and self-dependent execution of triaxial tests in soil mechanics, definition of adequate boundary conditions, Test evaluation, controlling and drawing of appropriate engineering conclusions.

Content
Geotechnical invariants of stress and strain, Failure criteria according to Coulomb, Matsuoka-Nakai etc., Contractancy and Dilatancy, Critical density, failure criteria according to Krey-Tiedemann, Soil behaviour under partial saturation, Collapse theorems and their application (Kinematic Element Analysis), Elasticity in soil mechanics (isotropic and anisotropic), Elastoplasticity with volumetric hardening using the example of the Cam-Clay-Model, Soil behaviour under cyclic loading, One-dimensional viscoplasticity. Test variants and boundary conditions, sample preparation methods, strain measurement, Typical stress-strain-relations for various soils (sand, gravel, silt, clay) for monotonous drained and undrained loading, Testing technique for cyclic loading, Strain accumulation for cyclic loading, pore water pressure accumulation (liquefaction) for undrained cyclic loading, Discussion of relevant influence quantities (pressure, void ratio, preload) on the soil behaviour for monotonous and cyclic loading.

Remarks
Literature: Niemunis (2009): Über die Anwendung der Kontinuumstheorie auf bodenmechanische Probleme (download)

Module: Earthworks and Foundation Engineering [bauiM5P2-ERDGB]

Coordination: T. Triantafyllidis
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6251701	Foundation Types (p. 213)	1/1	W	3	T. Triantafyllidis
6251703	Basics of Earthworks and Embankment Dams (p. 215)	1/1	W	3	A. Bieberstein

Learning Control / Examinations
graded:
examination “Earthworks and Foundation Engineering”, written exam, 90 minutes
preparatory assessment: approved term paper “Earth Dams and Foundation Engineering” (monitored by Institute)

Conditions
None.

Recommendations
Basic knowledge of Soil Mechanics and Foundation Engineering

Learning Outcomes
The students should be able to select and apply suitable methods for investigation, modelling, dimensioning, execution and control for geotechnical requirements of average complexity. Acquirement of competences in resolving geotechnical problems also with respect to managerial organization, expense budgeting, use of documents and presentation of results. Identification of relevant questions in earthworks and embankment dam engineering. Basic knowledge of design principles, construction materials, earthworks, seepage, erosion and suffusion stability as well as static calculations in dams which can be used independently in general outlines.

Content
Safety concepts in earthworks and foundation engineering, Project design for foundation problems, Frame constructions on partially soft soil, Bridge abutment and embankments on soft soil, Types of retaining constructions for a cut-and-cover metro tunnel, Quay wall structures with sheetpiles, Stabilization and drainage of embankments, Retaining constructions with structural slope stabilisation, Ground anchors, injections, underpinning and supporting, deformations of deep excavations, observation method. Cross section and longitudinal section of filled dams, requirements for zonation, Sealing, combined effects dam/subsoil, construction methods for seepage cuttoff, Building materials for dams with requirements and characteristics, construction of dams, Seepage and flow nets, flow cases with known and unknown boundarie, erosion, suffosion, piping, colmatation and joint erosion, Dam stability.

Remarks
Literature:
[1} Witt. K.J. (2008), Grundbau-Taschenbuch, Teil 1,
[2] Ernst & S. Smoltczyk, U. (2001), Grundbau-Taschenbuch, Teil 2-3,
[3] Ernst & S. Schmidt, H.G. & Seitz, J. (1998), Grundbau , Bilfinger & Berger

Module: Rock Mechanics and Tunneling [bauiM5P3-FMTUB]

Coordination: T. Triantafyllidis
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6251804	Stress, Strain and Limit States in Rock (p. 296)	1/1	S	3	E. Gerolymatou
6251806	Basics of Tunnel Construction (p. 217)	1/1	S	3	B. Fröhlich

Learning Control / Examinations
graded:
examination “Basics of Rock Mechanics and Tunneling”, written exam, 90 minutes
preparatory assessment: approved term paper “Rock Engineering” (monitored by Institute)

Conditions
None.

Recommendations
Basic knowledge of Engineering Geology

Learning Outcomes
Knowledge of essential strength and deformation properties of rock and of analytical methods for solving boundary value problems of surface and underground rock excavation. Application of fundamental methods of rock mechanics, static calculation and safety assessments on underground tunnel construction.

Content
Basics of petropraphy, rocks and rock mass, genity and tropy, Stress-strain-behaviour, Shear strength, compressive strength and tensile strength of compact and jointed rock, Basics and methods to determine compressibility parameters for rocks and rock mass, Circular tunnels in isotrope and biaxial primary stress fields (elastic), Circular tunnels in elastoplastic ground, Elliptical cross sections, shaft problem. Tunneling by drilling and blasting, driving by TBM, measuring technologies in tunnel construction, rock pressure and in-situ stress measurement, stresses in lining, Introduction to tunnel constructions (types and purposes), tunnel construction methods, Rock classification, Deformations, plastification, ground reaction line method, Ground water influence, Tunnel maintenance, repair and rehabilitation, Tunnel collapse mechanisms.

Remarks
Literature:
[1] Brady, B.H.G. & Brown, E.T. (2004), Rock Mechanics for Underground Mining, 3rd Ed.,
[2] Kluwer Kolymbas, D. (1998), Geotechnik - Tunnelbau und Tunnelmechanik, Springer

Module: Basics of Numeric Modelling [bauiM5P4-NUMGRUND]

Coordination: T. Triantafyllidis
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6251705	Course Continuum Mechanics for Geotechnics (p. 235)	1/1	W	3	T. Seelig
6251707	Course Numerics in Geotechnics (p. 260)	2	W	3	A. Niemunis

Learning Control / Examinations
graded:
oral examination, 45 minutes

Conditions
None.

Recommendations
BSc-Course "Introduction to Continuum Mechanics" or similar basic knowledge

Learning Outcomes
The purpose of this lecture is to familiarize with the general concepts of continuum mechanics (kinematics of deformation, balance relations, constitutive laws) as well as their application to engineering problems. Special emphasis is put on topics relevant in geotechnical applications. Knowledge of operative methods for the discretisation of typical differential equations (statics, consolidation, wave, seepage). Participants are aware of possible error of numerical computations and have decision-making ability in regard to the choice of commercial FE-Codes. Critical interpretation of FE-results.

Content
Kinematics of continuum deformation (general strain measures, geometrical linearization; balance relations for mass, linear momentum, angular momentum and energy; elasticity (isotropic and anisotropic constitutive laws); thermoelasticity; linear-elastic wave propagation (d'Alembert's solution, harmonic waves, dilatational waves, shear waves, surface waves); basic fracture mechanics; inelastic material behaviour (plasticity, viscoelasticity). Time dependent and time-independent numerical problems in soil mechanics, Finite difference method: Implicit and explicit solution of time-dependent differential equations, stability of the FD-scheme, Partial differential equations (consolidation, waves): numerical methods, stability, errors, Finite elements: weak form, discretization, boundary conditions according to Neumann and Dirichlet, Sample Finite Element computation for stationary two dimensional seepage flow, Finite Element computation for static equilibrium (2D), Locking, reduced integration, static condensation, Weak form of the consolidation equation and the GN-time integration, Material non-linearity, return-mapping and equilibrium iteration, Geometrical non-linearity, follower loads, simplified integration schemes, Introduction to the boundary-element-method.

Remarks
Literature:
[1] E. Becker, W. Bürger: Kontinuumsmechanik. Teubner, 1975
[2] J. Bonet, R.D., Wood: Nonlinear continuum mechanics for finite element analysis. Cambridge, 1997
[3] R. Greve: Kontinuumsmechanik. Springer, 2003
[4] L. Malvern: Introduction to the Mechanics of a Continuous Medium. Prentice Hall, 1969
[5] Th. Seelig: Kontinuumsmechanik. Skript zur Vorlesung
[6] Presss, W., e.a. (1992), Numerical Recipies, Cambridge Univ. Press

[7] Hughes, T.J.R. (2000): The FEM, Linear Static and Dynamic FE Analysis. Dover
[8] Bathe, K.-J. (200): Finite-Elemente-Methoden. Springer
[9] Smith, I.M.; Griffith, D.V. (2004): Programming the Finite Element Method. JWS
[10] Potts, D.M. Zdravkovic, L. (1999): Finite element analysis in geotechnical engineering. Thomas Telford Ltd
[11] Zienkewicz O.C. et.al. (2005): The Finite Element Method, Vol. 1, Wiley
[12] Hartmann, F. (1987): Methode der Randelemente, Springer

Module: Design and Construction of Components in Reinforced Concrete [bauiM5P5-BEMISTB]

Coordination: L. Stempniewski
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6211701	(p. 154)	2/2	W	6	L. Stempniewski

Learning Control / Examinations
graded: examination Design and Construction of Components in Reinforced Concrete, weighting acc. CP, written exam, 90 minutes

Conditions
None.

Recommendations
Basics of Reinforced Concrete

Learning Outcomes
Achieving a higher level of insight into complex subjects of reinforced concrete

Content
Design and Construction of Components, Design for bending and Torsion, Biaxial Bending, Punching, Truss Analogy

Remarks
Literature: Vorlesungsskriptum

Module: Special Issues of Soil Mechanics [bauiM5S01-SPEZBM]

Coordination: T. Triantafyllidis
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6251901	Soil as Viscous Multi-phase System (p. 337)	1/1	W	3	A. Niemunis, T. Wichtmann
6251903	Soil Dynamics (p. 144)	1/1	W	3	G. Huber

Learning Control / Examinations
graded: Examination “Special Issues of Soil Mechanics”, written exam, 90 minutes, 6 CP

Conditions
None.

Recommendations
Module “Theoretical Soil Mechanics”

Learning Outcomes
Enlargement of knowledge about mechanical, hydraulic and numerical tools to be able to handle specific soil mechanical problems. The students acquire the ability of operative handling with constitutive laws (recalculation and calibration of tests) and critical appraisal of results. Knowledge about the interrelation between hydraulic, mechanical and chemical processes for partial saturation. Overview of oscillations in the range from small strain tremors to earthquakes. In-depth knowledge of the standards, design recommendations and computational procedures for special geotechnical constructions with interaction of superstructure, foundation and subsoil. Structural knowhow, design rules and codes of practice shall be cross-linked with the theoretical knowledge basis about soil mechanics. Numerical tools commonly used in the design process and the ability to evaluate the applicability of their results shall be familiar.

Content
Hypoplastic constitutive laws (1D, 3D): Advantages, limitations, identification of parameters, Intergranular strain, Visco-hypoplasticity, application: creeping embankments with shead dowelling, Soils under cyclic load, high-cycle-model, Natural soils in comparison to idealized models, Phenomena of shear localization, Soil liquefaction, catastrophic soil avalanches, Chemism in soils, Sounding, soil penetration and contact problems, Hydraulic and mechanic properties of partly saturated soils, Recalculations of different element tests. Vibrations of systems with one degree of freedom, linear and non linear (time and frequency domain), Wave propagation in full and half space, also layered, Vibrations of rigid foundations (linear elastic, substructure method), Wave propagation (linear and linearised using adapted stiffness, numerical methods), Behaviour of soils under cyclic and dynamic loading: particle models, continuum models, Laboratory tests: resonant column test (RC), cyclic triaxial test, Wave propagation in real soils (influence of hysteretic material damping and increase of stiffness with depth), Effects related to saturated soil (cyclic mobility, liquefaction), 1D-wave propagation for earthquake loading: linearised model using program Shake including adapted stiffness, nonlinear using Hypoplasticity, Settlements caused by dynamic loading and transient loss of stiffness.

Remarks
Literature:

Module: Ground Investigation [bauiM5S02-BERKUND]

Coordination: T. Triantafyllidis
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6251808	Soil Mechanical Laboratory (p. 168)	2	S	3	G. Huber
6251809	Geomechanical Field Exercise (p. 207)	2	S	3	G. Huber

Learning Control / Examinations
graded:
Examination “Ground Investigation”, oral exam, 40 minutes

Conditions
None.

Learning Outcomes
Knowledge and self-dependent execution of standard tests in soil mechanics, definition of adequate boundary conditions, test evaluation, controlling and drawing of appropriate engineering conclusions. Knowledge of the most common geotechnical field testing methods in soil and rock in regard to planning, execution, evaluation and interpretation. Independent practical experience.

Content
Explanation, demonstration and execution of standard tests in soil mechanics: particle size distribution, state limits, water content, Density evaluation: limit densities, specific density, proctor test, Further lab tests: Oedometer (compressibility), simple shear, triaxial tests (drained, undrained), permeability. In-situ determination of density, dynamic probing, pressuremeter testing and vane shear test, Plate loading test, Inclinometer measurements, Exploratory drilling and sampling, sample handling and special samples, Survey of interface structures in rock (field exercise), evaluation and illustration of interface data, Choice of necessary laboratory tests according to the type, required sample quality and the testing boundary conditions, Subsoil and foundation report, expertise

Remarks
Literature:

Module: Applied Geotechnics [bauiM5S03-ANGEOTEC]

Coordination: T. Triantafyllidis
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6251810	Foundations and Retaining Structures (p. 212)	1/1	S	3	P. Kudella
6251812	Special Foundation Engineering and Design (p. 293)	1/1	S	3	P. Kudella

Learning Control / Examinations
graded:
Examination “Applied Geotechnics”, written exam, 90 minutes

Conditions
None.

Recommendations
Module “Earthworks and Foundation Engineering”

Learning Outcomes
Seld-dependent reasonable design decisions for pile foundations and excavations with regard to geological engineering, site managing and economical boundary conditions. In-depth understanding of the interaction between superstructure, foundation and subsoil. Structural know-how, design rules and codes of practice shall be cross-linked with the theoretical knowledge basis in soil mechanics. In-depth knowledge of the standards, design recommendations and computational procedures for special geotechnical constructions with interaction of superstructure, foundation and subsoil. Numerical tools commonly used in the design process and the ability to evaluate the applicability of their results shall be familiar.

Content
Pile types, Load bearing resistance and deformations of individual piles in axial and lateral direction, Negative skin friction, subgrade reaction, plastic flow resistance, Load bearing resistance and settlement of pile groups, Recommendations EA-Pfähle and pile tests, Pile raft design, Stress trapezoid, ground reaction and elastic halfspace method for slab foundations, Gravity walls, cantilever retaining walls, stone cages, space lattice walls, underpinning, Trench sheeting, timber sheeting, soldier pile walls, sheetpile walls, diaphragm walls, Anchoring and struts, dig-and-cast construction method, Bottom sealing and immersed troughs, grouted slabs, jetgrout slabs, underwater concrete, uplift piles and anchors. Combined pile-raft foundations, Caisson foundations, Geosynthetics and EBGEO recommendations on soil reinforcement, soil nailing, Recommendations EAB (load approaches, special shapes of excavations, excavations next to buildings, excavations in rock and soft soils), Buried structures, Numerical design and deformation prediction using elastic-beam models, Numerical design and deformation prediction, using elastioplastic FE-models, recommendations for modeling, 3D-FEM in examples, Recommendations EAU.

Remarks
Literature:
[1] Seitz, J. & Schmidt, H.-G. (2000), Bohrpfähle, Ernst & S.
[2] Triantafyllidis, Th. (1990), Planung und Bauausführung im Spezialtiefbau, Teil 1, Ernst & S.
[3] Weißenbach, A. (2001), Baugruben, Teil 1-3, Wiley
[4] EAPfähle 2. Aufl. (2012), Dt. Ges. f. Geotechnik, Ernst & S.
[5] EAB 5. Aufl. (2012), Deutsche Ges. f. Geotechnik, 4. Aufl., Ernst & S.
[6] EAU 11. Aufl. (2012), HTG und Deutsche Ges. f. Geotechnik, 10. Aufl., Ernst & S.

[7] EBGEO (2010), Deutsche Ges. f. Geotechnik, Ernst & S.
[8] Witt, J. Grundbau-Taschenbuch Teil 1-3, 7. Aufl. (2009), Ernst & S.

Module: Ground Water and Earth Dams [bauiM5S04-GWDAMM]

Coordination: T. Triantafyllidis
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6251814	Geotechnical Ground Water Problems (p. 208)	1/1	S	3	A. Bieberstein
6251816	Embankment Dams (Advanced) (p. 186)	1/1	S	3	A. Bieberstein

Learning Control / Examinations
graded:
Examination "Ground water and Earth Dams", written exam, 90 minutes

Conditions
None.

Recommendations
Module "Earthworks and Foundation Engineering"

Learning Outcomes
In-depth knowledge about different questions of ground water problems. Demonstration of the interrelations in sample calculations. In-depth study of Earthworks and Embankment Dams as well as of geotechnical construction technologies and verifications. Ability to develop self-dependent approaches for typical embankment dam construction problems.

Content
Investigation of the groundwater conditions, Geophysical exploration procedures, Overview of laboratory and field tests, Types and application possibilities of sounding equipment and measuring procedures, Permeability tests in the laboratory and in-situ, Air permeability of soils, Saturation and propagation of saturation fronts, Permeability anisotropy, Dewatering technologies, time scale of dewatering, dewatering along rivers, Dewatering effects, Seepage through dams and flow nets, load cases, underseepage of dams. Hydrologic and hydraulic design of dams, regulations for dams and embankments, Design of freeboard, slope stability concepts, proof of sliding stability Uplift stability, stress distribution in the dam base, spread stability, settlements, Hydraulic stability, seepage and flow nets, determination of the phreatic line, Erosion criteria, methods to prove inner erosion stability, Deformation of Embankments, safety against flaws, Earthquake design, Buried auxiliary structures, artificial sealings, asphalt concrete, Dams and embankments designed for overtopping.

Remarks
Literature:
[1] Cedergren, H.R. (1989), Seepage, Drainage, and Flow Nets, 3. Aufl. Wiley
[2] Herdt, W. & Arndts, E. (1985), Theorie und Praxis der Grundwasserabsenkung, 2. Aufl. Ernst & S.

Module: Rock Engineering and Underground Construction [bauiM5S05-FELSHOHL]

Coordination: T. Triantafyllidis
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6251905	Aboveground Rock Engineering (p. 194)	1/1	W	3	P. Kudella
6251907	Tunnel Construction in Soils and in Existence (p. 318)	1/1	W	3	B. Fröhlich, P. Kudella

Learning Control / Examinations
graded:
Examination “Rock Engineering and Underground Construction”, written exam, 90 minutes

Conditions
None.

Recommendations
Module “Rock Engineering and Tunneling”

Learning Outcomes
Overview of the planning, construction and design of safety systems for embankments and hillsides in rock. Recognition of critical failure mechanisms. Self-dependent realization of stability analysis and standard design exercises. In-depth and supplementary knowledge of strength and deformation properties of rocks as well as of rock testing in-situ and in laboratory. Knowledge of tunnel boring machines and the maintenance of tunnels. Outlook on tunnel boring in excursions.

Content
Types of rock slopes and failure mechanisms, Survey, analysis and interpretation of structural interface data (stereonet projection, rose diagram), Computational procedures for rock embankments: sliding, lateral buckling, rolling and jumping, Analytical computational procedures, Embankment construction: dismantling procedures, protection methods, retaining walls, anchors, Slope reinforcement: clearing, barrier fences, nets, monitoring systems. Tunnel sealing, tunnel lining, Rehabilitation of existing tunnels, safety analysis of existing tunnels, Open-face tunneling (cut-and-cover, sink tunnels, caisson tunnels) Tunneling shield machines, compressed air tunneling, Pipe and Frame jacking, Microtunneling and horizontal borings, Earth load, ground reaction and deformation prediction for surface-near tunneling in losse ground, Settlement compensation techniques

Remarks
Literature: Brady, B.H.G. & Brown, E.T. (2004), Rock Mechanics for Underground Mining, 3rd Ed., Kluwer

Module: Numerical Modelling in Geotechnics [bauiM5S06-NUMMOD]

Coordination: T. Triantafyllidis
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6251818	Exercises in Numeric Modelling (p. 322)	2	S	3	A. Niemunis
6251819	FEM Applications in Geotechnical Modelling (p. 195)	2	S	3	A. Niemunis

Learning Control / Examinations
graded:
Examination “Exercises in Numeric Modelling”, oral exam, 20 minutes, 3 CP
attested:
FEM Applications, presentation of a calculation example with colloquium, 3 CP

Conditions
None.

Recommendations
Module “Basics of Numeric Modelling

Learning Outcomes
Independent development of numerical approaches for typical boundary value problems. Practical realization (Fortran-Programming) of the FE-knowledge gained in “Numerics in Geotechnics”. Practical handling with the FE-Code ABAQUS (TM) for the modeling of geotechnical problems, exemplary application. Critical interpretation of the results of numerical simulations. Getting to know FE-Applications in different fields of geotechnics (foundation engineering, rock and tunnel engineering, embankment dam engineering).

Content
Beam on elastic half-space, Slope stability with layer procedure according to Bishop, 2D and 3D pile rafts, FE-modeling of spatially correlated fluctuations of soil parameters, Introduction to the FE-program ABAQUS (definition of joints and elements, assignment of material laws, definition of initial and boundary conditions), Examples of FE-applications in tunnel engineering, Numeric FE-modeling of a deep pit excavation under consideration of the construction sequence, Numeric FE-modeling of seepage through a zoned dam with partial saturation (different load cases)

Remarks
Literature:
[1] Smith, I.M.; Griffith, D.V. (2004): Programming the Finite Element Method. JWS
[2] ABAQUS for geotechnical problems
[3] Helwany, S. (2007) Applied Soil Mechanics with ABAQUS Applications, Wiley

Module: Geotechnical Testing and Measuring Technology [bauiM5S07-VERSMESS]

Coordination: T. Triantafyllidis
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6251909	Rock Testing (p. 335)	1	W	1,5	G. Huber
6251910	Testing in Dam and Wastefill Engineering (p. 187)	1	W	1,5	A. Bieberstein
6251911	Geotechnical Measuring Technology (p. 166)	1/1	W	3	G. Huber

Learning Control / Examinations
graded:
examination "Geotechnical Testing and Measuring Technolog", oral exam, 30 minutes

Conditions
None.

Learning Outcomes
In-depth understanding of the different procedures and methods for subsoil exploration and testing techniques (surpassing standard operations). Acquaintance with the special conditions for their application and the requirements of each procedure, choice of appropriate combinations. Basics knowledge about geophysical investigation methods. Basic knowledge of measuring methods and functional principles of sensors and data aquisition. Well-founded choice of suitable equipment in regard to limitation of resolution, accuracy, log-time-stability and interpretation. Familiarity using dataloggers, control elements, measuring and analysis precedures.

Content
Presentation of national and international standards for testing procedures, Basic measuring techniques in rock, Structure and function of testing devices, Selection and preparation of samples, Test execution (uniaxial and triaxial compression test, uniaxial and triaxial creep test, relaxation test, direct shear test, Brazilian test, swelling test, point load test, large-scale triaxial test, further index tests), Investigation of groundwater situation, Geophysica Exploration, Overview of lab and field tests for compressibility, shear resistance, permeability, filter tests, Rheological properties of suspensions, testing of densification and deformability. Measurement of physical quantities: displacement, strain, velocity, acceleration, force, pressure, stress, time, temperature, flow, moisture, Introduction to their measuring methods, sensors and limitations, Measuring electrical quantities: methods and devices, signal filtering, Optical measurements and correlation techniques using the example of the Particle-Image-Velocimetry (PIV), Development and analysis of a measurement chain from a physical quantity to a final reading, Influence of measurement on observed processes, influences of errors, noise e.g., Comparison of direct and compensating methods, Transmission of analogue and digital data, smart sensors, Methods of characterisation: time domain, frequency domain, state space. Description of dynamic measurement categories: time domain, frequency domain, state space, Control technology: concepts and application, Examples of measurements on construction site and in situ: anchor tests, measurement of settlement and inclination, stress measurement and borehole measurements in rock, Measurements in relation to the observational method (DIN1054), Training: electrical measuring, data acquisition, influence of noise, mounting of DMS to strain gauges, setup and test of a measurement chain for field measurements (anchor test or cone penetration test), density measurement

Remarks
Literature:

Module: Special Underground Engineering [bauiM5S08-SPEZTIEF]

Coordination: T. Triantafyllidis
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6251820	Ground Improvement, Grouting and Soil Freezing (p. 169)	1/1	S	3	W. Orth
6251822	Anchoring, Piling and Slurry Wall Technology (p. 135)	1/1	S	3	T. Triantafyllidis

Learning Control / Examinations
graded:
Examination “Ground Improvement, Grouting and Soil Freezing”, oral exam, 20 minutes
Examination “Anchoring, Piling and Slurry Wall Technology”, oral exam, 20 minutes

Conditions
None.

Learning Outcomes
Knowledge of the performance, ranges of application, necessary preliminary investigations and accompanying controls (monitoring) for special underground engineering technologies. The aim is to obtain the capability for independent selection of suitable procedures for certain tasks of building, establishment of necessary investigations, selection and definition of execution steps, indication of execution parameters, extent and kind of monitoring, quality management.

Content
Soil freezing: Brine and nitrogen cooling, Frost spreading under artificial and natural influence, frost heave and thaw settlement, Mechanical behavior of frozen soils, Mechanical and thermal calculation of simple frost bodies (underpinning and tunnel ring), monitoring, Grouting technology: Execution and application boundaries of injections, monitoring, Pore and gap injection, Soil fracturing, Jet grouting, Theory of the injections, characteristics of suspensions and solutions, Permeability and strength of injected soils, Soil improvement: Application areas, obtainable effects, monitoring, Deep vibro compaction, vibro replacement compaction, Dynamic (heavy) compaction. Bar, strand and pipe anchors, anchor drilling and mounting, Anchor tests, group effcets, dimensioning and design proofs, Piling and caisson technique, machines, suspension support, Slurry clays and testing, internal and external stability of open slurry trenches, corner trenches.

Remarks
Literature:

Module: Environmental Geotechnics [bauiM5S09-UMGEOTEC]

Coordination: T. Triantafyllidis
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6251913	Landfills (p. 321)	1/1	W	3	A. Bieberstein
6251915	Brownfield Sites - Investigation, Evaluation, Rehabilitation (p. 131)	2	W	3	A. Bieberstein, T. Neumann, H. Würdemann

Learning Control / Examinations
graded:
Examination “Landfills”, oral exam, 20 minutes
Examination “Brownfield Sites”, oral exam, 20 minutes

Conditions
None.

Learning Outcomes
Knowledge of the legal requirements regarding the depositing of waste. Presentation of the geotechnical concerns in the construction of landfill sites depending on the particular landfill classification, landfill elements, their relevant requirements and necessary certifications. Knowledge of the permitted limits for brown-fields. Interdisciplinary cross-linking of chemical, mineralogical, biological, hydraulic and geotechnical aspects of the treatment of brownfields. Knowledge of the relevant procedures of decontamination, their limitations and risks.

Content
Waste-situation and waste catalogue, Requirements from the authorities, legal basis, Planning landfill sites, Multibarrier system, Construction elements, Hydraulic analysis, Technical equipment for gas treatment of landfills, Statical analysis, Serviceability analysis, Construction, Special design solutions, strengthening of landfills. Introduction to the problematic of brownfields, Investigation and location assessment of brownfields, Harmful substances and their behavior in the environment, Environmental-chemical and mineralogical aspects of the accumulation of harmful substances in soil, Natural attenuation and active microbiological decontamination procedures, Reactive walls and electro-kinetic decontamination procedures, Soil washing, combustion, pyrolysis, immobilization and compression, Geotechnical aspects of the containment of industrial waste landfills, Hydraulic and pneumatic decontamination procedures, Case-studies, Excursion.

Remarks
Literature:

Module: Coupled Geomechanic Processes [bauiM5S10-GEKOPPRO]

Coordination: T. Triantafyllidis
Degree programme: Bauingenieurwesen (M.Sc.)
Subject:

ECTS Credits	Cycle	Duration
6	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
6251916	Time-dependent Phenomena in Hard Rock (p. 350)	1/1	W	3	T. Triantafyllidis, E. Gerolymatou
6251918	Coupled Phenomene in Geomechanics (p. 206)	1/1	W	3	E. Gerolymatou

Learning Control / Examinations
graded:
written examination “Coupled Geomechanic Processes”, 90 minutes

Conditions
None.

Recommendations
Module “Rock Engineering and Tunneling”

Learning Outcomes
In-depth and supplementary knowledge of strength and deformation properties of rocks as well as of rock testing in-situ and in laboratory.
Introduction to the basic physical and chemical phenomena that may alter the mechanical properties of geomaterials. Hydromechanical, chemomechanical, thermomechanical and biomechanical effects are considered. Ability to recognize the mechanisms involved from the physical point of view and express them mathematically.

Content
Extended material properties of rock:
Time-dependent material phenomena (swelling, creep),
Material anisotropy, scale effects,
Rock as multi-phase system (Biot theory)
Rock and fissure hydraulics, permeability,
Rock dynamics and basics of blasting techniques,
Rock drilling, cutting performance and bit consumption.

Coupled physical procedures in geomaterials: hydromechanical phenomena (effect of wetting, internal erosion, liquefaction, hydraulic fracturing), chemomechanical phenomena (dissolution, precipitation, swelling, solute transport), thermomechanical phenomena (heat production and transport, effect on mechanical properties, coupling to hydraulic effects) and biomechanical phenomena (effect of bacteria and flora)

Remarks
Literature: Brady, B.H.G. & Brown, E.T. (2004), Rock Mechanics for Underground Mining, 3rd Ed., Kluwer

2 Courses

2.1 All Courses

Course: Brownfield Sites - Investigation, Evaluation, Rehabilitation [6251915]

Coordinators: A. Bieberstein, T. Neumann, H. Würdemann
Part of the modules: Environmental Geotechnics (p. 129)[bauiM5S09-UMGEOTEC]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: [6211908]

Coordinators: J. Eckhardt, M. Vogel
Part of the modules: Durability and Service Life Design (p. 31)[bauiM1S25-DAUERLEB]

ECTS Credits	Hours per week	Term	Instruction language
1,5	1	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Appropriated Technologies [6223902]

Coordinators: E. Hoffmann
Part of the modules: Industrial Water Management (p. 73)[bauiM2S29-SW6]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Winter term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Applied Building Physics [6211909]

Coordinators: E. Kotan, Heiß
Part of the modules: Building Physics I (p. 33)[bauiM1S27-BAUPH-I]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Anchoring, Piling and Slurry Wall Technology [6251822]

Coordinators: T. Triantafyllidis
Part of the modules: Special Underground Engineering (p. 128)[bauiM5S08-SPEZTIEF]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Summer term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Facilities and Rolling Stock [6234802 / 6234803]

Coordinators: E. Hohnecker
Part of the modules: Track guided transport systems - basics of operating systems (p. 86)[bauiM3S07-EBBETRIEB]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Summer term	de

Learning Control / Examinations
See German version.

Conditions
See module description.

Learning Outcomes
See German version.

Content
stations and terminals for passengers and freight, basics of rolling stock and electrical drive

Remarks
See German version.

Course: [6215801]

Coordinators: T. Seelig
Part of the modules: Material Models in Solid Mechanics (p. 28)[bauiM1S22-MATTHEO]

ECTS Credits	Hours per week	Term	Instruction language
6	2/2	Summer term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: [6241701]

Coordinators: N. N.*, Mitarbeiter
Part of the modules: Construction Management and Work Planning (p. 96)[bauiM4P1-]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: [6211801]

Coordinators: L. Stempniewski
Part of the modules: Bracing and Stability in Reinforced Concrete (p. 7)[bauiM1S01-STABISTB]

ECTS Credits	Hours per week	Term	Instruction language
6	2/2	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Construction and Maintenance of Track Infrastructure [6234809]

Coordinators: E. Hohnecker, Mitarbeiter
Part of the modules: Dimensioning and construction of railway lines (p. 93)[bauiM3S14-EBBAU]

ECTS Credits	Hours per week	Term	Instruction language
1,5	1	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: [6241702]

Coordinators: N. N.*, Mitarbeiter
Part of the modules: Construction Management and Work Planning (p. 96)[bauiM4P1-]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Dynamics of Structures [6215701]

Coordinators: T. Seelig
Part of the modules: Surface Structures and Dynamics of Structures (p. 6)[bauiM1P3-FTW-BD]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: [6241901]

Coordinators: K. Lennerts, Mitarbeiter
Part of the modules: Upgrading of Existing Buildings and Energetic Refurbishment (p. 106)[bauiM4S07-]

ECTS Credits	Hours per week	Term	Instruction language
4,5	2/1	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Soil Dynamics [6251903]

Coordinators: G. Huber
Part of the modules: Special Issues of Soil Mechanics (p. 120)[bauiM5S01-SPEZBM]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: [6241704]

Coordinators: H. Schlick, H. Schneider
Part of the modules: Construction Equipment and Machinery (p. 97)[bauiM4P2-]

ECTS Credits	Hours per week	Term	Instruction language
4,5	2/1	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: [6241916]

Coordinators: S. Gentes, H. Schneider
Part of the modules: Advanced Construction Equipment Technology (p. 110)[bauiM4S11-]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: [6241804]

Coordinators: N. N.*, S. Gentes
Part of the modules: Economics and Management in Construction (p. 98)[bauiM4P3-]

ECTS Credits	Hours per week	Term	Instruction language
1,5	1	Summer term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: [6211813]

Coordinators: H. Müller, E. Kotan, M. Vogel
Part of the modules: Preservation and Rehabilitation of Concrete and Masonry Constructions (p. 32)[bauiM1S26-BBM], Building Preservation in Concrete and Masonry Constructions (p. 113)[bauiM4S14-]

ECTS Credits	Hours per week	Term	Instruction language
1,5	1	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: [6213903]

Coordinators: R. Görlacher
Part of the modules: Preservation of steel and timber structures (p. 17)[bauiM1S11-BAUING-BSH]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Winter term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Preservation of steel structures [6212909]

Coordinators: T. Ummenhofer
Part of the modules: Preservation of steel and timber structures (p. 17)[bauiM1S11-BAUING-BSH]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Determination of Demand, Timetable Construction and Alignment [6234810 / 6234811]

Coordinators: E. Hohnecker
Part of the modules: Traffic infrastructure (p. 95)[bauiM3S16-EBVERKEHR]

ECTS Credits	Hours per week	Term	Instruction language
4,5	2/1	Summer term	de

Learning Control / Examinations
The conjoined assessment of the lectures *Determination of demand, Timetable construction and Alignment* [6234810; 6234811] and *"Standardisierte Bewertung" in public transport using an example* [6234904] consists of an oral presentation and a written paper according §4(2), 3 of the examination regulation.
The mark consist of both parts of the assessment (66% of the mark of the presentation and 34% of the written paper).
The exam is offered each semester. The re-examination is offered upon prior agreement with the interested participants and not later than the next regular examination date.

Conditions
See module description.
The lecture is obligatory in the module *Project in Public Transportation*.

Recommendations
See module description.

Learning Outcomes
See German version.

Content
practise: urban traffic project: Planning and line-layouting

Remarks
See German version.

Course: [6211807]

Coordinators: L. Stempniewski
Part of the modules: Anchorage in Concrete (p. 11)[bauiM1S05-BEFTECH]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Summer term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: [6211905]

Coordinators: L. Stempniewski
Part of the modules: Anchorage in Concrete (p. 11)[bauiM1S05-BEFTECH]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: [6211701]

Coordinators: L. Stempniewski
Part of the modules: Design and Construction of Components in Reinforced Concrete (p. 4)[bauiM1P1-BEMISTB], Design and Construction of Components in Reinforced Concrete (p. 119)[bauiM5P5-BEMISTB]

ECTS Credits	Hours per week	Term	Instruction language
6	2/2	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Pavement Structural Design and Failure Analysis [6233905]

Coordinators: C. Karcher
Part of the modules: Road Construction (p. 85)[bauiM3S06-STRBAUT]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Methods and Models in Transportation Planning [6232701]

Coordinators: P. Vortisch, M. Kagerbauer
Part of the modules: Models and Methods in Traffic Engineering and Transportation Planning (p. 76)[bauiM3P2-VERMODELL]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Winter term	de

Learning Control / Examinations
The assessment consists of an oral exam (15 minutes) according to §4(2), 2 of the examination regulation.

Conditions
See module description.

Learning Outcomes

Content

Course: Special Topics in Highway Engineering [6233807]

Coordinators: R. Roos
Part of the modules: Special Topics in Highway Engineering (p. 92)[bauiM3S13-STRSPEZ]

ECTS Credits	Hours per week	Term	Instruction language
1,5	1	Summer term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: [6241819]

Coordinators: N. N.*, F. Kohlbecker
Part of the modules: Construction Process Engineering and Quality Management (p. 103)[bauiM4S04-]

ECTS Credits	Hours per week	Term	Instruction language
2	1	Summer term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: [6211809]

Coordinators: M. Haist, V. Kvitsel
Part of the modules: Concrete Construction Technology (p. 30)[bauiM1S24-BETONTECH]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Operation [6234801]

Coordinators: E. Hohnecker
Part of the modules: Track guided transport systems - basics of operating systems (p. 86)[bauiM3S07-EBBETRIEB]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Summer term	de

Learning Control / Examinations
See German version.

Conditions
See module description.

Learning Outcomes
See German version.

Content
Operation systems, signalling systems, operation schedule and timetable construction

Literature
Elective literature:
Fiedler: Grundlagen der Bahntechnik, Werner Verlag Düsseldorf
Pachl: Systemtechnik des Schienenverkehrs, Teubner-Verlag, Stuttgart

Remarks
See German version.

Course: Operation and Maintenance of Highways [6233802]

Coordinators: R. Roos
Part of the modules: Infrastructure Management (p. 77)[bauiM3P3-STRINFRA]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Summer term	de

Learning Control / Examinations
See module description.

Conditions
See corresponding module information.

Learning Outcomes

Content

Course: [6241809]

Coordinators: N. N.*
Part of the modules: Business and Human Resource Management (p. 100)[bauiM4S01-]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Operation Systems and Track Guided Infrastructure Capacity [6234804]

Coordinators: E. Hohnecker
Part of the modules: Track guided transport systems - operational logistics & management (p. 87)[bauiM3S08-EBLOGISTIK]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Summer term	de

Learning Control / Examinations
The assessment will consist of a oral exam (20 min) according to §4 (2), 1 of the examination regulation.
The exam is offered each semester. The re-examination is offered upon prior agreement with the interested participants and not later than the next regular examination date.

Conditions
See module description.

Learning Outcomes
See German version.

Content
Special signalling equipments, automatic driving, safety case, capacity of railway equpiments, dimensioning of marshaling yards.

Literature
Elective literature:
Fiedler: Grundlagen der Bahntechnik, Werner Verlag Düsseldorf
Pachl: Systemtechnik des Schienenverkehrs, Teubner-Verlag, Stuttgart

Remarks
See German version.

Course: Assessment and Evaluation Techniques [6232801]

Coordinators: P. Vortisch, B. Chlond
Part of the modules: Laws and Proceedings concerning Traffic and Roads (p. 79)[bauiM3P5-VERFRECHT]

ECTS Credits	Hours per week	Term	Instruction language
1,5	1/0	Summer term	de

Learning Control / Examinations
The assessment consists of an oral exam (15 minutes) according to §4(2), 2 of the examination regulation.

Conditions
None.

Learning Outcomes

Content

Course: Bioprocess Engineering [6225701]

Coordinators: J. Winter
Part of the modules: Mass Fluxes and Cycles (p. 44)[bauiM2P3-STK]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Geotechnical Measuring Technology [6251911]

Coordinators: G. Huber
Part of the modules: Geotechnical Testing and Measuring Technology (p. 127)[bauiM5S07-VERSMESS]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Triaxial Testing in Soil Mechanics [6251803]

Coordinators: T. Wichtmann
Part of the modules: Theoretical Soil Mechanics (p. 114)[bauiM5P1-THEOBM]

ECTS Credits	Hours per week	Term	Instruction language
1,5	1	Summer term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Soil Mechanical Laboratory [6251808]

Coordinators: G. Huber
Part of the modules: Ground Investigation (p. 121)[bauiM5S02-BERKUND]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Summer term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Ground Improvement, Grouting and Soil Freezing [6251820]

Coordinators: W. Orth
Part of the modules: Special Underground Engineering (p. 128)[bauiM5S08-SPEZTIEF]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: [6215903]

Coordinators: T. Seelig
Part of the modules: Fracture and Damage Mechanics (p. 27)[bauiM1S21-BRUCHMECH]

ECTS Credits	Hours per week	Term	Instruction language
6	2/2	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Computational Analysis of Structures [6214801]

Coordinators: W. Wagner
Part of the modules: Computational Analysis of Structures (p. 21)[bauiM1S15-CTWM]

ECTS Credits	Hours per week	Term	Instruction language
6	2/2	Summer term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: [6241907]

Coordinators: K. Lennerts, S. Beretitsch
Part of the modules: Real Estate Management (p. 107)[bauiM4S08-]

ECTS Credits	Hours per week	Term	Instruction language
1,5	1	Winter term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Data Analysis and Environmental Monitoring [6224805]

Coordinators: E. Zehe, J. Ihringer
Part of the modules: Data analysis and environmental monitoring (p. 48)[bauiM2S04-HY4]

ECTS Credits	Hours per week	Term	Instruction language
6	2/2	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: [6241917]

Coordinators: S. Gentes, Mitarbeiter
Part of the modules: Decommissioning of Nuclear Facilities (p. 111)[bauiM4S12-]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Winter term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: IT-based Road Design [6233901]

Coordinators: M. Zimmermann
Part of the modules: Highway Design (p. 84)[bauiM3S05-STRENTW]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Winter term	de

Learning Control / Examinations
See module description.

Conditions
See corresponding module information.

Learning Outcomes

Content

Course: Characteristics of Transportation Systems [6232806]

Coordinators: P. Vortisch
Part of the modules: Planning of Transportation Systems (p. 83)[bauiM3S04-VERPLAN]

ECTS Credits	Hours per week	Term	Instruction language
3	2/0	Summer term	de

Learning Control / Examinations
The assessment consists of an oral exam (15 minutes) according to §4(2), 2 of the examination regulation.

Conditions
See module description.

Learning Outcomes

Content

Course: Principles of Applied Ecology [6223807]

Coordinators: S. Fuchs
Part of the modules: Applied Ecology (p. 71)[bauiM2S27-SW4]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Transportation Data Analysis [6232901]

Coordinators: M. Kagerbauer, T. Streit
Part of the modules: Data Analysis and Transportation Modelling (p. 89)[bauiM3S10-VERDATAMOD]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Winter term	de

Learning Control / Examinations
The assessment consists of an oral exam (15 minutes) according to §4(2), 2 of the examination regulation.

Conditions
See module description.

Learning Outcomes

Content

Course: [6241903]

Coordinators: K. Lennerts, Mitarbeiter
Part of the modules: Upgrading of Existing Buildings and Energetic Refurbishment (p. 106)[bauiM4S07-]

ECTS Credits	Hours per week	Term	Instruction language
1,5	1	Winter term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: [6241816]

Coordinators: N. N.*, Mitarbeiter
Part of the modules: Environmental Engineering and Strategies for Energy Supply (p. 102)[bauiM4S03-]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Hydro Power Engineering [6222801]

Coordinators: P. Oberle
Part of the modules: Hydro Power Engineering (p. 55)[bauiM2S11-WB3]

ECTS Credits	Hours per week	Term	Instruction language
6	2/2	Summer term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Design and Construction of Highways [6233801]

Coordinators: R. Roos
Part of the modules: Infrastructure Management (p. 77)[bauiM3P3-STRINFRA]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Summer term	de

Learning Control / Examinations
See module description.

Conditions
See corresponding module information.

Learning Outcomes

Content

Course: Environmental Fluid Mechanics [6221907]

Coordinators: N.N.
Part of the modules: Environmental Fluid Mechanics (p. 63)[bauiM2S19-SM5]

ECTS Credits	Hours per week	Term	Instruction language
6	2/2	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: [6241913]

Coordinators: N. N.*, H. Schlick
Part of the modules: Advanced Studies in Construction Engineering (p. 109)[bauiM4S10-]

ECTS Credits	Hours per week	Term	Instruction language
1,5	1	Winter term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: [6211903]

Coordinators: L. Stempniewski
Part of the modules: (p. 10)[bauiM1S04-BAUDYN]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Winter term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Embankment Dams (Advanced) [6251816]

Coordinators: A. Bieberstein
Part of the modules: Ground Water and Earth Dams (p. 124)[bauiM5S04-GWDAMM]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Summer term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Testing in Dam and Wastefill Engineering [6251910]

Coordinators: A. Bieberstein
Part of the modules: Geotechnical Testing and Measuring Technology (p. 127)[bauiM5S07-VERSMESS]

ECTS Credits	Hours per week	Term	Instruction language
1,5	1	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Logistics, Supply and Disposal [6231805]

Coordinators: M. Jehling
Part of the modules: Space and Infrastructure (p. 81)[bauiM3S02-PLRAUMINF]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Summer term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Ethohydraulics [6222810]

Coordinators: B. Lehmann
Part of the modules: Nature-orientated river Engineering (p. 58)[bauiM2S14-WB6]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Experimental Methods [6221802]

Coordinators: Lang
Part of the modules: Experimental Techniques I: Small Scale Experiments (p. 59)[bauiM2S15-SM1]

ECTS Credits	Hours per week	Term	Instruction language
4,5	1/2	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Facility Management in Hospitals [6241921]

Coordinators: K. Lennerts, Mitarbeiter
Part of the modules: Facility Management in Hospitals and Hospital Management (p. 112)[bauiM4S13-]

ECTS Credits	Hours per week	Term	Instruction language
4,5	2/1	Winter term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: [6241808]

Coordinators: K. Lennerts
Part of the modules: Sustainability in Real Estate Management (p. 99)[bauiM4P4-]

ECTS Credits	Hours per week	Term	Instruction language
1,5	1	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: FE-Applications in Practical Engineering [6214803]

Coordinators: W. Wagner
Part of the modules: FE-Applications in Practical Engineering (p. 22)[bauiM1S16-FE-PRAXIS]

ECTS Credits	Hours per week	Term	Instruction language
6	2/2	Summer term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Aboveground Rock Engineering [6251905]

Coordinators: P. Kudella
Part of the modules: Rock Engineering and Underground Construction (p. 125)[bauiM5S05-FELSHOHL]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: FEM Applications in Geotechnical Modelling [6251819]

Coordinators: A. Niemunis
Part of the modules: Numerical Modelling in Geotechnics (p. 126)[bauiM5S06-NUMMOD]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Summer term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Long-distance and Air Traffic [6232904]

Coordinators: B. Chlond, N.N., Wilko Manz
Part of the modules: Intermodality in Long-distance, Freight and Air Transport (p. 90)[bauiM3S11-VERINTER]

ECTS Credits	Hours per week	Term	Instruction language
3	2/0	Winter term	de

Learning Control / Examinations
The assessment consists of an oral exam (15 minutes) according to §4(2), 2 of the examination regulation.

Conditions
None.

Learning Outcomes

Content

Course: [6241803]

Coordinators: K. Lennerts
Part of the modules: Economics and Management in Construction (p. 98)[bauiM4P3-]

ECTS Credits	Hours per week	Term	Instruction language
1,5	1	Summer term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: [6215905]

Coordinators: P. Betsch
Part of the modules: Finite Elements for Field and Time Dependent Problems (p. 37)[bauiM1S30-FE2]

ECTS Credits	Hours per week	Term	Instruction language
6	2/2	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Surface Structures [6214701]

Coordinators: W. Wagner
Part of the modules: Surface Structures and Dynamics of Structures (p. 6)[bauiM1P3-FTW-BD]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Surface Water Quality [6223805]

Coordinators: S. Fuchs
Part of the modules: Water Quality of Surface Water Bodies and Groundwater (p. 70)[bauiM2S26-SW3]

ECTS Credits	Hours per week	Term	Instruction language
4,5	1/2	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Fluid Mechanics of Turbulent Flows [6221806]

Coordinators: M. Uhlmann
Part of the modules: Turbulent Flows (p. 64)[bauiM2S20-NS1]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Summer term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Advanced Fluid Mechanics [6221701]

Coordinators: N.N.
Part of the modules: Advanced fluid mechanics (p. 42)[bauiM2P1-AFM]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Building- and Environmental Aerodynamics [6221905]

Coordinators: B. Ruck
Part of the modules: Interaction Flow - Building Structure (p. 60)[bauiM2S16-SM2]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Winter term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Building Theory [6231804]

Coordinators: Everts
Part of the modules: Urban Renewal (p. 80)[bauiM3S01-PLSTUMB]

ECTS Credits	Hours per week	Term	Instruction language
1,5	1	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Building Technology [6211910]

Coordinators: S. Wirth
Part of the modules: Building Physics I (p. 33)[bauiM1S27-BAUPH-I]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Coupled Phenomene in Geomechanics [6251918]

Coordinators: E. Gerolymatou
Part of the modules: Coupled Geomechanic Processes (p. 130)[bauiM5S10-GEKOPPRO]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Winter term	de

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Geomechanical Field Exercise [6251809]

Coordinators: G. Huber
Part of the modules: Ground Investigation (p. 121)[bauiM5S02-BERKUND]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Summer term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Geotechnical Ground Water Problems [6251814]

Coordinators: A. Bieberstein
Part of the modules: Ground Water and Earth Dams (p. 124)[bauiM5S04-GWDAMM]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: River Engineering [6222809]

Coordinators: B. Lehmann
Part of the modules: Nature-orientated river Engineering (p. 58)[bauiM2S14-WB6]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Aquatic Ecosystems [6224903]

Coordinators: C. Kämpf
Part of the modules: Aquatic Ecosystems (p. 50)[bauiM2S06-HY6]

ECTS Credits	Hours per week	Term	Instruction language
6	2/2	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Glass, plastic and cable structures [6212905]

Coordinators: D. Ruff
Part of the modules: Glass, plastic and cable structures (p. 15)[bauiM1S09- GlaKunSe]

ECTS Credits	Hours per week	Term	Instruction language
6	3/1	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Foundations and Retaining Structures [6251810]

Coordinators: P. Kudella
Part of the modules: Applied Geotechnics (p. 122)[bauiM5S03-ANGEOTEC]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Summer term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Foundation Types [6251701]

Coordinators: T. Triantafyllidis
Part of the modules: Earthworks and Foundation Engineering (p. 115)[bauiM5P2-ERDGB]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: [6241703]

Coordinators: S. Gentes, Mitarbeiter
Part of the modules: Construction Equipment and Machinery (p. 97)[bauiM4P2-]

ECTS Credits	Hours per week	Term	Instruction language
1,5	1	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Basics of Earthworks and Embankment Dams [6251703]

Coordinators: A. Bieberstein
Part of the modules: Earthworks and Foundation Engineering (p. 115)[bauiM5P2-ERDGB]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Winter term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: [6211803]

Coordinators: L. Stempniewski
Part of the modules: Basics of Prestressed Concrete (p. 8)[bauiM1S02-GDLSPANNB]

ECTS Credits	Hours per week	Term	Instruction language
6	2/2	Summer term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Basics of Tunnel Construction [6251806]

Coordinators: B. Fröhlich
Part of the modules: Rock Mechanics and Tunneling (p. 116)[bauiM5P3-FMTUB]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: [6215901]

Coordinators: P. Betsch
Part of the modules: Basis of Finite Elements (p. 26)[bauiM1S20-GRUNDFE]

ECTS Credits	Hours per week	Term	Instruction language
6	2/2	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Groundwater Quality [6221811]

Coordinators: U. Mohrlok
Part of the modules: Water Quality of Surface Water Bodies and Groundwater (p. 70)[bauiM2S26-SW3]

ECTS Credits	Hours per week	Term	Instruction language
1,5	1/0	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Groundwater Management [6221801]

Coordinators: U. Mohrlok
Part of the modules: Groundwater management (p. 52)[bauiM2S08-HY8]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Summer term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Freight Transport [6232808]

Coordinators: B. Chlond
Part of the modules: Intermodality in Long-distance, Freight and Air Transport (p. 90)[bauiM3S11-VERINTER]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Summer term	de

Learning Control / Examinations
The assessment consists of an oral exam (15 minutes) according to §4(2), 2 of the examination regulation.

Conditions
See module description.

Learning Outcomes

Content

Course: Hollow section structures [6212903]

Coordinators: S. Herion
Part of the modules: Hollow section structures (p. 14)[bauiM1S08-HOHLPROFIL]

ECTS Credits	Hours per week	Term	Instruction language
6	2/2	Winter term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: [6213803]

Coordinators: Sandhaas
Part of the modules: Timber and wood-based materials (p. 19)[bauiM1S13-BAUING-HHW]

ECTS Credits	Hours per week	Term	Instruction language
6	2/2	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: [6213801]

Coordinators: H. Blaß
Part of the modules: Timber structures (p. 18)[bauiM1S12-BAUING-HB]

ECTS Credits	Hours per week	Term	Instruction language
6	2/2	Summer term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: [6241810]

Coordinators: K. Lennerts, K. Janowski
Part of the modules: Business and Human Resource Management (p. 100)[bauiM4S01-]

ECTS Credits	Hours per week	Term	Instruction language
1,5	1	Summer term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Experimental Hydrology and Process Monitoring in Environmental Systems [6224807]

Coordinators: U. Scherer, U. Ehret
Part of the modules: Experimental hydrology and process monitoring in environmental systems (p. 49)[bauiM2S05-HY5]

ECTS Credits	Hours per week	Term	Instruction language
6	0/4	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Infrastructure Equipment of Railway Tracks [6234808]

Coordinators: E. Hohnecker, Mitarbeiter
Part of the modules: Dimensioning and construction of railway lines (p. 93)[bauiM3S14-EBBAU]

ECTS Credits	Hours per week	Term	Instruction language
1,5	1	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: examination Infrastructure Dimensioning and Railway Traffic [6234806]

Coordinators: E. Hohnecker, Mitarbeiter
Part of the modules: Dimensioning and construction of railway lines (p. 93)[bauiM3S14-EBBAU]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: [6241812]

Coordinators: N. N.*, S. Gentes
Part of the modules: Innovation in Construction Process Engineering - Case Studies (p. 101)[bauiM4S02-]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Summer term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: [6241801]

Coordinators: S. Gentes
Part of the modules: Economics and Management in Construction (p. 98)[bauiM4P3-]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: [6215910]

Coordinators: P. Betsch
Part of the modules: Model Formation in Strength of Materials and Theory of Kinetic Stability for Structures (p. 41)[bauiM1S34-MOFEKIST]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: [6215803]

Coordinators: A. Konyukhov
Part of the modules: Contact Mechanics I - Statics (p. 29)[bauiM1S23-KONTMECH-I]

ECTS Credits	Hours per week	Term	Instruction language
6	2/2	Summer term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: [6215907]

Coordinators: A. Konyukhov
Part of the modules: Contact Mechanics II - Dynamics (p. 38)[bauiM1S31-KONTMECH-II]

ECTS Credits	Hours per week	Term	Instruction language
6	2/2	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: [6215702]

Coordinators: T. Seelig, I. Schmidt
Part of the modules: (p. 39)[bauiM1S32-KONTIMECH]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Course Continuum Mechanics for Geotechnics [6251705]

Coordinators: T. Seelig
Part of the modules: Basics of Numeric Modelling (p. 117)[bauiM5P4-NUMGRUND]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: [6211907]

Coordinators: J. Eckhardt, M. Haist, M. Vogel
Part of the modules: Durability and Service Life Design (p. 31)[bauiM1S25-DAUERLEB]

ECTS Credits	Hours per week	Term	Instruction language
4,5	3	Winter term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Hospital Management []

Coordinators: S. Nickel
Part of the modules: Facility Management in Hospitals and Hospital Management (p. 112)[bauiM4S13-]

ECTS Credits	Hours per week	Term	Instruction language
1,5	1	Summer term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Cleaner Production – Closing the Loop [6223810]

Coordinators: E. Hoffmann
Part of the modules: Industrial Water Management (p. 73)[bauiM2S29-SW6]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Practical Laboratory Training in Road Construction [6233904]

Coordinators: C. Karcher
Part of the modules: Road Construction (p. 85)[bauiM3S06-STRBAUT]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: [6241908]

Coordinators: N. N.*, Mitarbeiter
Part of the modules: Lean Construction (p. 108)[bauiM4S09-]

ECTS Credits	Hours per week	Term	Instruction language
6	2/2	Winter term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: [6241807]

Coordinators: K. Lennerts, Mitarbeiter
Part of the modules: Sustainability in Real Estate Management (p. 99)[bauiM4P4-]

ECTS Credits	Hours per week	Term	Instruction language
1,5	1	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Management in Public Transport [6234805]

Coordinators: E. Hohnecker
Part of the modules: Track guided transport systems - operational logistics & management (p. 87)[bauiM3S08-EBLOGISTIK]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Summer term	de

Learning Control / Examinations
The assessment will consist of a oral exam (20 min) according to §4 (2), 1 of the examination regulation.
The exam is offered each semester. The re-examination is offered upon prior agreement with the interested participants and not later than the next regular examination date.

Conditions
See module description.

Learning Outcomes
See German version.

Content
See German version.

Remarks
See German version.

Course: [6211901]

Coordinators: L. Stempniewski
Part of the modules: Solid Construction Bridges (p. 9)[bauiM1S03-MASSBRUE]

ECTS Credits	Hours per week	Term	Instruction language
6	2/2	Winter term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Materials Testing in the Field of Concrete [6211913]

Coordinators: N. Herrmann
Part of the modules: Materials Testing and Measuring Techniques (p. 35)[bauiM1S29-MATPRÜF]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: [6215805]

Coordinators: T. Seelig
Part of the modules: (p. 39)[bauiM1S32-KONTIMECH]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: [6241914]

Coordinators: S. Gentes, Mitarbeiter
Part of the modules: Advanced Construction Equipment Technology (p. 110)[bauiM4S11-]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Winter term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Multi-Phase Flow [6222701]

Coordinators: F. Nestmann
Part of the modules: Dynamics of water and mass transport in river basins (p. 43)[bauiM2P2-WSF]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: [6215703]

Coordinators: T. Seelig, C. Ruck
Part of the modules: Laboratory Course on Structural Vibrations (p. 40)[bauiM1S33-MESSPRAK]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: [6215806]

Coordinators: T. Seelig, C. Ruck
Part of the modules: Laboratory Course on Structural Vibrations (p. 40)[bauiM1S33-MESSPRAK]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Measuring Techniques in Civil Engineering [6211911]

Coordinators: N. Herrmann
Part of the modules: Materials Testing and Measuring Techniques (p. 35)[bauiM1S29-MATPRÜF]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Practical use of numerical methods in fluid mechanics [6222903]

Coordinators: P. Oberle
Part of the modules: Practical use of numerical methods in fluid mechanics (p. 54)[bauiM2S10-WB2]

ECTS Credits	Hours per week	Term	Instruction language
6	2/2	Winter term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: [6215807]

Coordinators: P. Betsch
Part of the modules: Model Formation in Strength of Materials and Theory of Kinetic Stability for Structures (p. 41)[bauiM1S34-MOFEKIST]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Summer term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Modelling Mass Fluxes in River Basins [6223904]

Coordinators: S. Fuchs
Part of the modules: River Basin Modeling (p. 74)[bauiM2S30-SW7]

ECTS Credits	Hours per week	Term	Instruction language
3	0/2	Winter term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Morphodynamics [6222805]

Coordinators: B. Lehmann
Part of the modules: River dynamics (p. 57)[bauiM2S13-WB5]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Summer term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: [6241805]

Coordinators: K. Lennerts
Part of the modules: Sustainability in Real Estate Management (p. 99)[bauiM4P4-]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Summer term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: [6241822]

Coordinators: S. Gentes
Part of the modules: Advanced Project Management (p. 104)[bauiM4S05-]

ECTS Credits	Hours per week	Term	Instruction language
1,5	1	Summer term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: [6241919]

Coordinators: S. Gentes, Mitarbeiter
Part of the modules: Decommissioning of Nuclear Facilities (p. 111)[bauiM4S12-]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Non-linear Analysis of Surface Structures [6214903]

Coordinators: W. Wagner
Part of the modules: Non-linear Analysis of Surface Structures (p. 25)[bauiM1S19-NILI-FTW]

ECTS Credits	Hours per week	Term	Instruction language
6	2/2	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Non-linear Analysis of Beam Structures [6214702]

Coordinators: I. Münch
Part of the modules: Non-linear Analysis of Beam Structures (p. 20)[bauiM1S14-NILI-STAB]

ECTS Credits	Hours per week	Term	Instruction language
6	2/2	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Course Numerics in Geotechnics [6251707]

Coordinators: A. Niemunis
Part of the modules: Basics of Numeric Modelling (p. 117)[bauiM5P4-NUMGRUND]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Groundwater Modelling [6221901]

Coordinators: U. Mohrlok
Part of the modules: Groundwater management (p. 52)[bauiM2S08-HY8]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Winter term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Numerical Methods in Structural Analysis [6214901]

Coordinators: I. Münch
Part of the modules: Numerical Methods in Structural Analysis (p. 24)[bauiM1S18-FEM-BS]

ECTS Credits	Hours per week	Term	Instruction language
6	2/2	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Numerical Fluid Mechanics I [6221702]

Coordinators: M. Uhlmann
Part of the modules: Advanced fluid mechanics (p. 42)[bauiM2P1-AFM]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Numerical fluid mechanics II [6221809]

Coordinators: M. Uhlmann
Part of the modules: Advanced Computational Fluid Dynamics (p. 65)[bauiM2S21-NS2]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Summer term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Parallel programming techniques for engineering problems [6221807]

Coordinators: M. Uhlmann
Part of the modules: Advanced Computational Fluid Dynamics (p. 65)[bauiM2S21-NS2]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Summer term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Planning Techniques and Planning Methods [6231807]

Coordinators: S. Keller
Part of the modules: Space and Infrastructure (p. 81)[bauiM3S02-PLRAUMINF]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Wastewater analyses and application [6225801]

Coordinators: C. Gallert, J. Winter
Part of the modules: Wastewater Analyses in Practice (p. 66)[bauiM2S22-IB1]

ECTS Credits	Hours per week	Term	Instruction language
6	4	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: [6211805]

Coordinators: L. Stempniewski
Part of the modules: (p. 10)[bauiM1S04-BAUDYN]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Summer term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Practical Fire Protection [6211815]

Coordinators: H. Schröder
Part of the modules: Building Physics II (p. 34)[bauiM1S28-BAUPH-II]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Practical Noise Control [6211814]

Coordinators: R. Grigo
Part of the modules: Building Physics II (p. 34)[bauiM1S28-BAUPH-II]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: [6230901]

Coordinators: Assistenten
Part of the modules: Project “Integrated Planning” (p. 88)[bauiM3S09-PROJEKTIP]

ECTS Credits	Hours per week	Term	Instruction language
6	4	Winter term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: [6241906]

Coordinators: K. Lennerts, Mitarbeiter
Part of the modules: Real Estate Management (p. 107)[bauiM4S08-]

ECTS Credits	Hours per week	Term	Instruction language
1,5	1	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: [6241824]

Coordinators: N. N.*, Mitarbeiter
Part of the modules: Advanced Project Management (p. 104)[bauiM4S05-]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: [6241823]

Coordinators: G. Schlick
Part of the modules: Advanced Project Management (p. 104)[bauiM4S05-]

ECTS Credits	Hours per week	Term	Instruction language
1,5	1	Summer term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Highway design project study [6233903]

Coordinators: M. Zimmermann, R. Roos
Part of the modules: Highway Design (p. 84)[bauiM3S05-STRENTW]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: [6241826]

Coordinators: S. Gentes
Part of the modules: Environmentally-friendly Recycling and Disassembly of Buildings (p. 105)[bauiM4S06-]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: [6241821]

Coordinators: N. N.*, G. Schlick
Part of the modules: Construction Process Engineering and Quality Management (p. 103)[bauiM4S04-]

ECTS Credits	Hours per week	Term	Instruction language
1	1	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: [6241905]

Coordinators: K. Lennerts, Mitarbeiter
Part of the modules: Real Estate Management (p. 107)[bauiM4S08-]

ECTS Credits	Hours per week	Term	Instruction language
1,5	1	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: [6241904]

Coordinators: K. Lennerts, Mitarbeiter
Part of the modules: Real Estate Management (p. 107)[bauiM4S08-]

ECTS Credits	Hours per week	Term	Instruction language
1,5	1	Winter term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: [6241820]

Coordinators: N. N.*, Mitarbeiter
Part of the modules: Construction Process Engineering and Quality Management (p. 103)[bauiM4S04-]

ECTS Credits	Hours per week	Term	Instruction language
2	1	Summer term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Law Aspects of Guided Transport Systems [6234903]

Coordinators: E. Hohnecker
Part of the modules: Economics, law and environmental aspects in railway transportation (p. 94)[bauiM3S15-EBUMWELT]

ECTS Credits	Hours per week	Term	Instruction language
1,5	1	Winter term	de

Learning Control / Examinations
The assessment will consist of a oral exam (20 min) according to §4 (2), 1 of the examination regulation.
The exam is offered each semester. The re-examination is offered upon prior agreement with the interested participants and not later than the next regular examination date.

Conditions
See module description.

Learning Outcomes
See German version.

Content
Judical basics, law in european and national rail transportation, federal state law in public transport

Literature
Elective literature:
Kunz (Hrsg): Eisenbahnrecht, Nomos-Verlag, Baden-Baden

Remarks
See German version.

Course: Regional Planning [6231703]

Coordinators: W. Jung
Part of the modules: Urban and Regional Planning (p. 75)[bauiM3P1-PLSTAREG]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Shell Structures [6214805]

Coordinators: I. Münch
Part of the modules: Shell Structures and Stability of Structures (p. 23)[bauiM1S17-STABISHELL]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: [6211811]

Coordinators: E. Kotan, H. Müller

Part of the modules: Preservation and Rehabilitation of Concrete and Masonry Constructions (p. 32)[bauiM1S26-BBM], Building Preservation in Concrete and Masonry Constructions (p. 113)[bauiM4S14-]

ECTS Credits	Hours per week	Term	Instruction language
4,5	2/1	Winter term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: [6241813]

Coordinators: N. N.*, H. Schneider
Part of the modules: Innovation in Construction Process Engineering - Case Studies (p. 101)[bauiM4S02-]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Summer term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Seminar: Ecological Management of Water Bodies [6223901]

Coordinators: S. Fuchs
Part of the modules: Applied Ecology (p. 71)[bauiM2S27-SW4]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Seminar in Highway Engineering [6233908]

Coordinators: M. Zimmermann
Part of the modules: Road Safety (p. 91)[bauiM3S12-STRVSICH]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Seminar in Transportation [6232903]

Coordinators: P. Vortisch, B. Chlond
Part of the modules: Data Analysis and Transportation Modelling (p. 89)[bauiM3S10-VERDATAMOD]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter / Summer Term	de

Learning Control / Examinations
Non exam assessment (following §4(2), 3 of the examination regulation).

Conditions
See module description.

Learning Outcomes

Content

Course: Safety Management in Highway Engineering [6233906]

Coordinators: M. Zimmermann
Part of the modules: Road Safety (p. 91)[bauiM3S12-STRVSICH]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Winter term	de

Learning Control / Examinations
See module description.

Conditions
See corresponding module information.

Learning Outcomes

Content

Remarks
For further information, see http://www.ise.uni-karlsruhe.de/16.php

Course: Signal Processing in Fluid Mechanics [6221812]

Coordinators: B. Ruck
Part of the modules: Experimental techniques II: measurement techniques (p. 62)[bauiM2S18-SM4]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Summer term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Traffic Flow Simulation [6232804]

Coordinators: P. Vortisch
Part of the modules: Traffic Management und Simulation Methods (p. 82)[bauiM3S03-VERMANAGE]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Summer term	de

Learning Control / Examinations
The assessment consists of an oral exam (15 minutes) according to §4(2), 2 of the examination regulation.

Conditions
See module description.

Learning Outcomes

Content

Course: Simulations and analysis methods in Highway Engineering [6233806]

Coordinators: R. Roos, Mitarbeiter
Part of the modules: Special Topics in Highway Engineering (p. 92)[bauiM3S13-STRSPEZ]

ECTS Credits	Hours per week	Term	Instruction language
1,5	1	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Special Foundation Engineering and Design [6251812]

Coordinators: P. Kudella
Part of the modules: Applied Geotechnics (p. 122)[bauiM5S03-ANGEOTEC]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: [6241818]

Coordinators: N. N.*, F. Kohlbecker
Part of the modules: Construction Process Engineering and Quality Management (p. 103)[bauiM4S04-]

ECTS Credits	Hours per week	Term	Instruction language
1	1	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Stress, Strain and Limit States in Soils [6251801]

Coordinators: A. Niemunis
Part of the modules: Theoretical Soil Mechanics (p. 114)[bauiM5P1-THEOBM]

ECTS Credits	Hours per week	Term	Instruction language
4,5	2/1	Summer term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Stress, Strain and Limit States in Rock [6251804]

Coordinators: E. Gerolymatou
Part of the modules: Rock Mechanics and Tunneling (p. 116)[bauiM5P3-FMTUB]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Track Guided Transport Systems - Technical Design and Components [6234701 / 6234702]

Coordinators: E. Hohnecker
Part of the modules: Track guided transport systems - technical design & components (p. 78)[bauiM3P4-EBTECHNIK]

ECTS Credits	Hours per week	Term	Instruction language
6	3/1	Winter term	de

Learning Control / Examinations
See German Version.

Conditions
See module description.

Learning Outcomes
See German Version.

Content
Law and Organisation of track guided transport systems, basics of driving dynamics, dimensioning and construction of railway tracks, basics of railway facilities, basics of signalling

Literature
Zilch, Diederichs, Katzenbach, Beckmann (Hrsg): Handbuch für Bauingenieure, Springer-Verlag 2012

Course: Stability of Structures [6214807]

Coordinators: I. Münch
Part of the modules: Shell Structures and Stability of Structures (p. 23)[bauiM1S17-STABISHELL]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Summer term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Urban Management [6231801]

Coordinators: W. Jung
Part of the modules: Urban Renewal (p. 80)[bauiM3S01-PLSTUMB]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Summer term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Urban Planning [6231701]

Coordinators: B. Brester
Part of the modules: Urban and Regional Planning (p. 75)[bauiM3P1-PLSTAREG]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Winter term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: History of Urban Planning and the Built Environment [6231803]

Coordinators: J. Vogt
Part of the modules: Urban Renewal (p. 80)[bauiM3S01-PLSTUMB]

ECTS Credits	Hours per week	Term	Instruction language
1,5	1	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Steel and Composite Structures [6212801]

Coordinators: T. Ummenhofer
Part of the modules: Steel and Composite Structures (p. 5)[bauiM1P2-STAHLBAU]

ECTS Credits	Hours per week	Term	Instruction language
6	2/2	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Construction of steel and composite bridges [6212901]

Coordinators: T. Ummenhofer
Part of the modules: Construction of steel and composite bridges (p. 13)[bauiM1S07- STAHLBRÜ]

ECTS Credits	Hours per week	Term	Instruction language
6	2/2	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Material science, welding and fatigue [6212803]

Coordinators: T. Ummenhofer
Part of the modules: Material science, welding and fatigue (p. 12)[bauiM1S06-SCHWEISSEN]

ECTS Credits	Hours per week	Term	Instruction language
6	3/1	Summer term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Standard Valuation in Public Transport. Using an Example [6234904]

Coordinators: E. Hohnecker
Part of the modules: Traffic infrastructure (p. 95)[bauiM3S16-EBVERKEHR]

ECTS Credits	Hours per week	Term	Instruction language
1,5	0/1	Winter term	de

Learning Control / Examinations
The conjoined assessment of the lectures *Determination of demand, Timetable construction and Alignment* [6234810; 6234811] and *"Standardisierte Bewertung" in public transport using an example* [6234904] consists of an oral presentation and a written paper according §4(2), 3 of the examination regulation.
The mark consist of both parts of the assessment (66% of the mark of the presentation and 34% of the written paper).
The exam is offered each semester. The re-examination is offered upon prior agreement with the interested participants and not later than the next regular examination date.

Conditions
See module description.
The lecture is obligatory in the module *Project in Public Transportation*.

Recommendations
See module description.

Learning Outcomes
See German version.

Content
practise: urban traffic project: economic evaluation

Remarks
See German version.

Course: Steady and Unsteady-state Operation of Hydraulic Systems [6221804]

Coordinators: Lang, N.N.
Part of the modules: Technical Hydraulics (p. 61)[bauiM2S17-SM3]

ECTS Credits	Hours per week	Term	Instruction language
6	2/2	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Process Technologies in Storm Water Treatment [6223801]

Coordinators: S. Fuchs, E. Hoffmann
Part of the modules: Water Treatment Technologies (p. 68)[bauiM2S24-SW1]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Mass Fluxes [6223701]

Coordinators: S. Fuchs
Part of the modules: Mass Fluxes and Cycles (p. 44)[bauiM2P3-STK]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Mass Fluxes in River Basins [6223812]

Coordinators: S. Fuchs
Part of the modules: River Basin Modeling (p. 74)[bauiM2S30-SW7]

ECTS Credits	Hours per week	Term	Instruction language
3	2/0	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Traffic Engineering [6232703]

Coordinators: P. Vortisch
Part of the modules: Models and Methods in Traffic Engineering and Transportation Planning (p. 76)[bauiM3P2-VERMODELL]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Winter term	de

Learning Control / Examinations
The assessment consists of an oral exam (15 minutes) according to §4(2), 2 of the examination regulation.

Conditions
See module description.

Learning Outcomes

Content

Course: Flow Measuring Technique [6221703]

Coordinators: B. Ruck
Part of the modules: Experimental techniques II: measurement techniques (p. 62)[bauiM2S18-SM4]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Flow Behavior [6222807]

Coordinators: F. Seidel
Part of the modules: River dynamics (p. 57)[bauiM2S13-WB5]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Technical and economical management tools in Highway Engineering [6233805]

Coordinators: H. Rethage
Part of the modules: Special Topics in Highway Engineering (p. 92)[bauiM3S13-STRSPEZ]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Thermodynamics in Environmental Systems [6224901]

Coordinators: E. Zehe, U. Ehret
Part of the modules: Thermodynamics in environmental systems (p. 46)[bauiM2S02-HY2]

ECTS Credits	Hours per week	Term	Instruction language
6	2/2	Winter term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: [6241911]

Coordinators: N. N.*, H. Schneider
Part of the modules: Advanced Studies in Construction Engineering (p. 109)[bauiM4S10-]

ECTS Credits	Hours per week	Term	Instruction language
1,5	1	Winter term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: [6213901]

Coordinators: Frese
Part of the modules: Structures in steel and timber (p. 16)[bauiM1S10-BAUING-TSH]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Supporting steel structures [6212907]

Coordinators: T. Ummenhofer
Part of the modules: Structures in steel and timber (p. 16)[bauiM1S10-BAUING-TSH]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Tunnel Construction in Soils and in Existence [6251907]

Coordinators: B. Fröhlich, P. Kudella
Part of the modules: Rock Engineering and Underground Construction (p. 125)[bauiM5S05-FELSHOHL]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: [6241910]

Coordinators: N. N.*, H. Schlick
Part of the modules: Advanced Studies in Construction Engineering (p. 109)[bauiM4S10-]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Modelling of Turbulent Flows - RANS and LES [6221913]

Coordinators: M. Uhlmann
Part of the modules: Turbulent Flows (p. 64)[bauiM2S20-NS1]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Landfills [6251913]

Coordinators: A. Bieberstein
Part of the modules: Environmental Geotechnics (p. 129)[bauiM5S09-UMGEOTEC]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Winter term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Exercises in Numeric Modelling [6251818]

Coordinators: A. Niemunis
Part of the modules: Numerical Modelling in Geotechnics (p. 126)[bauiM5S06-NUMMOD]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Environmental Aspects of Guided Transport Systems [6234901]

Coordinators: E. Hohnecker
Part of the modules: Economics, law and environmental aspects in railway transportation (p. 94)[bauiM3S15-EBUMWELT]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter term	de

Learning Control / Examinations
The assessment will consist of a oral exam (20 min) according to §4 (2), 1 of the examination regulation.
The exam is offered each semester. The re-examination is offered upon prior agreement with the interested participants and not later than the next regular examination date.

Conditions
See module description.

Learning Outcomes
See German version.

Content
Active and passive noise protection, determination of sound emission, environmental aspects, quality in public transport, customer satisfaction and loyalty in long distance and local rail traffic

Remarks
See German version.

Course: Environmental Communication [6224905]

Coordinators: C. Kämpf
Part of the modules: Environmental Communication (p. 51)[bauiM2S07-HY7]

ECTS Credits	Hours per week	Term	Instruction language
6	2/2	Winter term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Environmental Impact Assessment [6233804]

Coordinators: R. Roos
Part of the modules: Laws and Proceedings concerning Traffic and Roads (p. 79)[bauiM3P5-VERFRECHT]

ECTS Credits	Hours per week	Term	Instruction language
1,5	1	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Urban Water Management [6220902]

Coordinators: S. Fuchs, P. Klingel, U. Mohrlok
Part of the modules: Urban Water Management (p. 69)[bauiM2S25-SW2]

ECTS Credits	Hours per week	Term	Instruction language
6	2/2	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Construction Methods in Environmental Engineering [6241814]

Coordinators: H. Schneider
Part of the modules: Environmental Engineering and Strategies for Energy Supply (p. 102)[bauiM4S03-]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Summer term	de

Learning Control / Examinations
The assessment consists of an oral exam (20 min.) taking place in the recess period (according to §4(2), 2 of the examination regulation).

Conditions
None.

Learning Outcomes
Students have specialized knowledge in important areas of environmental protection engineering in construction. They can plan and evaluate the use of construction methods based on fundamental knowledge about environmental protection.

Content
The lecture comprises

- Introduction, Overview and legal foundations of environmental protection engineering.
- Construction methods in environmental protection engineering.
- Landfill construction, technology and remediation.
- Sewer line and pipe remediation
- Remediation of contaminated sites and soil remediation.
- Groundwater remediation (event of damage, process engineering).
- Renewable resources in facility management.

Media
Lecture prints.

Course: Processing of wastes, excursions [6225802]

Coordinators: J. Winter, C. Gallert
Part of the modules: Technologies for solid waste management (p. 67)[bauiM2S23-IB2]

ECTS Credits	Hours per week	Term	Instruction language
6	2/2	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: [6241828]

Coordinators: S. Gentes
Part of the modules: Environmentally-friendly Recycling and Disassembly of Buildings (p. 105)[bauiM4S06-]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Summer term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Process Technologies in Water Supply and Wastewater Disposal [6223803]

Coordinators: E. Hoffmann
Part of the modules: Water Treatment Technologies (p. 68)[bauiM2S24-SW1]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: [6211810]

Coordinators: H. Müller, E. Kotan
Part of the modules: Concrete Construction Technology (p. 30)[bauiM1S24-BETONTECH]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Laws concerning Traffic and Roads [6233803]

Coordinators: D. Hönig
Part of the modules: Laws and Proceedings concerning Traffic and Roads (p. 79)[bauiM3P5-VERFRECHT]

ECTS Credits	Hours per week	Term	Instruction language
3	2/0	Summer term	de

Learning Control / Examinations
See module description.

Conditions
See corresponding module information.

Learning Outcomes

Content

Course: Traffic Management and Transport Telematics [6232802]

Coordinators: P. Vortisch
Part of the modules: Traffic Management und Simulation Methods (p. 82)[bauiM3S03-VERMANAGE]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Summer term	de

Learning Control / Examinations
The assessment consists of an oral exam (15 minutes) according to §4(2), 2 of the examination regulation.

Conditions
See module description.

Learning Outcomes

Content

Course: Waterway Engineering [6222803]

Coordinators: A. Kron
Part of the modules: Waterway Engineering (p. 56)[bauiM2S12-WB4]

ECTS Credits	Hours per week	Term	Instruction language
6	2/2	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Rock Testing [6251909]

Coordinators: G. Huber
Part of the modules: Geotechnical Testing and Measuring Technology (p. 127)[bauiM5S07-VERSMESS]

ECTS Credits	Hours per week	Term	Instruction language
1,5	1	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: [6241811]

Coordinators: R. Kohlhammer
Part of the modules: Business and Human Resource Management (p. 100)[bauiM4S01-]

ECTS Credits	Hours per week	Term	Instruction language
1,5	1	Summer term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Soil as Viscous Multi-phase System [6251901]

Coordinators: A. Niemunis, T. Wichtmann
Part of the modules: Special Issues of Soil Mechanics (p. 120)[bauiM5S01-SPEZBM]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: [geök-WB2-2b]

Coordinators: E. Zehe, U. Scherer
Part of the modules: Dynamics of water and mass transport in watersheds (p. 47)[bauiM2S03-HY3]

ECTS Credits	Hours per week	Term	Instruction language
6	2+2	Summer term	en

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Dynamics of Water and Mass Transport in Catchments [6224803]

Coordinators: E. Zehe, U. Scherer
Part of the modules: Dynamics of water and mass transport in watersheds (p. 47)[bauiM2S03-HY3]

ECTS Credits	Hours per week	Term	Instruction language
6	2/2	Summer term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Terrestrial Water Flows and Mass Transport [6224701]

Coordinators: E. Zehe
Part of the modules: Dynamics of water and mass transport in river basins (p. 43)[bauiM2P2-WSF]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Water Treatment [6223808]

Coordinators: E. Hoffmann
Part of the modules: Water Supply and Sanitation Systems and Plants (p. 72)[bauiM2S28-SW5]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Hydraulic Engineering Project [6220901]

Coordinators: Lang, B. Lehmann, F. Seidel
Part of the modules: Experimental Techniques I: Small Scale Experiments (p. 59)[bauiM2S15-SM1]

ECTS Credits	Hours per week	Term	Instruction language
1,5	0/1	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: [geök-WB2-2a]

Coordinators: J. Ihringer
Part of the modules: Water ressources and river basin management (p. 45)[bauiM2S01-HY1]

ECTS Credits	Hours per week	Term	Instruction language
6	2+2	Summer term	de

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Water Resources and River Basin Management [6224801]

Coordinators: J. Ihringer, U. Ehret
Part of the modules: Water ressources and river basin management (p. 45)[bauiM2S01-HY1]

ECTS Credits	Hours per week	Term	Instruction language
6	2/2	Summer term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Water Distribution [6222905]

Coordinators: P. Klingel
Part of the modules: Water Supply and Sanitation Systems and Plants (p. 72)[bauiM2S28-SW5]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Studies of Development Projects in Water Resources Management [6222901]

Coordinators: F. Nestmann
Part of the modules: Studies of Development Projects in Water Resources Management (p. 53)[geök-WB1-4]

ECTS Credits	Hours per week	Term	Instruction language
6	2/2	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Interaction Flow-Building Structure [6221903]

Coordinators: Lang
Part of the modules: Interaction Flow - Building Structure (p. 60)[bauiM2S16-SM2]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Winter term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Tendering, Planning and Financing in Public Transport [6232807]

Coordinators: W. Weißkopf
Part of the modules: Planning of Transportation Systems (p. 83)[bauiM3S04-VERPLAN]

ECTS Credits	Hours per week	Term	Instruction language
3	2/0	Summer term	de

Learning Control / Examinations
The assessment consists of an oral exam (15 minutes) according to §4(2), 2 of the examination regulation.

Conditions
See module description.

Learning Outcomes

Content

Course: Economic Efficiency of Guided Transport Systems [6234902]

Coordinators: E. Hohnecker
Part of the modules: Economics, law and environmental aspects in railway transportation (p. 94)[bauiM3S15-EBUMWELT]

ECTS Credits	Hours per week	Term	Instruction language
1,5	1	Winter term	de

Learning Control / Examinations
The assessment will consist of a oral exam (20 min) according to §4 (2), 1 of the examination regulation.
The exam is offered each semester. The re-examination is offered upon prior agreement with the interested participants and not later than the next regular examination date.

Conditions
See module description.

Recommendations
See module description.

Learning Outcomes
See German version.

Content
basics of economy, accounting and finance, financing of investments, demand and offer for transportation, transportation market, transport policy

Remarks
See German version.

Course: Time-dependent Phenomena in Hard Rock [6251916]

Coordinators: T. Triantafyllidis, E. Gerolymatou
Part of the modules: Coupled Geomechanic Processes (p. 130)[bauiM5S10-GEKOPPRO]

ECTS Credits	Hours per week	Term	Instruction language
3	1/1	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content