TECHNISCHE UNIVERSITÄT DRESDEN

Faculty of Civil Engineering

CIVIL ENGINEERING

TU DRESDEN

ECTS

EUROPEAN CREDIT TRANSFER SYSTEM

July 2010

CONTENTS

1 PREFACE

Dear prospective students,

the Faculty of Civil Engineering is very proud to offer you an elaborated curriculum for the education in civil engineering. We warmly invite you to choose the Technische Universität Dresden for your study abroad.

There are many possibilities to apply for the enrolment at our faculty namely the "Doppeldiplom" from ESTP Paris, INSA Strasbourg, Università degli Studi di Trento e.g. and the international exchange programs on the basis of Erasmus, Socrates, Tempus or others. If your personal desire is to study in Dresden, we as well would be very glad to contribute to your education. Since many years there exists an European agreement about the acceptance of foreign education. To enable an easier transfer of merits you have obtained at an European university, the ECTS-System (European Credit Transfer System) has been introduced. This is an opportunity to compare the effort and the goals of individual courses you take even in the case you don't graduate at the hosting university with a bachelor or masters degree as it is intended within the so called Bologna Process. The following document will give you a brief description of the Faculty of Civil Engineering at the Technische Universität Dresden and of the offered curriculum. The main part of this document will be a description of the individual courses.

For those of you who are not familiar with the ECTS-System, a short explanation of the main aspects will be included within the introductory chapter as well.

Hoping to see you soon in Dresden.

Prof. Dr.-Ing. habil. Bernd W. Zastrau
Dean of Student Affairs

2 GENERAL INTRODUCTION

This information package describes the Faculty of Civil Engineering at the Technische Universität Dresden and its courses in order to help the prospective ECTS student to prepare for his/her study period in this institution.

What is ECTS?

ECTS, the European Credit Transfer System, was developed by the Commission of the European Union in order to provide common procedures to guarantee academic recognition of studies abroad. It provides a way of measuring and comparing learning achievements and transferring them from one institution to another.

Credits and Modules

ECTS credits are a value allocated to modules to describe the student workload required to complete them. They reflect the quantity of work each module requires in relation to the total quantity of work necessary to complete a full year of academic study at the institution, which includes lectures, practical work, seminars, private work and examinations or other assessment activities.

In ECTS, 60 credits represent the workload of a year of study or 30 credits for a semester. It is important that no special modules are set up for ECTS purposes, but that all ECTS courses are mainstream modules of the participating institutions, followed by native students under normal regulations. Credits are awarded only when the modules have been completed and all required examinations have been successfully taken.

ECTS-Students

The students participating in ECTS will receive full credit for all academic work successfully carried out at any of the ECTS partner institutions and they will be able to transfer these academic credits from one participating institution to another as long as there is prior agreement between the institutions involved.

Most students participating in the ECTS will go to one host institution in an EU member state or EFTA country, study there for a limited period of time and then return to their home institution. Some may decide to stay at the host institution and finish their degree there. Some may also decide to proceed to a third institution to continue their studies. In each of these three cases, students will be required to comply with the legal and institutional requirements of the country and institution where they take their degree.

When the student returns and has successfully completed the study programme previously agreed between the home and host institutions, credit transfer will then take place, and the student will continue the study courses at the home institution without any loss of time or credit. If the student decides to stay at the host institution and to take his/her degree there, he/she may have to adapt his/her study course to the legal, institutional and departmental rules in the host country, institution and department.

For more details on ECTS, please contact:

http://tu-dresden.de/studium/internationales/ects

ECTS Department, Erasmus Bureau, Rue Montoyer 70, B-1040 BRÜSSEL
Tel.: 0032/2/2330111, Fax: 0032/2/2330150

3 INFORMATIONS ABOUT THE UNIVERSITY

3.1 Institution

Technische Universität Dresden
Helmholtzstraße 10
01069 DRESDEN

3.2 Institutional ECTS-Coordinator

Mrs. Dagmar Krause
Office address: Mommsenstraße 10/12, Toepler-Bau, Room Number 219
Phone: 0049/351/463-34698
E-Mail: Dagmar.Krause@tu-dresden.de

3.3 Academic Calendar

The academic year is divided into a winter and a summer semester. Each semester includes 15 weeks for teaching and 4 weeks for examinations. Additional there are several weeks intended for scientific work.

Winter semester (WS) 01.10.-31.03.
Summer semester (SS) 01.04.-30.09.

The modules of the winter semester are starting during October and last until February, followed by exams. The courses of the summer semester are starting during April and last until July, also followed by exams. Actual data you will obtain from http://tu-dresden.de/studium/organisation/studienjahresablauf.

Technische Universität Dresden publishes a calendar for each semester, called "Vorlesungsverzeichnis". This files modules, courses and lectures of the respective semester, together with date, time, location and the teaching professor. It can be purchased at the university and in local bookstores.

3.4 General Description

Dresden, the capital of the Freistaat Sachsen, counts at present about 500.000 inhabitants. Dresden as a city of art and culture is held in international esteem. It is situated bothsides of the river Elbe in a flat wide valley bordered with lovely hills. The historic centre with its famous buildings and rich collections of fine old and new arts is the heart of the cultural life. The ensemble of the Zwinger, the traesury collection "Grünes Gewölbe", the picture gallery "Alte Meister" with its most famous painting Sixtine Madonna by Raphael, the Semperoper and the Frauenkirche are a must of knowledge for european culture. Dresden is easily accessible by plane, by train as well as via the motorway.

In the surroundings of Dresden are many sights of international format. The historic city of Meissen is located some 20 km north-west down the Elbe and is famous as the birthplace of the European porcelain. South-east of Dresden, the mountains of saxonian swiss rise on both sides of the river Elbe, a beautiful landscape with canyons of sandstone rocks and meadows. As Dresden is located in the south-east of Germany, weekend excursions into the attractive landscapes of the Czech Republic and Poland can easily be arranged.

Technische Universität Dresden is one of the oldest technical universities in Germany and is justifiably proud of its fine tradition in education. The large

campus just south of the city centre and also the extended area of the Faculty of Medical Science form integral parts of the city of Dresden. Originally founded as a technical college in 1828, it was awarded the status of a Technical Academy in 1890 and in 1961 was recognized as a University of Technology. Famous scholars established the international reputation of Technische Universität Dresden, among them:

- Wilhelm Gotthelf Lohrmann (1796-1840), cartographer, astronomer and meteorologist,
- Johann Andreas Schubert (1808-1870), engineer and designer of the first German steam locomotive,
- Gustav Zeuner (1829-1907), founder of technical thermodynamics and longserving director of the Royal Saxon Polytechnic,
- Hubert Engels (1854-1945), founder of the first stationary laboratories for river research,
- Fritz Foerster (1866-1931); under his direction the laboratory of electrochemistry was extended and become the Institute for Electrochemistry and Physical Chemistry,
- Kurt Beyer (1881-1952), structural engineer and bridge designer,
- Viktor Klemperer (1881-1960), specialist for Romance and Germanic literatures.

After 1990 there were some structural changes in the landscape of education and sciences of Dresden. Some new faculties have been added to the traditionals of sciences and engineering. These include economics, humanities, social sciences and medicine. As a result the range of research and educational possibilities offered by TUD has broadened and is quite unique in Germany.

The Dresden University of Technology consists of fourteen faculties:

- Mathematics and Natural Science
- Arts, Humanities and Social Science
- Linguistics, Literature and Cultural Studies
- Education
- Law
- Business and Economics
- Computer Science
- Electrical Engineering and Information Technology
- Mechanical Engineering
- Civil Engineering
- Architecture
- Transport and Traffic Sciences "Friedrich List"
- Forest, Geo and Hydro Sciences
- Medicine "Carl Gustav Carus"

Each faculty is responsible for the correct realization of the respective courses of study. Faculties are subdivided into institutes that carry out teaching and research.

The student population at Dresden University of Technology counts at present about 35.000, 10 percent of them are foreign students from about 120 countries. The faculty of Civil Engineering counts about 1000 students in direct studies, roughly 100 of them are foreign students.

The following central institutions are serving the entire university:

- University Library (SLUB)
- Center for Information Technologie Services and High Performance Computing (ZIH)
- Teaching Centre for Languages and Area Studies (LSK)
- University Sports Centre (USZ)

3.5 Admission and Registration Procedures

Students wanting to study at Dresden University of Technology within the framework of the ECTS programme are recommended to contact the respective SOCRATES or ECTS coordinator of their home university. ECTS-application forms should be sent as early as possible to the Institutional Coordinator of Technische Universität Dresden, i.e. to

Technische Universtität Dresden
International Office
01062 DRESDEN
http://tu-dresden.de/internationales/akademisches_auslandsamt

Please note that, in accordance with ERASMUS/SOCRATES regulations, no tuition fees are charged. However, all the students, including ECTS-students, are requested to pay a semester fee of currently 169,70 EUR. This amount is made up of a contribution to the "Studentenrat" (student council), a contribution to the "Studentenwerk" (housing administration and cultural affairs) and, above all, the price for a semester ticket valid for the entire public transport system of Dresden (tramways and busses).

3.6 Language Requirements

It is recommended that ECTS students have a good command of the German language already before they come to Dresden in order to follow courses, take part in the general conversation and in special discussions and pass the examinations in German. To raise the level of their German language proficiency Technische Universität Dresden offers several language courses. For further information see http://www.tu-dresden.de/sulifg/daf/home.htm.

Please also note that during international summer courses run at TUD in August / September, also German language classes for international students are offered. For further information please contact TUDIAS (TU Dresden Institute of Advanced Studies),
http://www.tudias.de/de/Startseite.html.

For regular registration for full-time study at TUD different regulations apply regarding both access and language requirements. Further informations can be obtained from the International Office.

3.7 Accomodation, Board, Leisure

The Student Services Organization (Studentenwerk) is located in the vicinity of the campus. It is in charge of the social and cultural welfare of the students. The office is located at:

Studentenwerk Dresden
Fritz-Loeffler-Straße 18
01069 DRESDEN
Phone: 0049/351/4697-50
Fax: 0049/351/4718154
E-mail: info@swdd.tu-dresden.de
http://www.studentenwerk-dresden.de/

The Studentenwerk provides accommodation in halls of residences of various categories and price levels. The typical room is designed for double occupancy. All halls are either in direct vicinity of the campus or easily accessible by public transport. ECTS-students get the application forms for the halls via the International Office. For the time being, ECTS-students can be sure to be granted a place in the dormitories.

At the university, several refectories and cafeterias offer breakfast, lunch and snacks at modest prices (approx. 2,50 EUR per meal). Students themselves have to take care of dinner and meals on weekends. This is why all the dormitories are equipped with cooking facilities.

The university hosts many choices of sports not only inside the campus training centre (Universitätssportzentrum). Some sections like climbing and sailing are also active in the beautiful surroundings. Furthermore there are about 15 student clubs with a large variety of social events, concerts, film sessions etc. In addition, the International Office organizes numerous events, excursions and gatherings, together with the German and the foreign students.

3.8 Visa Requirements

There are no special visa requirements for ECTS-students from EU-countries. Necessary formalities regarding permits of residence and other related issues are then taken care of during registration. For further details, especially concerning countries requiring visa, see International Office of the Technische Universität Dresden: http://tu-dresden.de/internationales/akademisches_auslandsamt.

3.9 Health Insurances

Foreign students must have an insurance in their home country that also covers the stay in Germany. Otherwise they have to join a German insurance plan upon registration. For further details see International Office of the Technische Universität Dresden http://tu-dresden.de/internationales/ akademisches_auslandsamt. Students are advised to effect a liability insurance.

3.10 Cost of Living

The comparatively low costs of living in Dresden amount to approx. € 600 per month.

Further information is available under http://tu-dresden.de/internationales/ects.

4 INFORMATIONS ABOUT THE FACULTY

4.1 The Faculty

Faculty of Civil Engineering
Technische Universität Dresden
Dean: Prof. Dr.-Ing. Rainer Schach

Postal address: 01062 DRESDEN

Place of Dean: Beyer-Bau, Room 62d
George-Bähr-Straße 1
01069 DRESDEN
Phone: 0049/351/463-32336
Fax: 0049/351/463-37104

4.1.1 Faculty ECTS-Coordinator

Prof. Dr.-Ing. habil. Ulrich Häußler-Combe
Institute of Concrete Structures
Phone: 0049/351/463-39586
Fax: 0049/351/463-37279

4.1.2 Description of the Faculty

The faculty of Civil Engineering offers a broad range of civil engineering studies. The faculty has its own computing center and includes 11 institutes, which are shortly described in the following.

Institutes of the faculty of Civil Engineering:

- Institute of Mechanics and Shell Structures
- Institute of Construction Materials
- Institute of Construction
- Institute of Geotechnology
- Institute of Urban Engineering & Road Construction
- Institute of Construction Management
- Institute of Hydraulic Engineering and Technical Hydromechanics
- Institute of Construction Informatics
- Institute of Structural Analysis
- Institute of Concrete Structures
- Institute of Steel and Timber Construction

Institute of Mechanics and Shell Structures

Prof. Dr.-Ing. habil. Bernd W. Zastrau

In the institute students of civil engineering, water economy/hydrology and economics are educated.

Most important fields of instruction:
- engineering mechanics (elementary mechanics and theory of strength of materials)
- theory of discs and plates
- theory of shells
- special topics in engineering science and mechanics

Focal points in research:
- numerical analysis of plates and shell structures
- mechanics of materials
- damage and fracture mechanics
- contact problems
- structural dynamics
- numerical and computational methods in engineering mechanics

An efficient computer laboratory is at disposal for the students to deal with training and education (project work, diploma thesis) and with subjects of research.

Institute of Construction Materials

Prof. Dr.-Ing. Viktor Mechtcherine

The lectures of the Institute of Construction Materials are offered the students of the following faculties: Civil Engineering, Architecture, Education, Business and Economic sciences as well as Forest, Geo and Hydro Sciences.

The main topics of lectures include:
- discussion of all types of building materials and their morphological structure
- load dependent and load independent properties of building materials
- description of damage processes and the durability of building materials
- selected problems of building materials – repair materials.

The institute fundamental research is done in the fields of:
- concrete and its components
- textile reinforced concrete
- durability
- bond behaviour of building materials
- repairing and strengthening
- improvement of technological processes in concrete production.

Project and graduate works can be performed using a substantially experimental equipment both for technological and morphological oriented investigations.

Institute of Construction

Prof. Dr.-Ing. Bernhard Weller

The institute provides teaching for students of the faculties of Architecture, Civil Engineering, Water Management and Economics. In co-operation with professional associations of civil and structural engineers the institute offers professional training programmes.

The main focus of the academic teaching is on:
- building construction
- structural use of glass
- rehabilitation of buildings
- energy-saving rehabilitation
- architectural engineering

Main research areas are:
- structural use of glass
- historical buildings and energy
- architectural engineering

For the work on projects, diploma thesis' or research projects powerful computer and test equipment is available.

The institute operates an accredited glass laboratory for testing and certification of structural glass elements.

Institut of Geotechnology

Prof. Dr.-Ing. habil. Ivo Herle
Prof. Dr. rer. nat. habil. Bernd Ullrich

The institute comprises the chair of soil mechanics and foundation engineering and the chair of engineering geology. The education is offered for students of civil engineering, water management, economics and architecture.

The most important teaching subjects are:
- soil mechanics
- foundation engineering
- tunnelling
- engineering geology

Research interests are:
- soil behaviour and constitutive models
- numerical methods in geotechnical engineering
- laboratory and field testing
- geotechnical design

For research and student projects, a well-equipped laboratory of soil mechanics and a computer pool with various geotechnical software are at disposal.

Institute of Urban Engineering & Road Construction

Prof. Dr.-Ing. habil. Frohmut Wellner

The institute consists of the chair of urban engineering and the chair of pavement engineering and comprises urban land-use and layout planning, technical development of land-use areas, urban infrastructure and road building for research and for lectures. Corresponding lectures are offered to students of civil engineering and students of transport and traffic sciences. In addition, adjacent faculties like architecture, hydrological engineering and transport sciences offer the possibility to get a deepened training on town planning and traffic assessment, road and railway construction and urban engineering to civil engineer students.

The main focus of research is on:
- ageing and rehabilitation of urban infrastructure
- sustainable urban land-use and layout planning
- town supply and waste management
- testing and evaluation of road materials (asphalt, mineral aggregates und recycling materials, block pavements)
- mix design and analytical design and of pavement layers

For the performance of training courses, project courses, diploma thesis and research powerful computer equipment and an excellent equipped laboratory for road materials can be used.

Institute of Construction Management

Prof. Dr.-Ing. Rainer Schach
Prof. Dr.-Ing. Peter Jehle

The institute incorporates the chair of construction management and the chair of construction methods. The staff is involved in lecturing the curriculum of the study courses in civil engineering, architecture, landscape architecture, economical sciences, pedagogics for professional training, educational sciences and water management.

The most important modules and areas of teaching are:
- construction economics, construction industry, construction law
- construction methods
- project management, project development

Main areas of research are:
- organisation in the construction industry
- facility management
- economical, functional and organisational aspects of magnetic levitation transport systems
- communication in construction and construction informatics
- safety and health protection in construction

The facilities of the institute contain a well-equipped self-administrated computer pool with specific construction management software. It is used in lecturing, course work and research.

Institute of Hydraulic Engineering and Technical Hydromechanics

Prof. Dr.-Ing. Jürgen Stamm
Prof. Dr.-Ing. habil. Kai-Uwe Graw

The institute consists of the chair for hydraulic engineering and the chair for applied hydromechanics. It educates students of civil engineering, landscape architecture, transport and traffic science, hydro science, hydrology, waste management and contaminated site treatment and students of the MSc program "hydro science and engineering".

Main contents of teaching:
- hydraulic modeling
- dams and reservoirs
- river engineering
- hydro power stations
- water transportation facilities
- navigation engineering
- offshore and coastal engineering

Main fields of research:
- controlling of water management systems
- hydraulic structures of dams, weirs, ship-locks
- design of revetments
- rehabilitation and modernization of hydraulic structures
- sediment transport in open channels
- river restoration
- flood protection and coastal protection
- regenerative energy sources
- numerical simulations of one- and multidimensional flow
- physical modeling

The well equipped computer pool of the institute provides best facilities for elaboration of study papers and project work as well as for research activities.

Institute of Construction Informatics

Prof. Dr.-Ing. Raimar J. Scherer

The institute offers students of civil engineering to acquire knowledge and proficiency in:
- programming of software solutions for engineering problems
- CAD/CAE/CAD
- data structures
- graph theory
- data bases
- numeric methods in solving engineering problems

Research is mainly focused on:
- civil engineering product and process models
- mobile computing
- logical reasoning and ontologies
- semantic networks
- data analysis and data mining
- earthquake engineering

Students may use the institute's powerful computer centre for the elaboration of project theses, diploma thesis or research projects.

Institute of Structural Analysis

Prof. Dr.-Ing. habil. Michael Kaliske
apl.Prof. Dr.-Ing. Wolfgang Graf

The institute consists of the chairs of statics and dynamics of structures. It teaches and coaches students in following study courses and fields of study: civil engineering, management of water resources, forest sciences and mechanical engineering.

The most important disciplines are:
- statics of structures
- statics - energy methods, FEM, and BEM
- statics stochastic (structural reliability)
- statics optimization
- dynamics - basics
- boundary elements in dynamics
- advanced dynamics
- rehabilitation engineering
- soil dynamics

Significant topics of research are:
- structural analysis with numerical methods
- models of uncertainty (stochastic, fuzziness, fuzzy randomness) in construction engineering
- textile strengthened reinforced concrete
- simulation of blasting of structures
- soil-structure-interaction
- safety and reliability theory
- dynamical stability
- propagation problems

To handle project and diploma thesis as well as research projects a high-capacity computer pool with parallel computer (WAP-cluster) is useable.

Institute of Concrete Structures

Prof. Dr.-Ing. Manfred Curbach
Prof. Dr.-Ing. habil. Ulrich Häußler-Combe

The institute consists of the chairs for reinforced concrete and solid construction and the chair for special concrete structures. It teaches students from civil engineering und hydro sciences.

The main teaching subjects are:
- basics of reinforced concrete
- construction with reinforces concrete
- masonry construction
- prestressed concrete structures
- bridge construction
- special concrete structures

The main research areas are:
- textile reinforcement for concrete
- high strength and high performance concrete
- multiaxial material behaviour of concrete
- constitutive laws for concrete
- structural behaviour of concrete structural elements
- numerical methods for concrete structural behaviour

The institute owns a laboratory, the "Otto Mohr Laboratorium" with extensive testing and measuring equipment.

Institute of Steel and Timber Construction

Prof. Dr.-Ing. Richard Stroetmann
Prof. Dr.-Ing. Peer Haller

The institute consists of the chair of steel construction and the chair of timber engineering and building design. Students are trained in civil engineering and other professions such as mechanical engineering, process engineering, business studies and economics, and forestry.

The most important fields of study are:

Field of steel construction:
- basics of structural steelwork
- welding engineering - fundamentals
- steel buildings
- steel bridges engineering
- theory of stability
- steel structures of hydraulic engineering

Field of timber engineering and building design:
- timber engineering
- timber engineering and rehabilitation
- structural and fibre reinforced plastics
- wood physics and technology

Research activities are concentrated on:

Field of steel construction:
- time-dependant behaviour of trusses with steel concrete composite sections
- optimisation of tied arch bridges with crossed hangers
- development of reliability based standards

Field of timber engineering:
- change of wood properties
- textile reinforced timber structures
- thermo-mechanical treatment of load bearing structures made of solid wood
- development of new technologies

A workshop for making models, a laboratory and the Otto-Mohr-testing facility can be used for the preparation of student's projects, diploma thesis and research works.

4.1.3 Civil Engineering Studies

Studies of civil engineering consist of three parts:

1. Base studies according to Table 1 Page 21 with modules listed in Section 4.2.1.
2. Main studies for all study specializations – with a few exceptions – according to Table 2 Page 22 with modules listed in Section 4.2.2.
3. Specialized studies according to Table 3-14 Pages 23-40 with modules listed in Sections 4.2.3., 4.2.4 and 4.2.5

A module combines different teaching activities regarding a thematic focus. A module forms a closed teaching and learning entity with respect to content and duration. It may consist of lectures, exercises, seminars, assignments, project work etc. Each module is allocated with ECTS-credits and an examination.

Base and main studies are essentially the same for all civil engineering students. Base studies close with an intermediate examination after three semesters (Vordiplom), which has to be passed, but no final degree is awarded. The main studies begin with the 4th semester and last up to the 6th semester. The following study specializations may be selected for the spezialized studies:

- Structural Engineering (see Table 3 and Table 4 and Catalog KI-1 to KI-3)
- Construction Management (see Table 5 and Table 6 and Catalog BB)
- Urban and Transport Engineering (see Table 7 and Table 8 and Catalog SV)
- Hydraulic and Environmental Engineering (see Table 9 and Table 10 and Catalog WU-1 and WU-2)
- Computational Engineering (see Table 11 and Table 12 and Catalog CE-1 and CE-2)
- Building Energy Management (see Table 13 and Table 14 and Catalog GEM)

A study specialization has to be chosen by every student at the end of the 4th semester by registration. Within the specialized studies the student has a limited choice between modules related to her/his study specialization.

The 9th semester is also scheduled for project works, as they are required by educational regulations and examination regulations. The diploma degree is awarded for a successful study period of 9 semesters including final exams, completed by a thesis. The thesis has to be worked out within 4 months. The diploma degree qualifies the holder to apply for an admission for a doctoral work and is therefore comparable to second level degrees in two-tier programmes (e.g. master degrees).

Actual educational regulations and examination regulations are decisive for detailed questions regarding examinations.

Table 1: Base studies schedule

Number of module	Name of module	Sum SWS	1st sem.	2nd sem.	3rd sem.	Preparatory examination
			L / E	L / E	L / E	
Required modules for base studies						
BIW1-01	Building Construction	8	2 / 2	2 / 2		yes
BIW1-02	Existing Buildings and Building Physics	6			4 / 2	yes
BIW1-03	Engineering Mechanics, Part 1	12	3 / 3	3 / 3		yes
BIW1-04	Engineering Mechanics, Part 2	8			4 / 4	yes
BIW1-05	Linear Algebra and Analysis	12	4 / 2	4 / 2		no
BIW1-06	Linear Differential Equations and Stochastics	4			2 / 2	no
BIW1-07	Fundamentals of Construction Informatics	4	1 / 1	1 / 1		yes
BIW1-08	Construction Materials	8	1 / 1	1 / 1	2 / 2	no
BIW1-09	Basic Sciences	4	1 / 1	2 / 0		yes
BIW1-10	Environmental Sciences	4		1 / 1	2 / 0	yes
BIW1-11	Business Administration for Civil Engineers	2	2 / 0			no
BIW1-12	Basic Common Qualifications	2	2 / 0			see module description
Sums		74	26	24	24	

SWS: Contact hour per semester; L: Lecture; E: Exercise

Table 2: Main studies schedule – for all study specializations

Number of module	Name of module	Sum SWS	4th sem.	5th sem.	6th sem.	Preparatory examination
			L / E	L / E	L / E	
Required modules for main studies						
BIW2-01	Basics of Structural Design	2	2 / 0			yes
BIW2-02	Statics	7	2 / 1	1 / 1	1 / 1	yes
BIW2-03	Soil Mechanics and Foundation Engineering	6	3 / 1	0 / 2		yes
BIW2-04	Basics of Steel and Timber construction	5	4 / 1			yes
BIW2-05	Reinforced Concrete Construction	8	2 / 0	1 / 1	2 / 2	yes
BIW2-06	Basic Knowledge of Construction Management	8	2 / 2	2 / 2		no
BIW2-07[1]	Infrastructure	7	4 / 0	2 / 1		yes
BIW2-08[1]	Basics of Hydromechanics and Hydraulic Engineering	8	2 / 1	1 / 1	2 / 1	yes
BIW2-09[1]	Information Management and Numerical Mathematics	4		1 / 1	1 / 1	yes
BIW2-10	Public Building Law	2			2 / 0	no
BIW2-11[1]	Advanced Common Qualifications	4			4 / 0	see module description
BIW2-12[2]	Design and Energy Efficiency	6		2 / 1	2 / 1	no
BIW2-13[2]	Building Envelope	8	2 / 2	1 / 1	1 / 1	yes
BIW2-14[2]	Basics of Building Climatology and Building Energy Technology	4	2 / 2			no
BIW2-15[2]	System and Information Model for the Building Life Cycle	2			1 / 1	yes
BIW2-16[2]	Advanced Common Qualifications	2			2 / 0	see module description
Sums		61 [3]	27 [4]	17 [5]	17	

SWS: Contact hour per semester; L: Lecture; E: Exercise

[1] Not for Building Energy Management (GEM) Specialized studies

[2] Only for Building Energy Management (GEM) Specialized studies

[3] For Building Energy Management (GEM) 60 SWS

[4] For Building Energy Management (GEM) 28 SWS

[5] For Building Energy Management (GEM) 15 SWS

Table 3: Specialized studies schedule – Structural Engineering (KI)

Number of module	Name of module	Sum SWS	4th sem.	5th sem.	6th sem.	7th sem.	8th sem.	9th sem.	10th sem.	Preparatory examination
			L / E	L / E	L / E	L / E	L / E	L / E	L / E	
Required modules Structural Engineering										
	Module BIW2-01 to BIW2-11, see table 2 (p. 22)	61	27	17	17					
	Module from catalog KI-1	6		2 / 1	2 / 1					yes
	Module from catalog KI-1	6		2 / 1	2 / 1					yes
	Module from catalog KI-1	6				2 / 1	2 / 1			yes
BIW4-01	Variational Principles / FEM and Structural Safety	6				2 / 1	2 / 1			yes
BIW4-11	Design of Concrete Structures	6				2 / 0	1 / 3			no
BIW4-71	Vocational Oriented Common Qualifications	8				2 / 0	2 / 0	4 / 0		see respective module description
BIW5-01	Project Work	2						2 / 0[1] PA		no

Table 4: Specialized studies schedule part 2 – Structural Engineering (KI)

Number of module	Name of module	Sum SWS	4th sem.	5th sem.	6th sem.	7th sem.	8th sem.	9th sem.	10th sem.	Preparatory examination
			L / E	L / E	L / E	L / E	L / E	L / E	L / E	
Elective modules Structural Engineering										
	Modules from the offering of the faculty (BIW3[2]) or from catalog KI-1[3]	6		2 / 1	2 / 1					see respective module description
BIW4-14 BIW4-10	Steel Building Construction and Theory of Stability ***or*** Geotechnical Investigations and Case Studies	6				2 / 1	2 / 1			see respective module description
	Module from catalog KI-1[3] or KI-2	6				2 / 1	2 / 1			see respective module description
	Module from catalog KI-2 or KI-3	6				2 / 1	2 / 1			see respective module description
	Technical elective module (catalog KI-2 or KI-3, other study specializations, other faculties)	6				2 / 1	2 / 1			see respective module description
Diploma thesis									DA	Diploma thesis including defense
Sums		131	27	26	26	22	24	6+PA	DA	

SWS: Contact hour per semester; L: Lecture; E: Exercise
PA: Project work; DA: Diploma thesis

actual allocation in lectures and exercises see respective module description

[1] takes place as block meeting at the end of the term

[2] BIW3 stands for any module BIW3-01 to BIW3-13 with exception of the compulsory modules of the study specialization

[3] All four modules from KI-1 must be selected.

Specialized studies of structural engineering require selection of all modules of catalog KI-1 during the 3rd and 4th year of studies. Catalogues of required and elective modules of the structural engineering specialized studies are given in the following:

Catalog KI-1

BIW3-01	Basics of Structural Analysis
BIW3-02	Design of Concrete Members and Material Mechanics of Concrete
BIW3-03	Steel and Timber Construction and Application in Fracture Mechanics
BIW3-04	Geotechnical Safety Assessment, Rock Mechanics, Tunneling and Technology of Building Materials

Catalog KI-2

BIW4-02	Advanced Structural Analysis
BIW4-03	Theory and Numerics of Shells
BIW4-05	Dynamics
BIW4-06	Continuum Mechanics and Theory of Materials with Applications
BIW4-07	Numerical Methods in Mechanics and Statics including Lightweight Structures
BIW4-08	Computational Building Physical Design and Construction
BIW4-09	Structural Designs
BIW4-10	Geotechnical Investigations and Case Studies
BIW4-12	Strengthening of Existing Concrete Structures
BIW4-14	Steel Building Construction and Theory of Stability
BIW4-15	Composite Constructions, Hollow Section Constructions and Cable-supported Structures
BIW4-16	Bridge Construction
BIW4-17	Timber Construction and Fibre Reinforced Plastics (FRP)
BIW4-18	Structural Glass
BIW4-19	Damages on Building Constructions
BIW4-20	Structures and Fire Prevention
BIW4-21	Construction in Existing Structures – Repair Methods and Materials
BIW4-22	Co-operative Design Work and Numerical Methods

Catalog KI-3

BIW3-05	Basics of Project Planning
BIW3-06	Extensive Knowledge of Construction Management A
BIW3-07	Traffic Engineering
BIW3-08	Urban Water Management
BIW3-09	Dam Engineering and Hydroelectric Power Engineering
BIW3-10	Advanced Hydromechanics
BIW3-12	Advanced Mathematical Methods for Engineers
BIW3-13	Advanced Fundamentals of Construction Informatics
BIW4-04	Structures Subject to Extreme Loadings as Wind and Earthquake
BIW4-23	Advanced Knowledge of Construction Planning and Construction Management
BIW4-24	Building Laws and Legal Regulations
BIW4-25	Software in Construction Management
BIW4-26	Finishing Works and Building Services
BIW4-27	Concrete and Prefabricated Constructions
BIW4-31	Special topics of Construction Management
BIW4-34	Urban Utility Systems
BIW4-35	Rehabilitation Management
BIW4-36	Town Planning
BIW4-42	Pavement Construction and Maintenance
BIW4-45	Railway Construction
BIW4-46	River Engineering and Waterway Engineering
BIW4-52	Concrete in Hydraulic Structures and Steel Structures
BIW4-56	Ecology in Construction – the related Technology
BIW4-57	Construction Ecology - Soil
BIW4-58	Building Ecology - Energy
BIW4-60	Instruments of Ecological Engineering
BIW4-62	Numerical Models in Geotechnical Engineering
BIW4-63	Computational Fluid Dynamics
BIW4-64	Computational Engineering in Structural Glass
BIW4-65	Computational Engineering for Concrete Structures
BIW4-66	Numerical Dynamics
BIW4-67	Nondeterministic Methods in Structural Analysis
BIW4-68	Selected Topics of Discretization Methods, CAE
BIW4-69	Simulation and Monitoring of Engineering Systems
BIW4-70	Modul-Based Working
BIW4-72	Sustainable Building
BIW4-75	Green Building Design

Table 5: Specialized studies schedule – Construction Management (BB)

Number of module	Name of module	Sum SWS	4th sem.	5th sem.	6th sem.	7th sem.	8th sem.	9th sem.	10th sem.	Preparatory examination
			L / E	L / E	L / E	L / E	L / E	L / E	L / E	
Required modules Construction Management										
	Module BIW2-01 to BIW2-11, see Table 2 (p. 22)	61	27	17	17					
BIW3-05	Basics of Project Planning	6		2 / 1	2 / 1					no
BIW3-06	Extensive Knowledge of Construction Management A	6		2 / 1	3 / 0					yes
BIW4-23	Advanced Knowledge of Construction Planning and Construction Management	6				3 / 0	1 / 2			no
BIW4-24	Building Laws and Legal Regulations	6				3 / 0	3 / 0			no
BIW4-71	Vocational Oriented Common Qualifications	8				2 / 0	2 / 0	4 / 0		see respective module description
BIW5-01	Project Work	2						2 / 0[1] PA		no

Table 6: Specialized studies schedule part 2 – Construction Management (BB)

Number of module	Name of module	Sum SWS	4th sem.	5th sem.	6th sem.	7th sem.	8th sem.	9th sem.	10th sem.	Preparatory examination
			L / E	L / E	L / E	L / E	L / E	L / E	L / E	
Elective modules Construction Management										
	Modules from the offering of the faculty (BIW3[2] and BIW4[3])	6		2 / 1	2 / 1					see respective module description
	Module from catalog BB	6				2 / 1	2 / 1			see respective module description
	Module from the offering of the faculty (BIW3[2] and BIW4[3])	6				2 / 1	2 / 1			see respective module description
	Module from the offering of the faculty (BIW3[2] and BIW4[3])	6				2 / 1	2 / 1			see respective module description
	Module from the offering of the faculty (BIW3[2] and BIW4[3])	6				2 / 1	2 / 1			see respective module description
	Technical elective module (catalog BB, other study specializations, other faculties)	6				2 / 1	2 / 1			see respective module description
Diploma thesis									DA	Diploma thesis including defense
Sums		131	27	26	26	23	23	6+PA	DA	

SWS: Contact hour per semester; L: Lecture; E: Exercise
PA: Project work; DA: Diploma thesis

[1] takes place as block meeting at the end of the term

[2] BIW3 stands for any module BIW3-01 to BIW3-13 with exception of the compulsory modules of the study specialization.

[3] BIW4 stands for any module BIW4-01 to BIW4-70 with exception of the compulsory modules of the study specialization.

actual allocation in lectures and exercises see respective description of module

The elective modules catalog of the Construction Management specialized studies is given in the following:

Catalog BB

BIW4-25	Software in Construction Management
BIW4-26	Finishing Works and Building Services
BIW4-27	Concrete and Prefabricated Constructions
BIW4-28	Special Topics in Construction Business Management
BIW4-29	Project Development
BIW4-30	Corporate Real Estate Management
BIW4-31	Special Topics of Construction Management
BIW4-32	Selected Topics in Construction Methods
BIW4-33	Software Systems

Table 7: Specialized studies schedule – Urban and Transport Engineering (SV)

Number of module	Name of module	Sum SWS	4th sem.	5th sem.	6th sem.	7th sem.	8th sem.	9th sem.	10th sem.	Preparatory examination
			L / E	L / E	L / E	L / E	L / E	L / E	L / E	
Required modules Urban and Transport Engineering										
	Module BIW2-01 to BIW2-11, see Table 2 (p. 22)	61	27	17	17					
BIW3-07	Traffic Engineering	7		4 / 0	2 / 1					yes
BIW3-08	Urban Water Management	6		3 / 1	1/ 1					yes
BIW4-71	Vocational Oriented Common Qualifications	8				2 / 0	2 / 0	4 / 0		see respective module description
BIW5-01	Project Work	2						2 / 0[1] PA		no

Table 8: Specialized studies schedule part 2 – Urban and Transport Engineering (SV)

Number of module	Name of module	Sum SWS	4th sem.	5th sem.	6th sem.	7th sem.	8th sem.	9th sem.	10th sem.	Preparatory examination
			L / E	L / E	L / E	L / E	L / E	L / E	L / E	
Elective modules Urban and Transport Engineering										
	Modules from the offering of the faculty (BIW3[2])	6		2 / 1	2 / 1					see respective module description
	Module from catalog SV	6				2 / 1	2 / 1			see respective module description
	Module from catalog SV	6				2 / 1	2 / 1			see respective module description
	Module from catalog SV	6				2 / 1	2 / 1			see respective module description
	Module from catalog SV	6				2 / 1	2 / 1			see respective module description
	Module from catalog SV	6				2 / 1	2 / 1			see respective module description
	Module from catalog SV or from catalogs other study specialization	6				2 / 1	2 / 1			see respective module description
	Technical elective module (catalog SV, other study specializations, other faculties)	6				2 / 1	2 / 1			see respective module description
Diploma thesies									DA	Diploma thesis including defense
Sums		132	27	27	26	23	23	6+PA	DA	

SWS: Contact hour per semester; L: Lecture; E: Exercise
PA: Project work; DA: Diploma thesis
[1] takes place as block meeting at the end of the term
[2] BIW3 stands for any module BIW3-01 to BIW3-13 with exception of the compulsory modules of the study specialization.

actual allocation in lectures and exercises see respective description of module

The elective modules catalog of the Urban and Transport Engineering specialized studies is given in the following:

Catalog SV

BIW4-34	Urban Utility Systems
BIW4-35	Rehabilitation Management
BIW4-36	Town Planning
BIW4-38	Urban Transport
BIW4-39	Traffic Engineering
BIW4-40	Road Traffic Safety
BIW4-41	Road Design
BIW4-42	Pavement Construction and Maintenance
BIW4-43	Pavements and Environment
BIW4-44	Railway Infrastructure
BIW4-45	Railway Construction

Table 9: Specialized studies schedule – Hydraulic and Environmental Engineering (WU)

Number of module	Name of module	Sum SWS	4th sem.	5th sem.	6th sem.	7th sem.	8th sem.	9th sem.	10th sem.	Preparatory examination
			L / E	L / E	L / E	L / E	L / E	L / E	L / E	
Required modules Hydraulic and Environmental Engineering										
	Module BIW2-01 to BIW2-11, see Table 2 (p. 22)	61	27	17	17					
BIW3-09	Dam Engineering and Hydroelectric Power Engineering	6		2 / 1	2 / 1					yes
BIW4-46	River Engineering and Waterway Engineering	6				2 / 1	2 / 1			yes
BIW4-71	Vocational Oriented Common Qualifications	8				2 / 0	2 / 0	4 / 0		see respective module description
BIW5-01	Project Work	2						2 / 0[1] PA		no

Table 10: Specialized studies schedule part 2 – Hydraulic and Environmental Engineering (WU)

Number of module	Name of module	Sum SWS	4th sem.	5th sem.	6th sem.	7th sem.	8th sem.	9th sem.	10th sem.	Preparatory examination
			L / E	L / E	L / E	L / E	L / E	L / E	L / E	
Elective modules Hydraulic and Environmental Engineering										
	Module from catalog WU-1	6		2 / 1	2 / 1					see respective module description
	Modules from the offering of the faculty (BIW3[2])	6		2 / 1	2 / 1					see respective module description
	Module from catalog WU-1	6				2 / 1	2 / 1			see respective module description
	Module from catalog WU-2	6				2 / 1	2 / 1			see respective module description
	Module from catalog WU-2	6				2 / 1	2 / 1			see respective module description
	Module from catalog WU-2	6				2 / 1	2 / 1			see respective module description
	Module from catalog WU-1 and WU-2 or from catalogs other study specialization	6				2 / 1	2 / 1			see respective module description
	Technical elective module (catalog WU-2, other study specializations, other faculties)	6				2 / 1	2 / 1			see respective module description
Diploma thesis									DA	Diploma thesis including defense
Sums		131	27	26	26	23	23	6+PA	DA	

SWS: Contact hour per semester; L: Lecture; E: Exercise
PA: Project work; DA: Diploma thesis
[1] takes place as block meeting at the end of the term
[2] BIW3 stands for any module BIW3-01 to BIW3-13 with exception of the compulsory modules of the study specialization.

actual allocation in lectures and exercises see respective description of module

The Hydraulic and Environmental Engineering specialized studies offer two fields of competence, that is Structural Hydraulic Engineering and furthermore Geotechnics and Hydraulic Engineering. The Structural Hydraulic Engineering competence field requires attendance of the modules Advanced Hydromechanics (BIW3-10) and Flow Modelling (BIW4-47) and the Geotechnics and Hydraulic Engineering ccompetence field attendance of the modules Geotechnical Safety Assessment, Rock Mechanics, Tunneling and Technology of Building Materials (BIW3-04) and Geotechnical Investigations and Case Studies (BIW4-10) during the 3rd and 4th year of studies. Further possibilities for selection are given in the following catalogs:

Catalog WU-1

BIW3-04	Geotechnical Safety Assessment, Rock Mechanics, Tunneling and Technology of Building Materials
BIW3-10	Advanced Hydromechanics
BIW4-10	Geotechnical Investigations and Case Studies
BIW4-47	Flow Modelling
BIW4-59	Ecology in Civil Engineering - Infrastructur

Catalog WU-2

BIW3-10	Advanced Hydromechanics
BIW4-21	Construction in Existing Structures – Repair Methods and Materials
BIW4-47	Flow Modelling
BIW4-48	Coastal Engineering and Coastal Defense, Software Application in Hydraulic Engineering
BIW4-49	Renewables, Maritime Energy
BIW4-50	Selected Chapters Hydraulic Engineering
BIW4-51	Hydrology and Water Quality
BIW4-52	Concrete in Hydraulic Structures and Steel Hydraulic Structures
BIW4-53	Hydromelioration and Groundwater
BIW4-54	Urban Water Body Development – a Multidiscipline Approach
BIW4-56	Ecology in Construction – the Related Technology
BIW4-57	Construction Ecology - Soil
BIW4-58	Building Ecology - Energy
BIW4-59	Ecology in Civil Engineering - Infrastructur
BIW4-60	Instruments of Ecological Engineering
BIW4-61	River Restoration
BIW4-72	Sustainable Building

Table 11: Specialized studies schedule – Computational Engineering (CE)

Number of module	Name of module	Sum SWS	4^{th} sem.	5^{th} sem.	6^{th} sem.	7^{th} sem.	8^{th} sem.	9^{th} sem.	10^{th} sem.	Preparatory examination
			L / E	L / E	L / E	L / E	L / E	L / E	L / E	
Required modules Computational Engineering										
	Module BIW2-01 to BIW2-11, see Table 2 (p. 22)	61	27	17	17					
BIW3-01	Basics of Structural Analysis	6		1 / 2	2 / 1					yes
BIW4-71	Vocational Oriented Common Qualifications	8				2 / 0	2 / 0	4 / 0		see respective module description
BIW5-01	Project Work	2						2 / 0[1] PA		no

Table 12: Specialized studies schedule part 2 – Computational Engineering (CE)

Number of module	Name of module	Sum SWS	4th sem.	5th sem.	6th sem.	7th sem.	8th sem.	9th sem.	10th sem.	Preparatory examination
			L / E	L / E	L / E	L / E	L / E	L / E	L / E	
Elective modules Computational Engineering										
	Modules from the offering of the Faculty (BIW3[2])	6		2 / 1	2 / 1					see respective module description
BIW3-12 BIW3-13	Advanced Mathematical Methods for Engineers ***or*** Advanced Fundamentals of Construction Informatics	6		2 / 1	2 / 1					see respective module description
	Module from catalog CE-1	6				2 / 1	2 / 1			see respective module description
	Module from catalog CE-1	6				2 / 1	2 / 1			see respective module description
	Module from catalog CE-1	6				2 / 1	2 / 1			see respective module description
	Module from catalog CE-1 or CE-2	6				2 / 1	2 / 1			see respective module description
	Module from catalog CE-1 or CE-2	6				2 / 1	2 / 1			see respective module description
	Modul aus Katalog CE-1 oder CE-2	6				2 / 1	2 / 1			see respective module description
	Technical elective module (catalog CE, other study specializations, other faculties)	6				2 / 1	2 / 1			see respective module description
Diploma thesis									DA	Diploma thesis including defense
Sums		131	27	26	26	23	23	6+PA	DA	

SWS: Contact hour per semester; L: Lecture; E: Exercise
PA: Project work; DA: Diploma thesis
[1] takes place as block meeting at the end of the term
[2] BIW3 stands for any module BIW3-01 to BIW3-13 with exception of the compulsory modules of the study specialization.

actual allocation in lectures and exercises see respective description of module

The Computational Engineering specialized studies requires the attendance of the module Basics of Structural Analysis (BIW3-01). Further possibilities for selection are given in the following catalogs:

Catalog CE-1

BIW4-01	Variational Principles / FEM and Structural Safety
BIW4-02	Advanced Structural Analysis
BIW4-04	Structures Subject to Extreme Loadings as Wind and Earthquake
BIW4-06	Continuum Mechanics and Theory of Materials with Applications
BIW4-07	Numerical Methods in Mechanics and Statics including Lightweight Structures
BIW4-22	Co-operative Design Work and Numerical Methods
BIW4-62	Numerical Models in Geotechnical Engineering
BIW4-64	Computational Engineering in Structural Glass
BIW4-65	Computational Engineering for Concrete Structures
BIW4-68	Selected Topics of Discretization Methods, CAE

Catalog CE-2

BIW4-03	Theory and Numerics of Shells
BIW4-05	Dynamics
BIW4-33	Software Systems
BIW4-63	Computational Fluid Dynamics
BIW4-66	Numerical Dynamics
BIW4-67	Nondeterministic Methods of Structural Analysis
BIW4-69	Simulation and Monitoring of Engineering Systems
BIW4-70	Modul-Based Working

Table 13: Specialized studies schedule – Building Energy Management (GEM)

Number of module	Name of module	Sum SWS	4th sem.	5th sem.	6th sem.	7th sem.	8th sem.	9th sem.	10th sem.	Preparatory examination
			L / E	L / E	L / E	L / E	L / E	L / E	L / E	
Required modules Building Energy Management										
	Module BIW2-01 to BIW2-16, see Table 2 (p. 22)	60	28	15	17					
BIW3-05	Basics of Project Planning	6		2 / 1	2 / 1					no
BIW3-06	Extensive Knowledge of Construction Management A	6		2 / 1	3 / 0					yes
BIW4-19	Damages on Building Construction	6				2 / 1	2 / 1			no
BIW4-24	Building Laws and Legal Regulations	6				3 / 0	3 / 0			no
BIW4-71	Vocational Oriented Common Qualifications	8				2 / 0	2 / 0	4 / 0		see respective module description
BIW4-72	Sustainable Building	6				2 / 1	2 / 1			no
BIW5-01	Project Work	2						2 / 0[1] PA		no

Table 14: Specialized studies schedule part 2 – Building Energy Management (GEM)

Number of module	Name of module	Sum SWS	4th sem.	5th sem.	6th sem.	7th sem.	8th sem.	9th sem.	10th sem.	Preparatory examination
			L / E	L / E	L / E	L / E	L / E	L / E	L / E	
Elective modules Building Energy Management										
	Modules from the offering of the faculty (BIW3[2])	6		2 / 1	2 / 1					see respective module description
	Module from catalog GEM	6				2 / 1	2 / 1			see respective module description
	Module from catalog GEM	6				2 / 1	2 / 1			see respective module description
	Module from catalog GEM	6				2 / 1	2 / 1			see respective module description
	Technical elective module (catalog GEM, other study specializations[3], other faculties)	6				2 / 1	2 / 1			see respective module description
Diploma thesis									DA	Diploma thesis including defense
Sums		130	28	24	26	23	23	6+PA	DA	

SWS: Contact hour per semester; L: Lecture; E: Exercise
PA: Project work; DA: Diploma thesis
[1] takes place as block meeting at the end of the term
[2] BIW3 stands for any module BIW3-01 to BIW3-13 with exception of the compulsory modules of the study specialization.

(shaded) actual allocation in lectures and exercises see respective description of module

The Building Energy Management specialized studies have already to be selected after the 3rd semester, in contrast to all other specialized studies. The elective modules catalog fort eh Building Energy Management specialized studies are given in the following:

Catalog GEM

BIW4-25	Software in Construction Management
BIW4-29	Project Development
BIW4-30	Corporate Real Estate Management
BIW4-73	Glass facades
BIW4-74	Special Themes of Building Climatology and Building Energy Technology
BIW4-75	Green Building Design
BIW4-76	Finishing Works and Building Services B
BIW4-77	Business Management

4.1.4 MSC Programme in Advanced Computational and Civil Engineering Structural Studies (ACCESS)

Starting in October 2010, the Faculty of Civil Engineering at Technische Universität Dresden offers a new international MSc programme in the field of computational and advanced civil engineering. The course is taught in English and addresses a broad international community. The expertise of the Faculty with a strong emphasis on numerical methods and a large field of research topics in engineering is associated to a wide national and international research network.

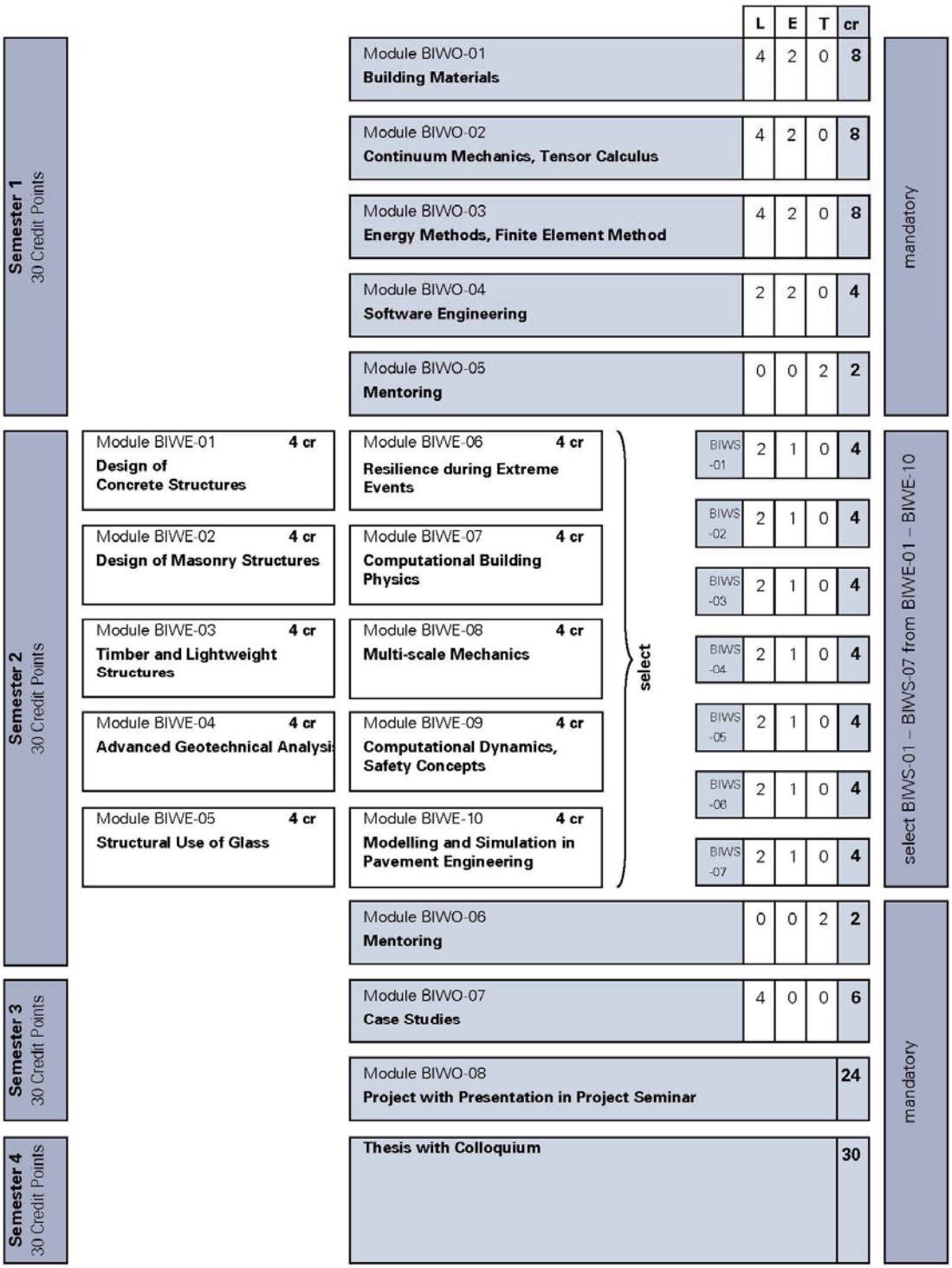
The goal of the programme is to impart knowledge leading to research competence and to high level engineering skills based on an individual choice of modules by the participants. Moreover, the course is intended to provide a close individual supervision of the participants by the teaching staff in order to achieve highest goals most efficiently.

ACCESS seeks to facilitate the development of a strong knowledge base in the field of computational mechanics and structural analysis, working collaboratively with advanced civil engineering design. Technical innovations for challenging engineering tasks rely heavily on numerical simulation tools. Therefore, the goal of the programme is to provide the skills for understanding, modelling and analysis of these approaches in the broader context of application and design by focus on:

- state-of-the-art computational mechanics
- current numerical structural analysis
- research in structural modelling and analysis
- current developments in civil engineering design
- advanced construction methods

Engineers with a strong computational background are in high demand in international companies, consultant agencies, engineering offices, construction enterprises and research.

Table 15: Curriculum Scheme ACCESS



L-Lecture, E-Exercise, T-Tutorial, cr-credits

4.2 Civil Engineering Studies, Module Descripions

4.2.1 Required modules for base studies

Number of module	**Name of module**	**Lecturer**
BIW1-01	Building Construction	Weller
Content and Course Goals	The introduction into the Building Construction starts with an explanation of the particular planning phases as well as with an explanation of the basics of creating correct construction drawings. Furthermore the relevant design features of a building are treated according to the process of building. After explanations concerning the proceeding of making excavations a part of the constructional bases is the design of foundations. The technical exact realization of sealing the construction is very important to provide that buildings are free of failure. The material choice and construction of walls and façades owns a special influence on the economic realization of a building project. In the context of ceiling constructions a number of different types of ceilings are discussed taking the choice of materials and the grade of prefabrication into account. Various constructions of floors, which depend on their use, are explained considering different aspects of construction physics. Design and construction of stairways, platforms and falling protections are further components of the module. The part of the lecture which deals with roofs contains the construction of flat and sloping roofs as well as the possibilities of constructing roofing. The student should be given the ability to plan and to design buildings using the knowledge of structural engineering. The module includes the lectures of structural design for establishing buildings.	
Teaching	60 hours of lecture (2 hours per week during lecture period) 60 hours of exercises (2 hours per week during lecture period)	
Classification	Required course in basic study period	
Prerequisites		
Examination	Credit points are gained with passing the module examinations. Module examinations consist of: written examination 120 min Prerequisites: Assignments (50 hours) are required per semester.	
Credits and Grading	10 credits. Module grade is given based on the grading of the exam.	
Work Load	Overall work time is 300 hours for lectures and exercises including preparatory and follow-up work, preparation for assignments and exams.	
Duration and Frequency	The module is offered every academic year beginning in the winter semester and continuing for 2 semesters.	

Number of module	**Name of module**	**Lecturer**
BIW1-02	Existing Buildings and Building Physics	**Weller**, Grunewald

Content and Course Goals	A very important part of the Structural Design is dealing with existing building constructions. In relation to them the content of the lectures will deal with foundations, wall constructions, ceiling constructions, stairs- and roof constructions very intensively. The analysis of typical damage symptoms concerning their causes as well as finding solutions for them and the development of energetic renovation concepts will complete the lecture. Beginning from the bases of thermo physics and the quantification of the external- and the room climate, physics relating to construction imparts the following contents: Thermal characteristics and requirements for the structural elements, thermal behavior of buildings during the heating period, thermal behavior of buildings in summertime as well as hygric behavior of structural elements and buildings in order to the prevention of humid-conditioned cases of damage. The lectures will be completed with the basics of the acoustics including the following chapters: Dimensions of the sound field, propagation of the sound in the outside space, sound field in the space and the quantification of the sound propagation in components. The student should be given the ability to work on building constructions of existing buildings according to the requirements as well as being able to judge the thermal behavior and the acoustics of structural elements.
Teaching	60 hours of lecture (4 hours per week during lecture period) 30 hours of exercises (2 hours per week during lecture period)
Classification	Required course in basic study period
Prerequisites	Good knowledge in mathematics and physics required as well as the gained skills of the module Building Construction (BIW1-01).
Examination	Credit points are gained with passing the module examinations Module examinations consist of: • Building Construction: 120 min • Building Physics: 120 min Prerequisites: Assignments required in Building Construction (50 hours) Prerequisites: Assignments required in Building Physics (30 hours)
Credits and Grading	8 credits. Module grade is given based on the grading of the exams. The total grade is weighted average of the grades in two courses (Building Construction: 2 weightage, Building Physics:1 weightage)
Work Load	240 h for lectures exercises, preparatory work and follow up work, preparation for exams and assignments Time for assignments: • Building Construction: 50 h • Construction Physics: 30 h while the university is in session
Duration and Frequency	The module is offered every academic year in the winter semester. 1 semester.

Number of module	**Name of module**	**Lecturer**
BIW1-03	Engineering Mechanics, Part 1	Zastrau

Content and Course Goals	This module includes the fundamental principles of calculating internal forces and moments in technical applications, as well as elasto-static aspects of deformation and loading of structures. After the successful completion of this module students know the definitions of structural system properties like bearings, inner joints and loads. They are able to determine internal forces of truss and beam structures as a foundation of calculating the solicitation of structures. They are capable of determining strains and stresses from internal forces to quantify the load-bearing capacity of structures. Furthermore, they have basic experience in deformation and stability analysis. In conclusion students are able to perform the static analysis of simple structures after the successful completion of this module.
Teaching	90 hours of lecture (3 hours per week during lecture period) 90 hours of exercises (3 hours per week during lecture period)
Classification	Required module to be taken during the basic studies. It is the basis for module BIW1-04 and many other modules of the main studies.
Prerequisites	Good knowledge (A-Level) in mathematics and physics.
Examination	Two written examinations in statics of statically determinate systems (120 min) and strength of materials (180 min). Prerequisite for each of the two examinations is an assignment with 50 hours work load and at least 80% being correctly solved.
Credits and Grading	14 credits. The module grade results from the weighted average of the grades in the two courses. The weights are 2 for the grade of statics of statically determinate systems and 3 for the grade of strength of materials, respectively.
Work Load	420 hours for lectures, exercises including preparatory and follow-up work, preparation for exams and assignments.
Duration and Frequency	This module is offered every academic year beginning in the winter semester and continuing for 2 semesters.

Number of module	**Name of module**	**Lecturer**
BIW1-04	Engineering Mechanics, Part 2	**Zastrau**, Graw

Content and Course Goals	This module provides the fundamental understanding of the dyna-mics of rigid bodies, continuum mechanics and hydrostatics. The students are familiar with the basics of kinematics and equations of motion and they understand the elementary theory of impact. They are able to analyze and solve vibration problems with one degree of freedom. The students recognize the basic principles of tensor calculus necessary for the understanding of continuum mechanics and the theory of elasticity. They can solve elementary problems of three-dimensional stress and strain states in elastic bodies. They are able to formulate material laws of non-linear elastic and time-dependent materials by means of rheological models. In the field of hydrostatics, students can calculate forces in fluids at rest and the resulting forces acting on structures. They are acquainted with the pressure distribution and the forces on plane and curved surfaces. Furthermore, they are familiar with buoyancy forces, floating and the stability of floating bodies.
Teaching	60 hours of lecture (4 hours per week during lecture period) 60 hours of exercises (4 hours per week during lecture period)
Classification	Required module to be taken during the basic studies.
Prerequisites	Good knowledge in Engineering Mechanics, Part 1 (module BIW1-03) and Linear Algebra and Analysis (module BIW1-05).
Examination	Two written examinations in dynamics of rigid bodies and continuum mechanics (180 min) and hydrostatics (90 min). Prerequisite for the examination in dynamics of rigid bodies and continuum mechanics are assignments with 80 hours work load and at least 80% being correctly solved.
Credits and Grading	10 credits. The module grade results from the weighted average of the grades in the two courses. The weights are 3 for the grade of dynamics of rigid bodies and continuum mechanics and 1 for the grade of hydrostatics, respectively.
Work Load	300 hours for lectures, exercises, laboratory experiments including preparatory and follow-up work, preparation for exams and assignments.
Duration and Frequency	The module is offered every academic year in the winter semester. 1 semester

Number of module	**Name of module**	**Lecturer**
BIW1-05	Linear Algebra and Analysis	Koksch

Content and Course Goals	The module starts with basics of Linear Algebra and the one-dimensional analysis, in particular complex numbers, systems of linear equations, vector spaces, analytical geometry, sequences and one-dimensional differential and integral calculus. Other main topics of the module are some deepening in linear algebra and the higher-dimensional analysis, in particular, linear mappings and eigenvalue problems, higher-dimensional integral calculus, vector analysis and special differential equations of first and second order. After finishing the module, the students know methods for solving systems of linear equations an criterions for the determination of the dimension of the space of solutions. They are able to apply this knowledge to the investigation of eigenvalue problems. They obtained skills in handling of methods of the analytical geometry for description and analysis of metrical and locating relations of geometrical objects. They have abilities in the handling with total and partial derivatives. They can classify differential-geometric questions, and solve extremal and approximation problems. They are also able to apply theorems of the vector analysis to calculate integrals on domains, curves and surfaces. They have a basic knowledge of metric and normed spaces.
Teaching	120 hours of lecture (4 hours per week during lecture period) 60 hours of exercises (2 hours per week during lecture period)
Classification	Good school knowlegde of mathematics.
Prerequisites	The module is an required module in the base studies of civil engineering. It provides a basis for the modules BIW1-04, BIW1-06 and BIW1-09 and many modules in the main studies.
Examination	The examination consists on two written examinations. 1. written examination (120min) on the basics of Linear Algebra and one-dimensional Analysis. 2. written examination (180min) on the deepenimg of Linear Algebra and higher-dimensional Analysis.
Credits and Grading	14 Credits. Module grade is given on the weighted grading of the written examinations, where the examination under Nr. 1 is weighted by 2 and the examination under Nr. 2 is weighted by 3.
Work Load	420 hours
Duration and Frequency	2 semester

Number of module BIW1-06	**Name of module** Linear Differential Equations and Stochastics	**Lecturer** Koksch
Content and Course Goals	The module covers first systems of linear differential equations and linear scalar differential equations of higher order and their theory of solution. Second, the module focusses on the stochastics, in particular, the basics of probability theory, special discrete and continuous distributions, limiting value theorems, statistical characterristics of the describing statistic, statistical estimates and tests. The students will learn some methods to solve special types of linear differential equations and to apply them to initial value and boundary value problems. The students know the most important distributions of the theory of probability and their application. They are able to achieve simple statistical evaluations and to utilize special statsitical tests.	
Teaching	30 hours of lecture (2 hours per week during lecture period) 30 hours of exercises (2 hours per week during lecture period)	
Classification	The module is an required module in the base studies of civil engineering. It provides a basis for many modules in the main studies.	
Prerequisites	Good knowlegde of the module Linear Algebra and Analysis (BIW1-05).	
Examination	One written examination (120 min).	
Credits and Grading	6 Credits. Module grade is given on the grading of the written examination.	
Work Load	180 hours	
Duration and Frequency	1 semester	

Number of module	**Name of module**	**Lecturer**
BIW1-07	Fundamentals of Construction Informatics	Scherer
Content and Course Goals	The module provides the fundamentals of algorithms and data structures as well as their modular implementation and application in an integrated software system. After completion of the module the students are able to generate and use data views on geometrical, topological and graphical representations of civil engineering objects using the relational and the object oriented approach. Students will learn to think object oriented and holistically, to structure complex problems modularly by systematic application of the duality of the complementary data structures and algorithms and therewith to develop generalizable modular solutions. After completion of the module students have the competence to make selective modifications and enhancements of existing software systems, i.e. analyse the system, specify the modifications and incorporate software libraries to minimize own new developments.	
Teaching	30 hours of lecture (1 hour per week during the lecture period) 30 hours of exercises (1 hour per week during the lecture period)	
Classification	Required module to be taken during the base studies period of the undergraduate diploma course civil engineering. The module provides the prerequisites for a variety of modules of the main studies.	
Prerequisites		
Examination	Written exam of 120 minutes; two assignments (15 hours each) as prerequisites for admission.	
Credits and Grading	5 credits. Module grade is based on the grading of the exam.	
Work Load	Total work load: 150 hours.	
Duration and Frequency	The module is offered every academic year beginning in the winter semester and continuing for 2 semesters (winter – summer)	

Number of module	**Name of module**	**Lecturer**
BIW1-08	Construction Materials	Mechtcherine

Content and Course Goals	Content of the course is micro- and mesostructure and the resulting mechanical, physical, and chemical properties of construction materials in consideration of the influences of loading, the passage of time, temperature, and in certain cases moisture, corrosion, and aging. On completion of the course students will have at their disposal a scientifically based knowledge of the structure, properties, and use of construction materials. They will have knowledge of the composition, production, and specific behaviour of organic, metallic, and inorganic, non-metal construction materials and of the investigation into and the description of their characteristic material properties. From their knowledge of the related determinative mechanisms, they will also be able to assess the behaviour of materials under varied external influences. Still further, they will understand the definitive processes leading to the deterioration of construction materials and will be able to develop measures to secure and prolong the materials' service lives.
Teaching	60 hours of lecture (1,5 hours per week during lecture period) 60 hours of exercises (1,5 hours per week during lecture period)
Classification	The course is a required part of the basic *Diplom* course of study. It is a prerequisite for a variety of courses.
Prerequisites	Prerequisites are a basic knowledge at the German *Abitur*-level of mathematics, physics, and chemistry.
Examination	The examination procedure for the course consists of: 1. An examination (150 min) in the basics of construction materials and specifics related to organic and metallic materials and 2. An examination (150 min) in inorganic, non-metal construction materials.
Credits and Grading	On successful completion of the course 10 credits are awarded, i.e., when the course examination has been passed. The grade for the course is calculated as the arithmetic average of the two examinations.
Work Load	The total work load is 300 hours.
Duration and Frequency	3 semesters The course is offered each year beginning in the winter semester.

Number of module	**Name of module**	**Lecturer**
BIW1-09	Basic Sciences	**Möser**, Lordick

Content and Course Goals	Contents of the module are on the one hand practical applications of constructive geometrical methods and on the other hand principles for the survey and for setting out of industrial objects as well as basics for the determination of coordinates. Students have after conclusion of the module a structured spatial imagination and are qualified for the production and interpretation of engineering drawings and CAD representations. They can depict spatial objects and solve complex tasks constructive. Students will learn the definitions to the coordinate systems and reference systems and have a good command of the evaluation of measuring data. They can establish a connection between building design and surveying with the goal of keeping demanded accuracy parameters of geometry of the building.
Teaching	45 hours of lecture (1,5 hours per week during lecture period) 15 hours of exercises (0,5 hours per week during lecture period)
Classification	The module is a required module in the base studies of the diploma course of studies civil engineering.
Prerequisites	Good knowledge in mathematics and physics as well as acquired authority from the module Linear Algebra and Analysis (BIW1-05) are required.
Examination	The module examination consist of: 1st examination in constructive geometry (90 min) and 2nd examination in surveying (90 min) Prerequisites for the examination are: - one assignment to the extent of 10 hours for the examination in constructive geometry and - one assignment to the extent of 10 hours for the examination in surveying
Credits and Grading	5 credits. The module grade results from the arithmetic means of the grades of the two examinations
Work Load	150 hours for lectures and exercises including preparatory an follow-up work, preparation for exams and assignments.
Duration and Frequency	This module is offered every academic year, beginning in the winter semester, and continuing for two semesters.

Number of module BIW1-10	**Name of module** Environmental Sciences	**Lecturer** **Ullrich**, Dudel
Content and Course Goals	The module provides basic knowledge for the fundamental understanding of the principles of engineering-geological investigation and of the ecology and environmental protection of construction. Students will learn • Fundamental principles of geology and issues of engineering-geological investigation • The role of exogenic and endogenic geodynamical processes • Classification and identification of minerals • Classification and identification of rocks • Fundamental principles of ecology and environmental protection • Aspects of the analysis of ecological systems with focus on ecology of plants and micro-organisms; fundamental understanding of function, stability, dynamics and regeneration of natural and adequate ecosystems • Effects of complex disturbances in context with global change	
Teaching	45 hours lecture (1,5 hours per week during lecture period) 15 hours exercises (0,5 hours per week during lecture period)	
Classification	Required module in base studies.	
Prerequisites	Good knowledge in natural sciences (chemistry, physics).	
Examination	Written examination: 1st examination: engineering geology (90 min, at the end of the 2nd semester) 2nd examination: ecology and environmental protection (120 min, at the end of the 3rd semester) prerequisites for the examinations (engineering geology): • Certificate in mineralogy/petrography (identification of minerals and rocks) • Report on the field trip	
Credits and Grading	4 credits. The module grade is the arithmetic mean of the grades obtained from both examinations.	
Work Load	120 hours for lectures, exercises, and field trip, including preparatory and follow-up work, preparation for exams.	
Duration and Frequency	The module is offered every academic year, starting in the summer semester and continuing in the winter semester.	

Number of module	**Name of module**	**Lecturer**
BIW 1-11	Business Administration for Civil Engineers	Schach
Content and Course Goals	The objective of the module is to provide students with fundamental understanding of business administration in order to account for the specific requirements in construction industry. After passing this module, students will have a general knowledge of different subjects of business administration like legal forms, association networks as well as national and international statistics in construction industry.	
Teaching	30 hours of lecture (2 hours per week during lecture period)	
Classification	This module is a required module of the base studies within the study program of civil engineering. It provides essential qualifications for numerous modules of the main studies.	
Prerequisites		
Examination	Credits are acquired by successfully passing the module examination. The examination consists of a written test (90 minutes).	
Credits and Grading	2 credits can be acquired. The grade of the module results from the grade of the written test.	
Work Load	The total work load amounts to 60 hours.	
Duration and Frequency	The duration of the module is 1 semester. The module is offered every academic year, starting in winter semester.	

Number of module	**Name of module**	**Lecturer**
BIW1-12	Basic Common Qualifications	Graf

Content and Course Goals	The completion of the module provides students with basic common vocational qualifications of a civil engineer. There are different fields to choose from as for instance foreign languages, electronic means of communication, library use, environment, negotiation and presentation skills, social competence or team work.
Teaching	30 hours of lecture (2 hours per week during lecture period) Teaching methods correspond to §8 of the study regulations for the diploma course in civil engineering. The required number of courses is to be selected from the AQUA-catalogue that will be announced by the faculty in the beginning of the semester. This catalogue will also indicate the necessary examinations.
Classification	
Prerequisites	The module is a required module in the base studies of the basic diploma course in civil engineering.
Examination	The credits are acquired by passing the module examination. The module examination consists of the ungraded course credits indicated in the AQUA catalogue of the faculty of civil engineering.
Credits and Grading	2 credits can be earned in this module. The module is passed if all partial performances were passed otherwise the module is failed.
Work Load	The total work load amounts to 60 hours.
Duration and Frequency	The module is offered in the winter semester of every academic year and lasts one semester.

4.2.2 Requiredy modules for main studies

Number of module	**Name of module**	**Lecturer**
BIW2-01	Basics of Structural Design	Haller

Content and Course Goals	The module deals with aesthetics and design of building structures. It concentrates on the field of tension between civil engineering and architecture. Future civil engineers are introduced into the architectural point of view by means of historical and contemporary examples. After the completion of the module students will be enabled to better cooperate with architects. They will be familiar with positions in philosophical aesthetics and their change from ancient to modern times. Moreover, students will know the fundamentals of proportion and colour theories as well as means of design and presentation. They will be able to implement these in a design task that is to be carried out in a team.
Teaching	30 hours of lecture (2 hours per week during lecture period)
Classification	The module is a required module in the base studies of the diploma course in civil engineering. It lays the foundations for modules BIW2-05, BIW2-12, BIW3-02, BIW4-05, BIW4-09, BIW4-11, BIW4-16 to BIW4-18, BIW4-21, BIW4-56, BIW4-66, BIW4-76, and BIW4-77.
Prerequisites	Knowledge and skills acquired in the modules of base studies (BIW1-01 to BIW1-11). Eight weeks of practical training in the building trade are required (PO article 27, paragraph 1), for details see current version of Practical Training Guidelines.
Examination	The credits are acquired by passing the module examination. The module examination consists of an assignment with colloquium (group work, 20 hours per student).
Credits and Grading	2 credits. Module grade is given based on the grading of the assignment with colloquium.
Work Load	The work load totals to 60 hours.
Duration and Frequency	1 semester. The module is offered in the summer semester of every academic year.

Number of module	**Name of module**	**Lecturer**
BIW2-02	Statics	Kaliske

Content and Course Goals	Contents of the module are the basic theories of the computation of structures. The students own at the end of the module the ability to calculate simple structures. They are able to calculate internal forces, influence lines, limit values and limit value functions for internal forces statically and kinematically and to apply the principle of virtual displacements, the principle of virtual forces and to compute displacements at local positions of structures as well as displacement functions and displacement influence functions. The students know force method (flexibility method) and slope-deflection method (stiffness method) for the computation of internal forces and displacements as well as their influence lines. Further, they have first experience with physical and geometrical nonlinear problems within the scope of the elasticity theory II. order (stress and bifurcation problems) by means of slope-deflection method as well as yield hinge theory I. and II. order for constant and variably repeatable load processes.
Teaching	60 hours of lecture (1,5 hours per week during lecture period) 45 hours of exercises (1,0 hours per week during lecture period)
Classification	The knowledge of the basic studies (BIW1-01 to BIW1-11) is prerequisite.
Prerequisites	This module is a compulsory module of the main studies within the study program of Civil Engineering. It teaches the prerequisites for the modules BIW2-05, BIW3-02, BIW4-01 to BIW4-05, BIW4-09, BIW4-11, BIW4-12, BIW4-14 to BIW4-17, BIW4-21, BIW4-64 to BIW4-68, BIW4-76 as well as BIW4-77.
Examination	Credits are acquired, if the module examination is passed. The module examination consists of a written examination (240 min). Prerequisites for the exam: course work of 75 hours
Credits and Grading	8 credits can be earned in this module. The result of the module is the grade of the written examination.
Work Load	The total work load amounts to 240 hours.
Duration and Frequency	The duration of the module is 3 semester. The module is offered every academic year, starting in summer semester.

Number of module	**Name of module**	**Lecturer**
BIW2-03	Soil Mechanics and Foundation Engineering	Herle
Content and Course Goals	This module provides an introduction into the fundamentals of the mechanical behaviour of soils and foundation design. Upon completion of this course students will be able to describe in-situ soil conditions and to derive soil mechanical properties from results of laboratory and field tests, e.g. characterization of compressibility and shear strength. They will have learned methods for the calculation of earth pressure, slope stability and safety against base failure. The students will understand the concept of effective stresses to allow for pore water pressure in the subsoil and will have gathered knowledge about construction processes and the assessment of foundations and retaining structures.	
Teaching	45 hours of lecture (1,5 hours per week during lecture period) 45 hours of exercises (1,5 hours per week during lecture period)	
Classification	Required module to be taken during the period of main studies. It is prerequisite for the participation in BIW2-07, BIW3-04, BIW3-09, BIW4-05, BIW4-09 to BIW4-12, BIW4-17, BIW4-21, BIW4-46, BIW4-48, BIW4-50, BIW4-57, BIW4-61, BIW4-62, BIW4-66, BIW4-76 and BIW4-77.	
Prerequisites	Knowledge of the content of the basic studies (BIW1-01 to BIW1-11), in particular Engineering Mechanics (BIW1-03, BIW1-04) and Environmental Sciences (BIW1-10).	
Examination	One assignment (45 hours during the 4th semester, 15 hours during the 5th semester) as prerequisite for the participation in the written exam (180 min).	
Credits and Grading	6 credits. Module grade is given based on the written examination.	
Work Load	180 hours of lecture and exercises including preparatory and follow-up work and one assignment.	
Duration and Frequency	The module is offered every academic year beginning Summer Semester and continuing for two semesters (Spring/Summer - Winter).	

Number of module	**Name of module**	**Lecturer**
BIW2-04	Basics of Steel and Timber Construction	**Stroetmann**, Haller

Content and Course Goals	Contents of the module are basics of construction methods of steel and wood constructions. After having finished the module the student knows about the basics in construction, calculation and execution. Based on the technological properties of steel and steel products for "structural steelwork" the module enables the students to design and calculate simple structures (girders, columns, bracings and so on). Furthermore they are able to explain relevant cases of stability: flexural buckling and lateral torsional buckling and are able to carry out simplified verifications of structural safety. Students have basic knowledge in construction and calculation of bolted and welded connections and joints of steel components. After the completion of the module the students are well grounded in both wood and wood based products. In this connection the availability of resources and the transformation of raw timber into load bearing cross sections are of importance. The students will be able to understand mechanical and physical basics of wood and wood based products and their consequences for the construction. They will know about traditional as well as engineered wood connections and will understand their structural behaviour. Moreover, based on examples of built wooden constructions and buildings the students receive an overview of the latest developments in timber engineering and their characteristics.
Teaching	60 hours of lecture (4 hours per week during lecture period) 15 hours of exercises (2 hours fortnightly during lecture period)
Classification	Required module to be taken during main studies.
Prerequisites	Good knowledge of the modules of the basic study period.
Examination	1st examination: steel construction basics (90 min) 2nd examination: timber construction basics (90 min) Prerequisites for the examinations: • Successful completion of one assignment in steel construction (24 hours) and one assignment in timber construction (16 hours).
Credits and Grading	6 credits. The credits are acquired on the basis of the written examination. The total grade is the weighted average of the grades, where the exams have the following weightage: • steel construction basics: 3 weightage • timber construction basics: 2 weightage
Work Load	180 hours for lectures and exercises including preparatory and follow-up work, preparation for exams and assignment. Time for assignments: 40 hours while the university is in session.
Duration and Frequency	This module is offered every academic year in summer semester.

Number of module	**Name of module**	**Lecturer**
BIW2-05	Reinforced Concrete Construction	**Curbach**, Häußler-Combe

Content and Course Goals	This module will provide the basis for the design, construction and performance assessment of reinforced concrete including models and computational techniques for determining the load-carrying capacity of reinforced concrete elements. Upon completion of this module, students will be able to perform ultimate limit state analysis of reinforced concrete members including bending, normal, transverse and torsional forces and stability analysis based on strength, stiffness and bond behavior of steel and concrete. Students will be able to use physical models to identify serviceability state conditions such as cracking, deformation, creep, shrinkage, and tension. Principles of connection and anchoring will be presented, as well. Students will be able to design typical cross-sections/constructive units and determine predicted behavior of the design after completion of this module. This work will include particular detail such as connections, frames, and areas of concentrated force. Students will learn about the impact pre-stressed concrete can have on a structures, as well as normal methods of pre-stressing used. Comparisons will be made between the use of pre-stressed concrete and traditionally reinforced concrete. Students will be able to compute the effects of pre-stressing on overall loads and take into account friction, shear, shrinkage, and creep, as well as design pre-stressed concrete construction components.
Teaching	75 hours of lecture (1,5 hours per week during lecture period) 45 hours of exercises (1,0 hours per week during lecture period)
Classification	Required course. Pre-requisite for BIW3-02, BIW4-05, BIW4-09, BIW4-11, BIW4-12, BIW4-16, BIW4-17, BIW4-21, BIW4-52, BIW4-66, BIW4-76 as well as BIW4-77.
Prerequisites	Must be competent, knowledgeable, and skilled in basic civil engineering area obtained in BIW1-01 through BIW1-11, as well as areas of specialization from BIW2-01 (design) and BIW2-02 (statics).
Examination	Examination consists of one 180-minute examination. Proof of 60 hours of exercises and homework is required to take the examination.
Credits and Grading	8 credits. Grade is based upon examination results.
Work Load	240 total hours
Duration and Frequency	This module covers 3 semesters and is offered every academic year beginning Spring/Summer Semester with the 2nd and 3rd semesters continuing in the respective Winter and Spring/Summer Semesters that follow.

Number of module	**Name of module**	**Lecturer**
BIW2-06	Basic Knowledge of Construction Management	**Schach**, Jehle
Content and Course Goals	The objective of the module is to provide students with fundamental technical and economical knowledge in construction management regarding for example typical construction equipment, construction machinery, construction methods as well as organisational and economical relations. Students will furthermore gain basic knowledge in the compilation of bills of quantities, item specification, estimating and billing of construction structures. After passing this module, students will be able to assess the functionality and the process flow as well as the capabilities and possible fields of application of basic machinery in structural engineering. Regarding the domain of construction management, the students will be capable of working on basic constructional planning and organisation tasks under supervision of a tutor. They will gain competency in essential tasks of the compilation of bills of quantities, item specification, estimating and controlling.	
Teaching	60 hours of lecture (2 hours per week during lecture period) 60 hours of exercises (2 hours per week during lecture period)	
Classification	This module is a required module of the main studies within the study program of civil engineering. It provides essential qualifications and prerequisites for the modules BIW3-05, BIW3-06, BIW4-05, BIW4-09, BIW4-11, BIW4-12, BIW4-17, BIW4-21, BIW4-23, BIW4-25, BIW4-28, BIW4-29, BIW4-66, BIW4-76 as well as BIW4-77.	
Prerequisites	Competencies gained in the module Business Administration for Civil Engineers (BIW 1-11) are required.	
Examination	Credits are acquired by successfully passing the module examination. The examination consists of 1. a written test (240 minutes) and 2. an assignment (80 hours).	
Credits and Grading	10 credits can be acquired. The grade of the module results from the weighted arithmetic mean value calculated from both the written test (weighting factor 3) and the assignment (weighting factor 1).	
Work Load	The total work load amounts to 300 hours	
Duration and Frequency	The duration of the module is 2 semesters. The module is offered every academic year, starting in summer semester.	

Number of module	**Name of module**	**Lecturer**
BIW2-07	Infrastructure	**Wellner**, Werner, Ahrens

Content and Course Goals	Provide students with basic knowledge about the geometric design and the operation of the infrastructure systems. The Infrastructure course is designed to give students an overview about the design procedures and special requirements in the operation of infrastructure systems. The students are provided with knowledge about the connections between the settlement structure and the infrastructure as well as basic knowledge about the balance between private and public interests during the planning process of land development plans.
Teaching	90 hours of lecture (3 hours per week during lecture period) 15 hours of exercises (0,5 hours per week during lecture period)
Classification	Required module in the 5th and 6th semester for the students with the specialisation traffic; optional module in the 5th and 6th semester for the students with other specialisations.
Prerequisites	Fundamental knowledge from the module (BIW1-05), (BIW1-06), (BIW1-09) and (BIW2-03).
Examination	The credits are offered on the basis of a written examination of 180 min. Pre-requisite for the examination: Assignment
Credits and Grading	8 credits.
Work Load	240 hours of lecture and exercises including preparatory and follow-up work.
Duration and Frequency	Offered every academic year (begin of the module is the summer semester)

Number of module	**Name of module**	**Lecturer**
BIW2-08	Basics of Hydromechanics and Hydraulic Engineering	**Stamm**, Graw
Content and Course Goals	The module provides an overview of basics in Hydromechanics, Hydrology and Hydraulic Engineering. The module will start with basics in Hydrodynamics, which describe the model of fluid dynamics and its interactions with boundaries. The students will be able to calculate and evaluate laminar and turbulent flow in pipelines as well as free surface steady flow. In the second lecture the students will learn the essentials of Hydrology. Key aspects are elements of hydrological cycle, characteristics of rivers, flow formulas, statistical analyses of discharge series, use of rivers, basic legal aspects, water quality, EU Water Framework Directive and flood protection measures. In the lecture of Hydraulic Engineering the students will learn the use of relevant standards and requirements as well as the essentials of design, material selection and the construction process based on current examples. Similarly, the students are able to detect conflicts between hydraulic structures and ecological aspects that may arise from construction and operation.	
Teaching	4th semester: 30 hours of lecture, 15 hours of exercises 5th semester: 15 hours of lecture, 15 hours of exercises 6th semester: 30 hours of lecture, 15 hours of exercises	
Classification	Required course in main study period of civil engineering (except GEM), qualification for BIW3-08, BIW3-09, BIW3-10, BIW4-05, BIW4-09, BIW4-17, BIW4-46, BIW4-47, BIW4-48, BIW4-50, BIW4-51, BIW4-53, BIW4-61, BIW4-63 and BIW4-66.	
Prerequisites	Well founded knowledge of Mathematics and Mechanics (BIW1-05, BIW1-06) especially of Engineering Mechanics (BIW1-03, BIW1-04). Lecture notes and worked examples incl. solutions are offered.	
Examination	Written examination in Hydrodynamics (90 min.) and examination in Hydrology and Hydraulic Engineering (90 min.) pre-requirement: approved 2 assignments in Hydrology (10 h) and Hydraulic Engineering (10 h)	
Credits and Grading	8 credits. Module grade is given based on the grade point average of the examinations in Hydrodynamics as well as Hydrology and Hydraulic Engineering.	
Work Load	240 hours of lecture and exercises including preparatory and follow-up work, two assignments and preparation for the examinations.	
Duration and Frequency	The module is offered every academic year beginning in the Spring/Summer Semester and continuing for three semesters (Spring/Summer – Winter - Spring/Summer).	

Number of module	**Name of module**	**Lecturer**
BIW2-09	Information Management and Numerical Mathematics	**Scherer**, Reuter
Content and Course Goals	The module provides the basic methods and procedures of numerical mathematics and information management for the solution of natural scientific and economic problems in civil engineering. After completion of the module the students know the basic algorithms for solution of linear systems of equations and they are able to apply matrix methods as well as approximation and interpolation methods, especially spline methods. Fundamentals in civil engineering product models and their object oriented data models enable the students to deal with the complexity and heterogeneity of information in civil engineering, with the resultant distributed modular data structures as well as with the interoperability methods, necessary to implement them. The knowledge of fundamental methods for structuring and formalisation of complex engineering information enables the students to enter complex information in civil engineering software applications so that interoperability and communication are realized for cooperative planning and project work.	
Teaching	30 hours of lecture (1 hour per week during the lecture period) 30 hours of exercises (1 hour per week during the lecture period)	
Classification	Required module to be taken during the main studies period of the undergraduate diploma course in civil engineering, except for study specialization in GEM. The module provides the prerequisites for modules BIW3-12, BIW4-03, BIW4-05, BIW4-09, BIW4-17, BIW4-63 to BIW4-66 as well as BIW4-68.	
Prerequisites	Competences acquired in modules of the base studies (BIW1-01 to BIW1-11)	
Examination	Written exam of 120 minutes; one assignment (20 hours) as prerequisite for admission.	
Credits and Grading	4 credits. Module grade is based on the grading of the exam.	
Work Load	Total work load: 120 hours.	
Duration and Frequency	The module is offered every academic year beginning in the winter semester and continuing for two semesters (winter – summer)	

Number of module	**Name of module**	**Lecturer**
BIW2-10	Public Building Law	**Schach**, Hennig

Content and Course Goals	This module provides basic knowledge of legal rules under public law with special regard to building coverage. The module focuses in particular on regulations concerning the legitimacy of structures and buildings as well as their erection, use, modification, removal and necessary quality. After passing this module, students will have competences regarding construction planning law, building regulations law as well as environmental law. They will be able to balance the respective interests of property owner and general public.
Teaching	30 hours of lecture (2 hours per week during lecture period)
Classification	This module is a required module of the main studies within the study program of civil engineering. It provides essential qualifications and prerequisites for the modules BIW4-05, BIW4-09, BIW4-17, BIW4-20, BIW4-24, BIW4-66, BIW4-76 as well as BIW4-77.
Prerequisites	
Examination	Credits are acquired by successfully passing the module examination. The examination consists of a written test (90 minutes).
Credits and Grading	2 credits can be acquired. The grade of the module results from the grade of the written test.
Work Load	The total work load amounts to 60 hours.
Duration and Frequency	The duration of the module is 1 semester. The module is offered every academic year, starting in summer semester.

Number of module	**Name of module**	**Lecturer**
BIW2-11	Advanced Common Qualifications	Graf

Content and Course Goals	The completion of the module provides students with advanced common vocational qualifications of a civil engineer. There are different fields to choose from as for instance foreign languages, sociology, geography, law, economy, political science, location research, energy, social order, demography, forestry, world food affairs, sustainability, arts, medical science or hygiene.
Teaching	60 hours of lecture (4 hours per week during lecture period) Teaching methods correspond to §8 of the study regulations for the diploma course in civil engineering. The required number of courses is to be selected from the AQUA-catalogue that will be announced by the faculty in the beginning of the semester. This catalogue will also indicate the necessary examinations.
Classification	
Prerequisites	The module is a required module in the main studies of the basic diploma course in civil engineering, except for study specialization GEM.
Examination	The credits are acquired by passing the module examination. The module examination consists of the ungraded course credits indicated in the AQUA catalogue of the faculty of civil engineering.
Credits and Grading	4 credits can be earned in this module. The module is passed if all partial performances were passed otherwise the module is failed.
Work Load	The total work load amounts to 120 hours.
Duration and Frequency	The module is offered in the summer semester of every academic year and lasts one semester.

Number of module	**Name of module**	**Lecturer**
BIW2-12	Design and Energy Efficiency	Weller, May, Unnewehr

Content and Course Goals	This module deals with the basics of energy-efficient and sustainable building. Since both aspects are decisively influenced by the architecture and the building services, "green" buildings can only be created with integral architectural concepts. One focus lies in the appropriate design, its influence on the energy performance of buildings and its historical role for the ecological, energetic and economic architectural developments from ancient to modern times. A second goal of the module is the interdisciplinary cooperation between civil engineering and architecture. The students have an understanding of aesthetics, design, style, architectural attitudes as well as the basics of proportions, colour and materials in order to design a sustainable building. The students can design buildings and facades from an architect's point of view. Upon successful completion of the module the student will be able to account for and judge building designs in respect to energy efficiency and sustainability.
Teaching	60 hours of lecture (2 hours per week during lecture period) 30 hours of exercises (1 hour per week during lecture period)
Classification	Required course for the study specializion GEM
Prerequisites	Knowledge of the contents of the module BIW2-01
Examination	Credit points are gained with passing the module examinations Module examinations consist of: Assignment (80 hours) followed by a colloquium
Credits and Grading	8 credits. Module grade is given based on the grading of the assignment and the colloquium.
Work Load	240 hours for lectures and exercises including preparatory and follow-up work, assignment and preparation for the colloquium.
Duration and Frequency	This module is offered every academic year, starting in the winter semester and continuing for two semesters

Number of module	**Name of module**	**Lecturer**
BIW2-13	Building Envelope	Weller

Content and Course Goals	The content of this module comprises planning and implementing contemporary cladding systems. In addition to the technological development from historical walls to modern building skins, other main topics of the course are technically demanding facade concepts, rainscreen systems and curtain walls. In this context, the complex requirements for building envelopes are covered too, including structural safety, fire, noise, humidity, burglary, and thermal performance. Appropriate materials, used in building envelopes and processing of the design and construction stages, are also presented. After completion of the module, the students shall have the ability to plan, design and implement contemporary curtain wall systems. In addition, they shall have a profound knowledge of facade construction and use of appropriate materials for building envelopes, such as aluminum, steel, glass, plastics, wood, stone and concrete. The students shall be familiar with the principles of a material-appropriate design process and are therefore able to manage tasks of the building practice in the field of facade engineering.
Teaching	60 hours of lecture (1,5 hours per week during lecture period) 60 hours of exercises (1,5 hours per week during lecture period)
Classification	Required course for the study specialization GEM
Prerequisites	Good knowledge of the modules of the basic study
Examination	Credit points are gained with passing the module examinations Module examinations consist of: Written examination 120 min Prerequisites: Assignment (40 hours) followed by a colloquium
Credits and Grading	8 credits. Module grade is given based on the grading of the exam.
Work Load	240 hours for lectures and exercises including preparatory and follow-up work, assignment and exam.
Duration and Frequency	This module is offered every academic year, starting in the summer semester and continuing for three semesters

Number of module	**Name of module**	**Lecturer**
BIW2-14	Basics of Building Climatology and Building Energy Technology	**Grunewald**, Richter
Content and Course Goals	Content of the model are the essential parameters and mechanism of the system Climate-Building-User. A second focus is the technical basics of supply and removal of heat and the ventilation under consideration of interaction room climate and supply of heat and air. At the end of this module students will know the thermodynamic basics of room climate and the central issues of building climatology and building energy technology. They should be able to make appropriate proofs for winter and summer heat and moisture protection for a building. With this the students are able to design simple heating and ventilation systems.	
Teaching	30 hours of lecture (2 hours per week during lecture period) 30 hours of exercises (2 hours per week during lecture period)	
Classification	Compulsory module in civil engineering for the specialized study of building energy management (GEM). It is necessary for the modules BIW4-72, BIW4-74 until BIW4-77.	
Prerequisites	The knowledge of the topics from modules building construction (BIW1-01), building physics (BIW1-02), linear algebra and analysis (BIW1-05), linear differential equations and stochastic (BIW1-06) and building materials (BIW1-08) is required.	
Examination	One examination (90 min)	
Credits and Grading	4 credits. Module grade is given based on the result of the examination.	
Work Load	120 hours	
Duration and Frequency	1 semester	

Number of module	**Name of module**	**Lecturer**
BIW2-15	System and Information Model for the Building Life Cycle	Scherer
Content and Course Goals	The contents of the module are formal languages for system modelling and information modelling in order to formally represent buildings and their life cycle as highly complex systems. After completion of the module the students know the principals of system and information modelling. They are able to investigate buildings holistically and to map complex sub-systems like building envelop, occupancy or energy supply in data objects, data-sub-models and relations. The students are able to perform life cycle investigations as well as to control the interaction of sub-systems in order to provide both comfort in all rooms and efficient operation of the whole building. They are able to formalise the overall system in a system modelling language initially without geometrical specification and therewith to objectively investigate the operability. They are able to transform the system model in a next step in an object oriented information model and to connect this with a building information model with explicit geometry, in order to realise a continuous information management system which allows planning, simulation and control for design, operation, modification and renewal. The students acquire the competence to complement qualitative concept development and scenario-based simulation by quantitative system modelling in order to early identify weak spots, detect influences of system components modification and recognize sensible components.
Teaching	15 hours of lecture (1 hour per week during the lecture period) 15 hours of exercises (1 hour per week during the lecture period)
Classification	Required module to be taken during the main studies period of the undergraduate diploma course in civil engineering for study specialization in GEM. The module provides the prerequisites for modules BIW4-76 and BIW4-77.
Prerequisites	Competences acquired in module BIW1-07
Examination	Written exam of 90 minutes; one assignment (10 hours) as prerequisite for admission.
Credits and Grading	2 credits. Module grade is based on the grading of the exam.
Work Load	Total work load: 60 hours.
Duration and Frequency	The module is offered every academic year in the summer semester. Duration is one semester.

Number of module	**Name of module**	**Lecturer**
BIW2-16	Advanced Common Qualifications	Graf

Content and Course Goals	The completion of the module provides students with advanced common vocational qualifications of a civil engineer. There are different fields to choose from as for instance foreign languages, sociology, geography, law, economy, political science, location research, energy, social order, demography, forestry, world food affairs, sustainability, arts, medical science or hygiene.
Teaching	30 hours of lecture (2 hours per week during lecture period) Teaching methods correspond to §8 of the study regulations for the diploma course in civil engineering. The required number of courses is to be selected from the AQUA-catalogue that will be announced by the faculty in the beginning of the semester. This catalogue will also indicate the necessary examinations.
Classification	
Prerequisites	The module is a required module in the main studies of the basic diploma course in civil engineering for study specialization GEM.
Examination	The credits are acquired by passing the module examination. The module examination consists of the ungraded course credits indicated in the AQUA catalogue of the faculty of civil engineering.
Credits and Grading	2 credits can be earned in this module. The module is passed if all partial performances were passed otherwise the module is failed.
Work Load	The total work load amounts to 60 hours.
Duration and Frequency	The module is offered in the summer semester of every academic year and lasts one semester.

4.2.3 Required/Elective modules for main studies

Number of module	**Name of module**	**Lecturer**
BIW3-01	Basics of Structural Analysis	**Kaliske**, Graf, Zastrau

Content and Course Goals	Contents of the module are algorithms and methods for basic structural systems and their application to structures with practical relevance. The students are able to evaluate space and time variable loadings of structures with linear and nonlinear models and to determine the internal force and displacement state of structures relevant for practice with computer oriented methods. They know at the end of the module basic algorithms for finite element analyses of solid mechanics and fluid mechanics and have an overview on discretization methods as well as on applications to basic tasks of structural engineering, pavement constructions, hydraulic engineering and environmental problems. They know the assessment of FE analyses and conclusions for design. Further, the students own experience in the analysis of plate- and plain structures. They are able to carry out static computations for these structures.
Teaching	45 hours of lecture (1,5 hours per week during the lecture period) 45 hours of exercises (1,5 hours per week during the lecture period)
Classification	The knowledge of the basic studies (BIW1-01 to BIW1-11) is prerequisite.
Prerequisites	In the basic diploma course of Civil Engineering: - required module in the main studies for Structural Engineering and Computational Engineering - elective module in the main studies for the remaining specializations In the postgraduate study course of Civil Engineering: - elective module in the main studies The module teaches the prerequisites for the modules BIW4-01 to BIW4-04, BIW4-06, BIW4-07, BIW4-16, BIW4-64, BIW4-65, BIW4-67 as well as BIW4-68.
Examination	Credits are acquired if the module examination is passed. The module examination exists of: - 1st examination-paper (120 min) on Applications Statics and Dynamics - 2nd examination-paper (120 min) on Plain and Plate Structures Prerequisite for exam: - course work of 60 hours for the examination-paper - Applications Statics and Dynamics - course work of 20 hours in Introduction to discretization methods for the 2nd examination-paper Plain and Plate Structures course work of 20 hours for the 2nd examination-paper - plain and plate structure
Credits and Grading	8 credits can be earned in this module. The total grate is the weighted average of the grades in both courses.
Work Load	The total work load amounts to 240 hours.
Duration and Frequency	The duration of the module is 2 semester. The module is offered every academic year, starting in winter semester.

Number of module	**Name of module**	**Lecturer**
BIW3-02	Design of Concrete Members and Material Mechanics of Concrete	**Curbach**, Mechtcherine, Häußler-Combe
Content and Course Goals	This module presents information pertinent to building materials used to construct concrete structures including the load bearing capacity of such structures, as well as methods of construction. Upon completion of this module, students will be able to determine stiffness, deformation and crack behavior of concrete under tensile and compressive loads resulting from material temperature changes, dampness, creep and shrinkage. Lectures and exercises will focus on building material characteristics needed to conform to the design parameters specific to concrete structures. Students will develop an understanding of and ability to correctly use strut and tie models in this context while learning to recognize and identify specific characteristics of slabs, deep beams, and reinforced concrete foundations. Use of relevant information in calculations, construction and the determination of appropriate material use will be developed, as well. Students will learn the basic characteristics of masonry construction including specific calculations and relevant structural design methods.	
Teaching	60 hours of lecture (2 hours per week during lecture period) 30 hours of exercises (1 hour per week during lecture period)	
Classification	Required course for students in structural engineering, Recommended elective course for other engineering students	
Prerequisites	Competence in basic civil engineering areas obtained in BIW1-01 through BIW1-11, as well as areas of specialization including: BIW2-01 (basic design), BIW2-02 (statics) and BIW2-05 (reinforced concrete).	
Examination	Examinations consist of two exams – 1) one 90-minute exam on the material mechanics of concrete and 2) one 180-minute exam on masonry construction and reinforced concrete construction. A passed assignment (40 hours workload) is prerequisite for exam 2).	
Credits and Grading	8 credits. Module grade is given with the weighted average of the two exam scores, exam 1) with weight 1 and exam 2) with weight 2.	
Work Load	240 hours total (4 hours lecture and 2 hours exercises).	
Duration and Frequency	This module is offered every academic year beginning Winter Semester and continuing for two semesters (Winter – Spring/Summer).	

Number of module	**Name of module**	**Lecturer**
BIW3-03	Steel and Timber Construction and Application in Fracture Mechanics	**Stroetmann**, Haller, Mechtcherine

Content and Course Goals	Contents of the module are joining techniques and basics of theory of stability in steel construction, construction and joining techniques in timber construction and the utilization of fracture mechanics in steel and wood construction. After having finished the module students have well-founded knowledge of initiation and propagation of cracks in steel and timber components. They understand the basics of fracture mechanics, their experimentally determined characteristic values and the utilization in steel and timber code. Students will have consolidated knowledge of connections and joints of structural members with bolts and welds. In the theory of stability they have knowledge of the mechanical context of flexural buckling and lateral torsional buckling. They are able to determine bifurcation loads and internal forces according to 2nd order theory and to carry out typical stability analysis. Moreover, the module the students will understand the anatomical, mechanical and physical basics of wood and its polymers as well as their time related microstructural changes and damages. They will also be familiar with modifications of wood properties. They will be able to design wooden components and joints and know about the different types of wood construction.
Teaching	60 hours of lecture (2 hours per week during lecture period) 30 hours of exercises (1 hour per week during lecture period)
Classification	Required module to be taken during main study in the specialized study period of Structural Engineering, elective module for all other specializations.
Prerequisites	Well-founded knowledge of the modules of the basic study period, as well as of the module "basics of steel and timber construction" (BIW2-04).
Examination	1st examination: steel construction (120 min) 2nd examination: timber construction and application in fracture mechanics (90 min) Prerequisites for the examinations: • Successful completion of one assignment in timber construction and fracture mechanics (17 hours) and one assignment in steel construction (33 hours).
Credits and Grading	8 credits. The credits are acquired on the basis of the written examination. The total grade is the weighted average of the grades, where the exams have the following weightage: • steel construction: 2 weightage • timber construction and application in fracture mechanics: 1 weightage
Work Load	240 hours for lectures and exercises including preparatory and follow-up work, preparation for exams and assignment. Time for assignments: 50 hours while the university is in session.
Duration and Frequency	This module is offered every academic year beginning in winter semester and continuing for two semesters.

Number of module BIW3-04	**Name of module** Geotechnical Safety Assessment, Rock Mechanics, Tunneling and Technology of Building Materials	**Lecturer** **Herle**, Mechtcherine
Content and Course Goals	This module treats common proofs of safety for geotechnical engineering constructions, the fundamentals of the mechanical behavior of rock, of tunneling and of the engineering properties of building materials commonly used in geotechnical engineering. Upon completion of this module the students are proficient in geotechnical proofs of safety for foundations, retaining and earth structures, including soil improvement and underpinning. The students will have gained understanding of the mechanical behavior of rock and of rock mass classification for tunneling purposes. They will know essential underground construction methods and will be able to judge important phenomena of rock mass behavior. Furthermore, the students will have gained profound knowledge of (fiber) shotcrete technology, injection materials for ground improvement, behavior of concrete in aggressive groundwater and further topics related to the technology of building materials in geotechnical engineering and tunneling.	
Teaching	60 hours of lecture (2 hours per week during lecture period) 30 hours of exercises (1 hour per week during lecture period)	
Classification	Required module to be taken during the period of specialized studies in construction engineering. Elective module to be taken during the period of main studies, especially for the study specialization hydraulic and environmental engineering.	
Prerequisites	Knowledge of the content of module BIW2-03.	
Examination	One assignment (15 hours) in rock mechanics, one assignment (15 hours) in Geotechnical Safety Assessment, as prerequisite for the participation in the written exams Rock Mechanics and Technology of Building Materials (120 min) and Geotechnical Safety Assessment and Tunneling (120 min), respectively.	
Credits and Grading	8 credits. Module grade is given based on the arithmetic mean value of the grades of the two written exams.	
Work Load	240 hours of lecture and exercises including preparatory and follow-up work and two assignments.	
Duration and Frequency	This module is offered every academic year beginning Winter Semester and continuing for two semesters (Winter – Spring/Summer).	

Number of module	**Name of module**	**Lecturer**
BIW3-05	Basics of Project Planning	**Schach**, Jehle

Content and Course Goals	The objective of the module is to provide students with detailed basic knowledge in technical and economical project management. In addition to different techniques of concrete processing as well as the legal and organizational specifications on building construction, the main focus of the module lies on the basics of cost management, controlling, scheduling and an introduction to project development. After passing this module, the students will be able to solve small tasks in the fields of planning, administration and construction independently and to understand the fundamental aspects of feasibility studies and risk analyses.
Teaching	60 hours of lecture (2 hours per week during lecture period) 30 hours of exercise (1 hour per week during lecture period)
Classification	Within the consecutive study program of civil engineering: This module is a required module of the main studies for the study specializations Construction Management and "Building, Energy, Management". For all other study specializations, especially Construction Engineering, it is an elective module. Within the postgraduate program of civil engineering: This module is an elective module, especially for the study specialization Construction Engineering. It provides essential qualifications and prerequisites for the modules BIW4-23, BIW4-25.
Prerequisites	Competencies gained in the module Basic Knowledge of Construction Management (BIW2-06) are required.
Examination	Credits are acquired by successfully passing the module examination. The examination consists of a written test (180 minutes).
Credits and Grading	8 credits can be acquired. The grade of the module results from the grade of the written test.
Work Load	The total work load amounts to 240 hours
Duration and Frequency	The duration of the module is 2 semesters. The module is offered every academic year, starting in winter semester.

Number of module	**Name of module**	**Lecturer**
BIW3-06	Extensive Knowledge of Construction Management A	**Jehle**, Schach
Content and Course Goals	In the part Work Planning the students learn the using of network planning technique for time scheduling and controlling. Therefore lectures and exercises give an introduction into the practical work with project management software like calculating and dealing with buffer-times. Beside the network planning the time-chainage-chart for road-, railway- and pipeline-constructions are shown in detail. In the part Demolition and Recycling/Reclamation of Contaminated Sites the students get knowledge in the law to the promotion of the cycle economy and safety device of the environmental compatible removal of wastes (KrW/Abfg, v. 27. 09. 1994), in the securing of ecologically harmless disposal of waste and in the different ways of waste disposal claimed by the legal guidelines. Furthermore the lecture shows how the legal guidelines influence the designing of demolition and recycling of structures as well as the avoidance of waste and harmful substances in a view of economical standards, safety work and occupational safety. In the part Investment Calculation the students learn different methods of estimation investments and the understanding of key performance indicators derived by the balances and the all inclusive income statement. The lectures in Work Planning, Demolition and Recycling/Reclamation of Contaminated Sites and Investment Calculation belong to the module.	
Teaching	15 hours of lecture, 15 hours of exercises Work Planning in winter semester 15 hours of lecture Demolition and Recycling/Reclamation of Contaminated Sites in winter semester 30 hours of lecture Demolition and Recycling/Reclamation of Contaminated Sites in summer semester 15 hours of lecture Investment Calculation in summer semester	
Classification	Elective module to be taken during the specialized study period of Construction and Site Management.	
Prerequisites	Knowledge in Basic Knowledge of Construction Management A (module BIW2-06).	
Examination	The credits are acquired after the passed module examination. The examination consists of a test (180 minutes). The test is offered every examination period. Prerequisite for the examination is an acknowledged assignment in Demolition and Recycling/Reclamation of Contaminated Sites.	
Credits and Grading	8 credits. The mark of the module is the mark of the test.	
Work Load	Total expenditures: 240 hours for lectures and exercises including preparatory and follow-up work, preparation for exams and assignment. Time for assignment: 60 hours during the summer semester.	
Duration and Frequency	2 semesters. The module is offered every academic year, starting in winter semester.	

Number of module	**Name of module**	**Lecturer**
BIW3-07	Traffic Engineering	**Wellner**, Lippold, Fengler

Content and Course Goals	Provide students with basic knowledge of geometric design of roads and railroads. The Pavement Construction course is designed to give students (1) an introduction to pavements; (2) detailed information on pavement design aspects (3) give a sense of the complexity and variability associated with pavement construction. Several coordinated, reinforcing courses about geometric design of roads, pavement design and construction and railroad design and construction. In the course geometric design of roads, basic knowledge of road infrastructure planning, cross section design, alignment, and junction design of rural roads and motorways is imparted. Exercises include dimensioning and bases of calculation for roads. Acquired knowledge is applied on alignment of a rural road in the assignment. The pavement construction course is designed to overview both flexible and rigid pavement construction. The topics include more than pavement construction with the goal of achieving a broad understanding of pavements with specific emphasis on construction aspects. Subjects will include an introduction to pavement types, pavement loading conditions, materials, design considerations, pavement drainage systems and how to avoid early pavement failures.
Teaching	60 hours of lecture in pavement construction (2 hours per week during lecture period) 30 hours of exercises (1 hour per week during lecture period) 30 hours of lecture in geometric design of roads (1 hour per week during lecture period) 30 hours of lecture in design and construction of railroads (1 hour per week during lecture period)
Classification	Required module in the 5th and 6th semester for the students with the specialisation traffic; optional module in the 5th and 6th semester for the students with other study specialisations.
Prerequisites	Fundamental knowledge from the basic studies in civil engineering and the module "infrastructure (BIW2-07)"
Examination	The credits are offered on the basis of a written examination comprising sub-examinations in Pavement Construction, Geometric Design of Roads and Railway Construction. Pre-requisite for the examination: Assignment
Credits and Grading	8 credits. The module grade is the weighted average of the grades in the three courses chosen. Each of the three exams has to be passed. Pre-requisites for the examination: Assignment: 20 hours Geometric Design of Roads, 20 hours Pavement Construction 20 hours design and construction of railroads.
Work Load	240 hours of lecture and exercises including preparatory and follow-up work.
Duration and Frequency	Offered every academic year (begin of the module is the winter semester)

Number of module	**Name of module**	**Lecturer**
BIW3-08	Urban Water Management	**Wellner**, Krebs, Werner

Content and Course Goals	The module provides the basic knowledge on Urban water management as well as the design of assets and networks for water supply systems and waste water removal systems. This includes a special topic dealing with storm water handling. Students will learn to recognize, evaluate and solve problems concerning urban water management. They will be able to design and dimension the various assets.
Teaching	60 hours of lecture (2 hours per week during lecture period) 30 hours of exercises (1 hour per week during lecture period)
Classification	Required module in base studies for Urban and Traffic Engineering studies, elective module in base studies for all other directions.
Prerequisites	Knowledge from modules BIW2-07 and BIW2-08.
Examination	One written exam on Urban water management (90 min) and one written exam on Water and Waste Water Systems (180 min) Pre-requisites for examination: one accepted assignment in Urban water management (15 h) and two accepted assignments in Water and Waste Water Systems (25 h each).
Credits and Grading	8 credits. Module grade is given based on the weighted average of the grades from the two written exams, where the exam grade on Urban water management has the weight 1 and the exam grade on Water and Waste Water Systems has the weight 2.
Work Load	240 hours of lectures and exercises including preparatory and follow-up work and three assignments.
Duration and Frequency	The module is offered every academic year beginning Winter semester and continuing for 2 semesters (Winter – Summer)

Number of module	**Name of module**	**Lecturer**
BIW3-09	Dam Engineering and Hydroelectric Power Engineering	**Stamm**, Carstensen
Content and Course Goals	The first part of this module provides an overview of fundamental and special aspects of weir and dam engineering, reservoir operation and rehabilitation of hydraulic structures. The hydraulic and functional optimization of structures, the impermeability and safe integration of the structure in the underground are presented. Students will learn aspects of hydraulic and structural design, construction and operation. This module further includes dam outlet works, dam safety, instrumentation and surveillance, water management and water distribution as well as ecological aspects. The primary area of the second part is the energy production with hydroelectric power schemes. Students will learn terms and definitions, renewable energy, hydraulic turbines and their performance curves, run-of-river plants, power plant sequences, small hydropower facilities. This includes the evaluation of ecological conflicts, the design of structural parts and the economic efficiency calculation.	
Teaching	60 hours of lecture (2 hours per week during the lecture period) 30 hours of exercises (1 hour per week during the lecture period)	
Classification	Undergraduate Civil Engineering Course: required module to be taken during the specialized study period of hydraulic and environmental engineering. Elective module for other specialized study periods, especially in specialized study period of construction engineering. Postgraduate Civil Engineering Course: Elective module for specialized study period especially in specialized study period of construction engineering. The module is a precondition for modules BIW4-46, BIW4-48, BIW4-50, BIW4-51, BIW4-53 and BIW4-61.	
Prerequisites	Good knowledge of fundamentals including primary study modules in mechanics (BIW1-04), soil mechanics and foundation engineering (BIW2-03) and basics of hydromechanics and hydraulic engineering (BIW2-08).	
Examination	Two written examinations (120 min. each) pre-requirement: two assignments (30 hours each)	
Credits and Grading	8 credits. Module grade is given based on the grade point average of the examinations in Dam Engineering and Hydroelectric Power Engineering.	
Work Load	240 hours of lecture and exercises including preparatory and follow-up work, two assignments and preparation for the examinations.	
Duration and Frequency	This module is offered every academic year beginning in the Winter Semester and continuing in Spring/Summer Semester.	

Number of module	**Name of module**	**Lecturer**
BIW3-10	Advanced Hydromechanics	Pohl

Content and Course Goals	The module includes the non-steady flow under pressure and with free surface as well as special problems of hydromechanics like potential flow, density currents, distribution problems and ecohydraulics. Students will learn to identify non-steady and special hydraulic phenomena, to model these with appropriate mathematical approaches and to find qualitative and quantitative descriptions. The students will be able to solve hydromechanical problems within an interdisciplinary context.
Teaching	45 hours of lecture (1,5 hours per week during lecture period) 45 hours of exercises (1,5 hours per week during lecture period)
Classification	Elective module to be taken during the specialized study period of civil engineering.
Prerequisites	The competences acquired in the modules Advanced Mechanics (BIW1-04) as well as Applied Hydromechanics and Hydraulic Engineering (BIW2-08) are required.
Examination	The credits will be gained by passing the module exam which consists of 1st written exam (90 min) on Non-Steady Flow and 2nd written exam (90 min) on Special Hydrodynamics.
Credits and Grading	8 credits. Module grade is given based on the grades of the two exams.
Work Load	Approximately 240 hours including lectures, exercises, preparatory and follow-up work, preparation for the exam.
Duration and Frequency	The module is offered every academic year beginning in the Fall (Winter semester) and takes two semesters.

Number of module	**Name of module**	**Lecturer**
BIW3-12	Advanced Mathematical Methods for Engineers	Picard
Content and Course Goals	To enable students to have a working command of higher mathematical tools so that they are able to read and understand modern engineering literature and have a better grasp of the theoretical background of mathematical methods of engineering. To enhance the students capability to manage complex issues, develop their potential for creative research and to train their ability to communicate their insights to others. This module is dedicated to develop competencies in the comprehension and communication of the mathematical foundations underlying the description of models in various applied fields such as for example continuum mechanics, fluid dynamics, electrodynamics etc. These foundations comprise key ideas of tensor analysis, operator theory, approximation theory and calculus of variations.	
Teaching	60 hours of lecture (2 hours per week during the lecture period) 30 hours of excercises (1 hours per week during the lecture period)	
Classification	The module is an elective course in the advanced part of the diploma study track „Mechanical Engineering“ (Diplomstudiengang Bauingenieurwesen), in particular in the specialization „Constructional Engineering“ (Konstruktiver Ingenieurbau) and Computational Engineering. It is also an elective course in advanced studies track „Mechanical Engineering“ (Aufbaustudiengang Bauingenieurwesen), in particular in the specialization „Constructional Engineering“ (Konstruktiver Ingenieurbau). The modul supplies pre-requisites for modules BIW4-64, BIW4-65 and BIW4-68.	
Prerequisites	Firm command of mathematical concepts and techniques at the undergraduate level of a standard engineering curriculum. In particular, reliable operative knowledge of the concepts and methods of applied mathematical analysis and applied linear algebra. Openness towards exposure to more sophisticated ideas in the analysis of mathematical models.	
Examination	The credit points are acquired on the basis of passing the modul exam. The modul exam requirements are writing of a term paper (60 h) and presentation of its contents at a colloquium. The exam is offered every study year.	
Credits and Grading	On completion of this module 8 credits can be acquired. The grade of the module is the grade given for one assignment (a term paper) with colloquium.	
Work Load	Total work load for lectures, preparation and review, exam preparation and term paper: 240 h work load for term paper: 60 h during term and partly during term break at the end of the summer term	
Duration and Frequency	The module is offered every academic year beginning in the winter term and running for two consecutive semesters.	

Number of module	**Name of module**	**Lecturer**
BIW3-13	Advanced Fundamentals of Construction Informatics	Scherer

Content and Course Goals	The contents of the module are the fundamentals of system theory, propositional logic, predicate logic as well as basics in relational algebra and graph theory. After completion of the module the students know the basic concepts of propositional logic as well as the basic rules of first and second order logic. Therewith they are able to carry out conceptual modelling, logical reasoning and consistency checking of systems. Basic knowledge in system theory and methods for composition and formal representation qualify the students to distinguish between state-space-oriented, event-oriented and activity-oriented formulation. The students have basic knowledge in relational algebra and graph theory. Fundamentals of graph based network planning, like paths in networks, path algebra, flows in networks and basic knowledge about Petri Nets enable the students to formally represent functions of static and dynamic systems and check their consistency, e.g. distribution of forces in structures, transport flow (logistics) for urban planning or construction operation as well as information flow and workflow (information logistics) in projects. After completion of the module the students have the competence to formalise complex relationships and procedures in civil engineering and to model them holistically in a system model.
Teaching	60 hours of lecture (2 hours per week during the lecture period) 30 hours of exercises (1 hour per week during the lecture period)
Classification	Within the undergraduate diploma course in civil engineering: Elective module to be taken during the main studies period, especially for study specializations in Structural Engineering and Computational Engineering Within the graduate diploma course civil in engineering: Elective module, especially for study specialization in Structural Engineering The module provides the prerequisites for modules BIW4-22, BIW4-64 and BIW4-68 to BIW4-70.
Prerequisites	Competences acquired in modules of the base studies (BIW1-01 to BIW1-11)
Examination	Written exam of 180 minutes; two assignments (20 hours each) as prerequisite for admission.
Credits and Grading	8 credits. Module grade is based on the grading of the exam.
Work Load	Total work load: 240 hours.
Duration and Frequency	The module is offered every academic year beginning in the winter semester and continuing for two semesters (winter – summer)

4.2.4 Required/Elective modules for specialized studies

Number of module	**Name of module**	**Lecturer**
BIW4-01	Variational Principles / FEM and Structural Safety	Kaliske
Content and Course Goals	Contents of the module are basic variational principles, finite element method and stochastic methods for the assessment of structural safety. The students know the minimum principle of potential energy, approximate solution by Ritz-Timoshenko, energetic stability criteria and their application, Hamilton´s law / principle, Lagrange equations, application for stationary / non-stationary vibration, minimum principle of the complementary energy, approximate solution for elastic structures, displacement method of FEM, generalized variational principles and hybrid elements for folded plates. Further, they own first experience in finite elements being applied to geometrically and physically nonlinear statics as well as to time dependent loads. They own at the end of the module detailed knowledge on safety concepts with stochastic description of actions and resistance. Level 3 analysis (integral formulae for probability of failure, relation between failure of system and elements, series and parallel systems), level 2 analysis (safety index, 1st and 2nd order reliability theory, approximation of random load processes) and level 1 analysis (semi-probabilistic: partial safety factors, classification in proofs and in codes). At the end of the module, the students own detailed knowledge and competence on the solution of demanding tasks of structural engineering under application of numerical simulation models.
Teaching	60 hours of lecture (2 hours per week during the lecture period) 30 hours of exercises (1 hour per week during the lecture period)
Classification	The knowledge of modules Statics (BIW2-02) and Structural Analysis (BIW3-01) is prerequisite.
Prerequisites	In the basic diploma course of Civil Engineering: - compulsory module in the main studies for Structural Engineering - elective module in the main studies for the remaining specializations, in particular Computational Engineering In the postgraduate study course of Civil Engineering: - compulsory module for Structural Engineering - elective module for the remaining specializations, in particular Computational Engineering
Examination	Credits are acquired if the module examination is passed. The module examination consists of: - 1st examination (written, 120 min) on Variational Principles / Finite Element Methods - 2nd examination (oral, group examination, 15 min each student) on Structural Safety Prerequisite for the exam : - course work of 40 hours for the written examination - Variational Principles / Finite Element Methods - course work of 20 hours for the oral examination - Structural Safety
Credits and Grading	8 credits can be earned in this module. The total grade is the weighted average of the grades in the two courses. - Variational Principles / Finite Element Methods 66% Structural Safety 33%
Work Load	The total work load amounts to 240 hours.
Duration and Frequency	The duration of the module is 2 semester. The module is offered every academic year, starting in winter semester.

Number of module	**Name of module**	**Lecturer**
BIW4-02	Advanced Structural Analysis	**Kaliske**, Schneider, Graf, Kluger

Content and Course Goals	Contents of the module are computational models for lightweight and ultra lightweight structures, structural optimization / structural synthesis and aspects of static design. The students are able to evaluate the static and dynamic behavior of light and ultra light constructions, e.g. cable structures, glass and glass steel constructions as well as failure scenarios, safety concepts and stability problems. They have insight into advanced static and dynamic problems with the help of numerical studies and obtain a detailed theoretical background. They can develop rehabilitation and revitalization concepts from the evaluation and investigation of case studies. They own competence in problem description and solution methods of structural optimization. This includes beside classical optimization methods of the directed and the non-directed search, the application of penalty functions, evolution strategies, sequential linearization and vector optimization. The students own experience with structure optimization of structural synthesis on the basis of examples of structural optimization, shape optimization and cost optimization. The students can look into the structural design within the scope of the whole planning. Focal points are modeling of the load, effective computational models with the help of projects and the efficient solution of demanding static tasks.
Teaching	60 hours of lecture (2 hours per week during the lecture period) 30 hours of exercises (1 hour per week during the lecture period)
Classification	The knowledge from modules Statics (BIW2-02) and Structural Analysis (BIW3-01) is prerequisite.
Prerequisites	In the basic diploma course of Civil Engineering: - elective module in the main studies, in particular for Structural Engineering and Computational Engineering In the postgraduate study course of Civil Engineering: - elective module in the main studies, in particular for Structural Engineering and Computational Engineering
Examination	Credits are acquired if the module examination is passed. The module examination consists of: - 1st examination (oral, 30 min, individual test) on computational models of light and ultra light structures - 2nd examination (oral, 30 min, individual test) on Structural Optimization / Structural Synthesis - 3rd course work (20 hours) on Static Design Prerequisite for the exam: - course work of 30 hours for the oral examination - Computational models of light and ultra light structures - course work of 30 hours for the oral examination – Structural Optimization / Structural Synthesis
Credits and Grading	8 credits can be earned in this module. The total grade is the weighted average of the grades in the three courses. - Computational models of light and ultra light structures 40% - Structural Optimization / Structural Synthesis 40% Static Design 20%
Work Load	The total work load amounts to 240 hours.
Duration and Frequency	The duration of the module is 2 semester. The module is offered every academic year, starting in winter semester.

Number of module	**Name of module**	**Lecturer**
BIW4-03	Theory and Numerics of Shells	Zastrau

Content and Course Goals	This module provides the knowledge of solving fundamental problems of shell structures analytically as well as complicated problems by means of an appropriate engineering software. Furthermore, it provides the ability of evaluating critical cases and identifying sources of error in numerical solutions. The students know the basics of single- and double-curved shells within the framework of a linear theory. They are familiar with the basic assumptions and hypotheses of a technical theory of shells. Additionally, the students are proficient in calculating rotational shells using the membrane and bending theory of shells. They have the knowledge of the basic concepts of numerical solution methods, in particular the Finite Element Method (FEM). They know the mechanical models for the analysis of shells. The students are familiar with efficient finite elements for shells and their application for shell structures and, hence, are capable of solving nonlinear problems of shells. They can evaluate critical tasks and are able to identify and analyse sources of errors. After the successful completion of this module the students have the ability to dimension lightweight structures and to evaluate results of finite element simulations even for complex structures.
Teaching	60 hours of lectures (2 hours per week during lecture period) 30 hours of exercises (1 hour per week during lecture period)
Classification	Elective module to be taken during the specialized study period of Structural Engineering or Computational Engineering.
Prerequisites	Good knowledge of fundamental aspects including the primary study modules in mathematics, mechanics and structural analysis, as well as the required modules of the specialized studies in Structural Engineering or Computational Engineering.
Examination	One assignment and corresponding colloquium with 80 hours work load.
Credits and Grading	8 credits. Module grade is given based on the grading of the assignment and the colloquium.
Work Load	240 hours of lectures and exercises including preparatory and follow-up work, one assignment and preparation for the colloquium.
Duration and Frequency	This module is offered every academic year beginning in the winter semester and continuing for two semesters.

Number of module	**Name of module**	**Lecturer**
BIW4-04	Structures Subject to Extreme Loadings as Wind and Earthquake	**Graf**, Schneider
Content and Course Goals	The module deals with numerical methods of structural analysis of time-dependent extreme stress. The students acquire the ability frames of wind and earthquake using specific numerical models to calculate. Students have experience in the evaluation of time dependence of all inputs of structural analysis. They develop special solution methods for structural processes which are caused by time dependent loadings. They have in particular insight into physical phenomena and mechanical-mathematical descriptions of wind loading, interaction, numerical simulation, vibration, damping and constructive measures. The module provides students with knowledge of mechanical-mathematical description of earthquake, interaction, numerical simulation, risk assessment and risk analysis. The students have more detailed knowledge and skills to resolve specific tasks of structural design.	
Teaching	60 hours of lecture (2 hours per week during the lecture period) 30 hours of exercises (1 hour per week during the lecture period)	
Classification	Good knowledge of modules statics (BIW2-02) and structural analysis (BIW3-01)	
Prerequisites	The module is an elective module in the main studies of the basic diploma course in civil engineering.	
Examination	The credits are offered on the basis of two examinations, conducted in each semester. 1st examination (oral, 30 minutes, individually): structures subject to wind loading 2nd examination (oral, 30 minutes, individually): structures subject to earthquake loading Pre-examination outputs are: a study work of 40 hours for the oral audit structures subject to wind loading and a study work of 40 hours for the oral audit structures under earthquake	
Credits and Grading	8 credits can be earned in this module. The total grad is the weighted average of the grads in the two courses.	
Work Load	The total work load amounts to 240 hours.	
Duration and Frequency	The module is offered in the winter semester of every academic year and lasts two semesters.	

Number of module	**Name of module**	**Lecturer**
BIW4-05	Dynamics	**Kaliske**, Graf

Content and Course Goals	Contents of the module are methods and phenomena of the vibration of structures. The students are able to solve classical tasks of structural dynamics: eigenvalue problems, modal analysis, integral transform, tuned mass damper systems and Rayleigh quotient etc. They know numerical and analytical solution methods for structures excited by humans, machines, wind and earthquake and have insight into the evaluation of the usability with respect to people, buildings and machines. The students know methods of wave propagation, basics of system identification and oscillation measurement. Further, they own knowledge and abilities on simulation of dynamical systems. Main focus are adaptive time-stepping algorithms, error indicators and estimators, numerical stability, optimization of dynamical systems, advanced damping phenomena, frequency time transformation, integral transformations, fractional derivatives in dynamics, parameter-excited systems like wind-turbines, unbalanced rotors, systems with time-delay, bridges with moving loads and also problems of the active structural control. At the end of the module, the students own detailed knowledge and competence on the solution of dynamical tasks of structural design.
Teaching	60 hours of lecture (2 hours per week during the lecture period) 30 hours of exercises (1 hour per week during the lecture period).
Classification	The knowledge of the basic studies (BIW1-01 to BIW1-11) is prerequisite.
Prerequisites	In the basic diploma course of Civil Engineering: - elective module in the main studies for Structural Engineering and Computational Engineering In the postgraduate study course of Civil Engineering: - elective module for Structural Engineering and Computational Engineering
Examination	Credits are acquired if the module examination is passed. The module examination consists of: - 1st examination-paper (120 min) on Structural Dynamics - 2nd examination (oral, 30 min, individual test) on Simulation of Dynamical Systems Prerequisite for the exam: - course work of 30 hours for the examination-paper – Structural Dynamics - course work of 30 hours for the oral examination - Simulation of Dynamical Systems
Credits and Grading	8 credits can be earned in this module. The total grade is the weighted average of the grades in the two courses. - Structural Dynamics 66% Simulation of Dynamical Systems 33%
Work Load	The total work load amounts to 240 hours.
Duration and Frequency	The duration of the module is 2 semester. The module is offered every academic year, starting in winter semester.

Number of module	**Name of module**	**Lecturer**
BIW4-06	Continuum Mechanics and Theory of Materials with Applications	Zastrau

Content and Course Goals	This module provides an overview of the basics of tensor calculus, continuum mechanics, theory of materials, and structural models. The students know the basics of tensor calculus being necessary for the treatment of continuum mechanics and theory of materials. They are familiar with the essential contents of continuum mechanics and material theory and, therefore, are capable of describing the deformation of material bodies subjected to mechanical and thermal loads. Furthermore, they are able to formulate the conservation laws and balance equations for a deformable body. The students are familiar with the material descriptions for both elastic and inelastic deformations in the context of thermodynamics, and are able to characterize the consistency of the formulation within the framework of thermodynamics. They are aware of the limits of application imposed by the chosen structural model (e.g. beam or shell model) and can state its advantages and disadvantages. After the successful completion of the module the students have the ability to independently elaborate basic topics in the context of continuum mechanics, material theory, and structural models.
Teaching	60 hours of lecture (2 hours per week during lecture period) 30 hours of exercises (1 hour per week during lecture period)
Classification	Elective module to be taken during the specialized study period of Structural Engineering or Computational Engineering.
Prerequisites	Good knowledge of fundamental aspects including the primary study modules in mathematics, mechanics and structural analysis, as well as the required modules of the specialized studies in Structural Engineering or Computational Engineering.
Examination	One assignment and corresponding colloquium with 60 hours work load.
Credits and Grading	8 credits. Module grade is given based on the grading of the assignment and the colloquium.
Work Load	240 hours of lectures and exercises including preparatory and follow-up work, one assignment and preparation for the colloquium.
Duration and Frequency	This module is offered every academic year beginning in the winter semester and continuing for two semesters.

Number of module	**Name of module**	**Lecturer**
BIW4-07	Numerical Methods in Mechanics and Statics including Lightweight Structures	Zastrau

Content and Course Goals	This module provides an overview on common numerical methods in mechanics and statics and introduces into the design of lightweight structures. The students have the basic knowledge about the construction and dimensioning of lightweight shell structures modelled as flexural constructions and membranes. They are familiar with special aspects of finite element modelling for geometrically and physically non-linear simulations of shell structures. They can identify and analyse the reasons for artificial stiffening effects of finite elements and know methods to reduce them. Furthermore they are able to formulate and implement selected rate-independent and rate-dependent inelastic material models. The students are familiar with selected aspects of the numerical treatment of contact mechanics, fluid-structure interaction and related advanced topics. After the successful completion of the module, the students have the ability to dimension lightweight structures and to evaluate results of finite element simulations even for complex structures.
Teaching	60 hours of lecture (2 hours per week during lecture period) 30 hours of exercises (1 hour per week during lecture period)
Classification	Elective module to be taken during the specialized study period of Structural Engineering or Computational Engineering.
Prerequisites	Good knowledge of fundamental aspects including the primary study modules in mathematics, mechanics and structural analysis, as well as the required modules of the specialized studies in Structural Engineering or Computational Engineering.
Examination	One assignment and corresponding colloquium with 60 hours work load.
Credits and Grading	8 credits. Module grade is given based on the grading of the assignment and the colloquium.
Work Load	240 hours of lectures and exercises including preparatory and follow-up work, one assignment and preparation for the colloquium.
Duration and Frequency	This module is offered every academic year beginning in the winter semester and continuing for two semesters.

Number of module	**Name of module**	**Lecturer**
BIW4-08	Computational Building Physical Design and Construction	Grunewald
Content and Course Goals	Content of this module are physical models and parameter of heat and moisture transfer in building materials, building constructions and whole buildings as well as its implementation in analytical and numerical solutions. One focus is the use of this knowledge for the use of building physical simulation software for buildings in the frame of design and renovation, damage avoidance, energetic optimisation and optimal adjustment of the system building – facilities – user. One focus are practical examples from building renovation and new buildings including its realization. At the end of this module the student should have the ability to identify building physical problems and to solve these problems under use of appropriate software. Furthermore the student should be able to optimise a building energetically in order to guarantee a optimal room climate und minimal use of primary energy.	
Teaching	30 hours of lecture (1 hour per week during lecture period) 60 hours of exercises (2 hours per week during lecture period)	
Classification	Elective module to be taken during the specialized study of constructive civil engineering.	
Prerequisites	The knowledge of the topics from modules building construction (BIW1-01), building physics (BIW1-02), linear algebra and analysis (BIW1-05), linear differential equations and stochastic (BIW1-06) and building materials (BIW1-08) is required.	
Examination	One assignment (60 hours) and a corresponding colloquium.	
Credits and Grading	8 credits. Module grade is given based on the result of the assignment and colloquium.	
Work Load	240 hours.	
Duration and Frequency	2 semester. Beginning winter semester.	

Number of module	**Name of module**	**Lecturer**
BIW4-09	Structural Design	Haller

Content and Course Goals	The module presents basic principles and techniques for the structural design of building constructions regardless of construction materials and methods. It also presents methods and techniques for a systematic search for solutions and their analysis. The module concentrates on typologies by means of which load bearing structures can be classified according to shape (bar, plate, shell) and stress (tension, compression, bending). Particular attention is paid to the relationship between material, form and function. Form finding covers elementary geometric models, mathematical and physical principles of shape optimization as well as nature's examples. Consideration is also given to the collaboration between architects and civil engineers in structural planning and execution paying special attention to new technologies as e. g. computer-assisted production. New materials and technologies as well as insights into innovative developments are also included in the module. Students will know about the individual steps of the design and planning process and can apply methods and techniques of a systematic design, both model-based and computer-aided. This will be exercised during the exercises and by the assignment.
Teaching	60 hours of lecture (2 hours per week during lecture period) 30 hours of exercises (1 hour per week during lecture period)
Classification	In the diploma course in civil engineering: Elective module of main studies, especially for study specialization in structural engineering In the postgraduate course in civil engineering: Elective module, especially for study specialization in structural engineering
Prerequisites	Knowledge and skills acquired in the modules of base studies (BIW1-01 to BIW1-11) as well as in the modules of main studies (BIW2-01 to BIW2-10)
Examination	The credits are acquired by passing the module examination. The module examination consists of a written examination (90 minutes) and an assignment with colloquium (group work, 80 hours per student).
Credits and Grading	8 credits. The module grade is the arithmetic mean of the grades of the two examination parts.
Work Load	The work load totals to 240 hours.
Duration and Frequency	2 semesters. The module is offered in every academic year and starts in the winter semester.

Number of module	**Name of module**	**Lecturer**
BIW4-10	Geotechnical Investigations and Case Studies	Herle
Content and Course Goals	This module treats experimental methods in geomechanics and selected case studies of geotechnical engineering constructions. Upon completion of this module students are proficient in experimental laboratory and in situ methods for the examination of building ground including monitoring during construction processes. They will have learned conventional and special testing facilities and will be able to interpret experimental results and to derive material parameters for different constitutive models of soils. With the aid of case studies students will understand complex interrelations of geotechnical projects and will be able to plan geotechnical investigations and to judge measurements by means of rough calculations.	
Teaching	60 hours of lecture (2 hours per week during lecture period) 30 hours of exercises (1 hour per week during lecture period, (partly laboratory tutorials)	
Classification	Elective module to be taken during the period of main studies, especially for the study specializations construction, hydraulic and environmental engineering.	
Prerequisites	Knowledge of the content of module BIW2-03.	
Examination	One assignment (60 hours) and a corresponding colloquium.	
Credits and Grading	8 credits. Module grade is given based on the grade of the assignment and the colloquium.	
Work Load	240 hours of lecture and exercises including preparatory and follow-up work, one assignment and preparation for the colloquium.	
Duration and Frequency	This module is offered every academic year beginning Winter Semester and continuing for two semesters (Winter – Spring/Summer).	

Number of module	**Name of module**	**Lecturer**
BIW4-11	Design of Concrete Structures	Curbach

Content and Course Goals	The focus of this module is on the determination of suitable concepts and construction methods, technology, and techniques employed by engineered concrete structures, such as bridges, multi-storey buildings, towers and other buildings, all within the context of the effects of engineering on the structures' functions and form. Students will become familiar with the types of standard load-bearing systems used for a variety of engineered structures and be able to apply this knowledge to structure-/site-specific and functional situations gaining an understanding of the holistic design criteria relating to form, construction, and function, as well as ecology and economics. Students will be able to independently design, model and compute suitable system solutions while simultaneously working as part of a team to develop workable concepts which will be presented to interested third (public) parties.
Teaching	45 hours of lecture (1,5 hours per week during lecture period) 45 hours of exercises (1,5 hours per week during lecture period)
Classification	Required course for students in structural engineering, Recommended elective course for other engineering students
Prerequisites	Must be competent, knowledgeable, and skilled in basic civil engineering areas obtained in BIW1-01 through BIW1-11, as well as areas of specialization from BIW2-02 – BIW2-06
Examination	Students must successfully complete: one 90-minute exam (Winter semester) and one colloquium with team project work (60 hours of preparation for each course requirement).
Credits and Grading	8 credits. Grades are based on the average of the examination grade and the team project grade.
Work Load	240 hours total
Duration and Frequency	This module is 2 semesters and is offered every academic year beginning Winter Semester with the 2nd semester continuing in the Spring/Summer semester.

Number of module	**Name of module**	**Lecturer**
BIW4-12	Strengthening of Existing Concrete Structures	**Curbach**, Mechtcherine
Content and Course Goals	This module will provide instruction pertaining to the analysis, reinforcement, and repair and rehabilitation of existing concrete structures. More specifically, study will include the development of knowledge in static analyses based on computational and experimental methods and procedures. Students will be able to analyze the condition and load bearing capacity of existing structures and to subsequently plan and calculate various aspects of necessary strengthening measures needed for continued structural sustainability. Particular emphasis will be placed on the use of textile reinforced concrete (TRC) Upon completion of this module, students will be able integrate the use of modern concrete technology and methods into the rehabilitation of existing concrete structures. In particular, students will be familiar with the production, material characteristics and areas of application of high-performance concrete in which fiber reinforcement may or may not be used.	
Teaching	60 hours of lecture (2 hours per week during lecture period) 30 hours of exercises (1 hour per week during lecture period)	
Classification	Elective course (recommended for structural engineering students)	
Prerequisites	Must be competent, knowledgeable, and skilled in basic civil engineering areas obtained in BIW1-01 through BIW1-11, as well as areas of specialization from BIW2-02 – BIW2-06	
Examination	Examinations consist of two 120-minute exams – 1) one exam covering the strengthening of concrete structures and 2) one exam concerning high-performance concrete including measuring and experimental techniques.	
Credits and Grading	8 credits. Grades are based on the average of the examinations.	
Work Load	240 hours total (4 hours lecture, 2 hours exercises, and homework)	
Duration and Frequency	This module is 2 semesters and is offered every academic year beginning Winter Semester with the 2nd semester continuing in the Spring/Summer semester.	

Number of module	**Name of module**	**Lecturer**
BIW4-14	Steel Building Construction and Theory of Stability	Stroetmann

Content and Course Goals	Contents of the module are design, construction and evaluation of steel building constructions, especially hall constructions and crane runways, the analysis of fatigue resistance, warping torsion of members with thin-walled open sections, evaluation of stability of elements regarding to lateral torsional buckling as well as the buckling of plates and shells. After having finished the module students have well-founded knowledge of design, construction and evaluation of hall constructions, truss constructions and crane runways. They know different load-bearing systems and the stiffening of building constructions. They are able to carry out fatigue strength analysis based on Wöhler-curves, damage models and notch cases for welded and bolted constructions to avoid damages due to fatigue. Furthermore students have knowledge of the evaluation of members according to the warping torsion theory, including the calculation of section properties and the evaluation of the differential equation. The students have knowledge of the evaluation of members vulnerable to lateral torsional buckling considering specific effects like bracings, notches at the end of beams and interconnections. Furthermore they are able to determine the bifurcation load and load carrying capacity of plates and shells vulnerable to buckling.
Teaching	60 hours of lecture (2 hours per week during lecture period) 30 hours of exercises (1 hour per week during lecture period)
Classification	Elective module to be taken during the specialized study period of Structural Engineering.
Prerequisites	Well-founded knowledge of the modules of the basic study period, as well as of the modules "statics" (BIW2-02), "basics of steel and timber construction" (BIW2-04) and "steel and timber construction and application in fracture mechanics" (BIW3-03).
Examination	Examination (180 min) Prerequisites for the examination: • Successful completion of one assignment (50 hours)
Credits and Grading	8 credits. The credits are acquired on the basis of the written examination. The total grade is the grade of the examination.
Work Load	240 hours for lectures and exercises including preparatory and follow-up work, preparation for exams and assignment. Time for assignments: 50 hours while the university is in session.
Duration and Frequency	This module is offered every academic year beginning in winter semester and continuing for two semesters.

Number of module	**Name of module**	**Lecturer**
BIW4-15	Composite Constructions, Hollow Section Constructions and Cable-supported Structures	Stroetmann

Content and Course Goals	Contents of the module are design, construction and evaluation of buildings and components in composite constructions, hollow section constructions and cable-supported structures as well as corrosion protection. After having finished the module students have well-founded knowledge of evaluation and structural design of beams, columns and slabs in composite construction. They know the fabrication and mode of operation of the composite, the different shear connectors and their application, interaction of steel and concrete as well as the adequate utilization of both materials. They are able to apply design standards and methods, can verify structural safety and serviceability of constructions. Furthermore students have knowledge of the design and construction of hollow section constructions, the configuration of joints and the assessment of beams and their connections. Thereby shape stability of joints and the ductility of connections are of specific importance. Supplementary students know the different types of wire ropes, their fabrication and joining technique. They know the different application areas and kinds of construction of cable structures like cable girders, cable spoke wheel constructions and cable network claddings. Students are able to perform basic evaluations of cables including ultimate limit state analysis. Students have knowledge of different constructive and material possibilities for corrosion protection of steel constructions. To this belong metallic and organic coatings. They are able to choose a corrosion protection system depending on the corrosion risk due to environmental influence and the desired term of protection.
Teaching	60 hours of lecture (2 hours per week during lecture period) 30 hours of exercises (1 hour per week during lecture period)
Classification	Elective module to be taken during the specialized study period of Structural Engineering.
Prerequisites	Well-founded knowledge of the modules of the basic study period, as well as of the modules "statics" (BIW2-02), "basics of steel and timber construction" (BIW2-04) and "steel and timber construction and application in fracture mechanics" (BIW3-03).
Examination	Examination (180 min) Prerequisites for the examination: • Successful completion of one assignment (50 hours)
Credits and Grading	8 credits. The credits are acquired on the basis of the written examination. The total grade is the grade of the examination.
Work Load	240 hours for lectures and exercises including preparatory and follow-up work, preparation for exams and assignment. Time for assignments: 50 hours while the university is in session.
Duration and Frequency	This module is offered every academic year beginning in winter semester and continuing for two semesters.

Number of module	**Name of module**	**Lecturer**
BIW4-16	Bridge Construction	Stroetmann

Content and Course Goals	Contents of the module are design, construction and evaluation of steel, concrete and composite bridges. Thereby road bridges are relevant as well as railway and pedestrian bridges. After having finished the module students have well-founded knowledge of load assumptions on bridges, like dead and live loads as well as loads due to temperature, wind including aerodynamic effects or due to colliding ship. They know the different types of bridges like beam bridge, arched bridge, cable-stayed bridge and suspension bridge and are able to design, construct and analyze these types of construction. Furthermore they know rules for aesthetic design and construction of bridges. Students realize the interaction between local conditions, creative requirements and assembly process and are able to consider these factors during structural design. They are able to create adequate computation models and carry out a load bearing capacity analysis. They know the most important equipment elements for bridges like transition constructions, bearings and dewatering devices and are able to consider while planning.
Teaching	60 hours of lecture (2 hours per week during lecture period) 30 hours of exercises (1 hour per week during lecture period)
Classification	Elective module to be taken during the specialized study period of Structural Engineering.
Prerequisites	Well-founded knowledge of the modules of the basic study period, as well as of the modules (BIW2-01), (BIW 2-02), (BIW2-04), (BIW2-05), (BIW3-01), (BIW 3-02), (BIW3-03) of the main study period.
Examination	Examination (180 min) Prerequisites for the examination: • Successful completion of one assignment (60 hours)
Credits and Grading	8 credits. The credits are acquired on the basis of the written examination. The total grade is the grade of the examination.
Work Load	240 hours for lectures and exercises including preparatory and follow-up work, preparation for exams and assignment. Time for assignments: 60 hours while the university is in session.
Duration and Frequency	This module is offered every academic year beginning in winter semester and continuing for two semesters.

Number of module	**Name of module**	**Lecturer**
BIW4-17	Timber Construction and Fibre Reinforced Plastics (FRP)	Haller
Content and Course Goals	The module covers plastics in construction including their chemical, physical and mechanical fundamentals. Students can design simple structural components for temperature and time dependent stresses. Special attention is paid to fibre-reinforced plastics, their technology, analyses (laminate theory) and construction methods that the students will get to know and apply. A further important topic is timber construction including traditional and modern timber construction with an outlook into the latest developments. The students have theoretical knowledge of timber-concrete composite construction and its design. With the help of selected examples students are enabled to apply this knowledge in the field of restoration and new constructions especially of multi-storey timber structures. The students can describe the construction of shell and folded structures made of lattice-like connected boards and/or panel material and apply methods for form finding. On the basis of built examples they know different types of structures with their respective technical and structural features. The students are able to consider wooden bridges and footbridges in Europe and Northern America in a historical review reflecting the connection between design and state of the art. They have an insight into different types of current bridge constructions and recent developments. With regard to repair and reconstruction they know traditional timber construction methods of different times and cultural areas. The students have knowledge about damages in wood and wooden structures and know how to record and assess these damages by using non-destructive and low-destructive methods of diagnosis. In addition they know how to make use of techniques for their repair and reinforcement.	
Teaching	60 hours of lecture (2 hours per week during lecture period) 30 hours of exercises (1 hour per week during lecture period)	
Classification	In the diploma course in civil engineering: Elective module of main studies, especially for study specialization in structural engineering In the postgraduate course in civil engineering: Elective module, especially for study specialization in structural engineering	
Prerequisites	Knowledge and skills acquired in the modules of base studies (BIW1-01 to BIW1-11) as well as in the modules of main studies (BIW2-01 to BIW2-10)	
Examination	The credits are acquired by passing the module examination. The module examination consists of a written examination (120 minutes). Prerequisites for the examination are the completion of an assignment in timber engineering (60 hours, design task in groups) and an assignment in Fibre Reinforced Plastics (20 hours).	
Credits and Grading	8 credits. The module grade is the grade of the written examination.	
Work Load	The work load totals to 240 hours.	
Duration and Frequency	2 semesters. The module is offered in every academic year and starts in the winter semester.	

Number of module BIW4-18	**Name of module** Structural Glass	**Lecturer** Weller
Content and Course Goals	The lecture comprehensively deals with the bases of design and engineering of structural used glass in the field of civil engineering. This is especially directed towards to the constructing, appropriate for the material involved, with the brittle building material glass inside the building cover. Concepts of window systems, façades made of glass and transparent roof constructions are developed by means of practical examples. Furthermore knowledge of valid and future safety concepts, methods of analysis and design for horizontal and vertical glazing, overhead glazing, insulation glazing, glazing protecting against falling, point-fitted glazing as well as structural sealant glazing is imparted. The results of theoretical analysis are verified in practical component tests. The post break behavior as well as stability problems with the construction with glass are likewise treated. A final introduction to the expertise and assessment of cases of damage provides basic knowledge in the development of repair concepts. Besides the skills for constructing, calculating and measuring of structural glass constructions, practical qualification purpose is the knowledge of practical handling with non-regulated building products and designs of glass. The module includes the lectures of the field of structural glass constructions.	
Teaching	60 hours of lecture (2 hours per week during lecture period) 30 hours of exercises (1 hour per week during lecture period)	
Classification	Facultative core course in main study period, especially for the specialization in structural engineering. A parallel selection of the modules BIW4-64 and BIW4-73 is not possible.	
Prerequisites	Good knowledge of the modules of the basic study	
Examination	Credit points are gained with passing the module examinations Module examinations consist of: Written examination 120 min Prerequisites: Assignment (40 hours) followed by a colloquium.	
Credits and Grading	8 credits. Module grade is given based on the grading of the exam.	
Work Load	240 hours for lectures and exercises including preparatory and follow-up work, preparation for exams and assignments	
Duration and Frequency	The module is offered every academic year, starting in the winter semester and continuing for two semesters.	

Number of module	**Name of module**	**Lecturer**
BIW4-19	Damages on Building Construction	Weller

Content and Course Goals	Building damages are a very complex topic. The main focuses of the lectures are, especially in relation to residential buildings, the presentation of typical damages and very badly damaged building constructions. Damages which occurred because of wrong restoration issues are considered as well as damages at totally new building structures. With the help of examples damage diagnosis are visualized, the mechanization of damages shown and the rehabilitation methods demonstrated. A very important issue of the lecture is the often given advice to the variable assessment of damages with the help of standards, guidelines and instructions. Rehabilitation technology treats the restoration of existing buildings from the point of view of the structural design. The lectures deal with the analyses, of the planning, and of the methods of rehabilitation. Contents and methods of a good appraisal will be shown up as well as the instruments and methods of capture for an appropriate analysis of the structure. Based on this, suitable sanitation methods like the object-related plant maintenance or the reconditioning of building structures and the modernization will be explained. These structural measures will be exemplified with the help of building structures with different dates of origins. The student should be given the ability to develop damage analyses and to use effective and adequate renovation technologies. The module consists of the lectures treating damages of building structures and rehabilitation technology.
Teaching	60 hours of lecture (2 hours per week during lecture period) 30 hours of exercises (1 hour per week during lecture period)
Classification	Facultative core course in main study period
Prerequisites	Good knowledge from the basic module courses required.
Examination	Credit points are gained with passing the module examinations module examinations consist of: 1 assignment (80 h) including a colloquium
Credits and Grading	8 credits. Module grade is given based on the grading of the assignment and the colloquium.
Work Load	240 h for lectures exercises, preparatory work and follow up work, preparation for exams and assignments.
Duration and Frequency	The module is offered every academic year, starting in winter semester.

Number of module	**Name of module**	**Lecturer**
BIW4-20	Structures and Fire Prevention	Weller

Content and Course Goals	Design and construction are worked out together with the students of the faculty of architecture. To every architectural draft different versions of structures are under instruction developed and discussed. Rough static designs and calculations are a component of the draft planning. According to the requirements of the practice a fire prevention concept is provided to every building project interdisciplinary. An insight into the practical activity of a consultant engineer is given by the collaboration of students of the faculties of architecture and civil engineering. For the precautionary fire prevention the juridical and technical bases as well as the constructive, functional and conditioned of utilization connections are shown and explained applicable. At the same time the lecture refers to the classical standard works in the fire prevention as well as on current developments in the fire prevention engineering. Safety drafts are developed for special constructions like meeting sites, sales sites, accommodation sites, schools, high-rise buildings, kindergartens and garages. Protection intentionally orientated attempts also find special consideration in existing and monument-protected buildings. By practical examples the participants should learn the basic principles to secure a defined safety level and apply them. The participants are enabled to put up an entirely functioning, test- and approve capable, fire prevention concept. The module includes the lectures of the field of architecture, structure and fire prevention.
Teaching	60 hours of lecture (2 hours per week during lecture period) 30 hours of exercises (1 hour per week during lecture period)
Classification	Elective course in the specialized study period.
Prerequisites	Good knowledge of the modules of the basic study period
Examination	Credit points are gained with passing the module examinations Module examinations consist of: Assignment (80 hours) followed by a colloquium
Credits and Grading	8 credits. Module grade is given based on the grading of the assignment and the colloquium.
Work Load	240 hours for lectures and exercises including preparatory and follow-up work, preparation for exams and assignments
Duration and Frequency	The module is offered every academic year, starting in the winter semester and continuing for two semesters.

Number of module	**Name of module**	**Lecturer**
BIW4-21	Construction in Existing Structures – Repair Methods and Materials	Mechtcherine

Content and Course Goals	Included in the module are the diagnostic and repair methods for construction in and on existing structures as well as a discussion of the applicable technical procedures and materials. On completion of the module students will have deepened their knowledge of the durability of construction materials and components. They will be familiar with investigative methods in the diagnosis of problems in structures and with the harmful mechanisms worthy of note therein. Consequently they will understand the strategies and, with emphasis on concrete, reinforced concrete, and steel, the methods for building protection, maintenance, and restoration. Furthermore, they will be familiar with protection against corrosion and the materials and procedures used in reprofiling and constructive restoration. Beyond that, students will be able to use the corresponding technical references (norms, guidelines, etc.).
Teaching	60 hours of lecture (2 hours per week during lecture period) 30 hours of exercises (1 hour per week during lecture period)
Classification	Basic diploma course of study in civil engineering: Elective module in the main course of study, especially for study specialization of construction engineering as well as hydraulic engineering and environmental protection Intermediate course of study in civil engineering: Elective module, especially for study specialization of construction engineering as well as hydraulic engineering and environmental protection
Prerequisites	The skills learned in the basic modules BIW1-01 through BIW1-11 and in the basic speciality modules BIW2-01 through BIW2-06 are assumed.
Examination	The module is concluded with a final examination (180 min).
Credits and Grading	8 credits are given for successful completion of the module, i.e., on passing the final examination. Grade for the module is determined by the grade on the final examination.
Work Load	The total work load is 240 hours.
Duration and Frequency	The module covers 2 semesters and is offered every year, beginning in the winter semester.

Number of module	**Name of module**	**Lecturer**
BIW4-22	Co-operative Design Work and Numerical Methods	Scherer

Content and Course Goals	The contents of the module comprise basics of distributed information management, co-operation methods, workflow methods as well as fundamentals of numerical analysis. The students know after completion of the module numerical algorithms and methods for approximation of functions, differentiation and quadrature, for solution of non-linear equation systems, of boundary-value-problems for standard differential equations first and higher order, of partial differential equations and of Eigenvalue problems. The students have the knowledge to evaluate stability and uniqueness of numerical solutions. Basic knowledge about visualisation of multi-dimensional quantities enables the students to use graphical methods for targeted visualisation of engineering values and for the evaluation of the system behaviour. The students have knowledge in distributed information management with very long engineering transactions. They are skilled in co-operation methods, workflow methods and they have basic knowledge about data security. They have the mathematical and information-technological competence for networked, co-operative design and for co-operative solving of complex engineering problems.
Teaching	60 hours of lecture (2 hours per week during the lecture period) 30 hours of exercises (1 hour per week during the lecture period)
Classification	Within the undergraduate diploma course in civil engineering: Elective module to be taken during the main studies period, especially for study specializations in Structural Engineering and Computational Engineering Within the graduate diploma course in civil engineering: Elective module, especially for study specialization in Structural Engineering and Computational Engineering
Prerequisites	Competences acquired in modules of the base studies (BIW1-01 to BIW1-11) and module BIW3-13
Examination	One assignment (work load 40 hours) and a corresponding colloquium
Credits and Grading	8 credits. Module grade is based on the grading of the assignment and the colloquium.
Work Load	Total work load: 240 hours.
Duration and Frequency	The module is offered every academic year beginning in the winter semester and continuing for two semesters (winter – summer)

Number of module	**Name of module**	**Lecturer**
BIW4-23	Advanced Knowledge of Construction Planning and Construction Management	**Schach**, Jehle

Content and Course Goals	The objective of the module is to provide students with advanced knowledge of construction methods and the application of specifically developed equipment and machinery for special construction tasks under consideration of the particular boundary conditions. A further main topic is the thorough discussion of construction management and the corresponding tasks and functions of a site manager which result from regional building regulations as well as from the regulations within the construction company. The module deals furthermore with subjects of business management, organization and human resources management. After passing this module, students will be able to choose and plan optimal construction methods for road-, bridge-, tunnel-, and waterway constructions. In addition, they will be capable to assess the respective demands of different leading positions at constructions sites and in business departments. They will have the competency to develop structured and scientifically based solutions for different tasks in the field of construction management.
Teaching	60 hours of lecture (2 hours per week during lecture period) 30 hours of exercises (1 hour per week during lecture period)
Classification	Within the consecutive study program of civil engineering: This module is a required module of the main studies for the study specialization Construction Management. For all other study specializations, especially Construction Engineering, it is an elective module of the main studies. Within the postgraduate program of civil engineering: This module is a required module for the study specialization Construction Management. For all other study specializations, especially Construction Engineering, it is an elective module (The parallel choice of module BIW4-77 is not possible.)
Prerequisites	Competencies gained in the modules Basic Knowledge of Construction Management (BIW2-06) and Basics of Project Planning (BIW3-05) are required.
Examination	Credits are acquired by successfully passing the module examination. The examination consists of 1. a written test (120 minutes) concerning special construction methods, construction management as well as business management and organization and 2. an assignment (80 hours) with colloquium reflecting the content of "Seminar für Baubetriebswesen".
Credits and Grading	8 credits can be acquired. The grade of the module results from the weighted arithmetic mean value calculated from both the written test (weighting factor 2) and the assignment with colloquium (weighting factor 1).
Work Load	The total work load amounts to 240 hours
Duration and Frequency	The duration of the module is 2 semesters. The module is offered every academic year, starting in winter semester.

Number of module	**Name of module**	**Lecturer**
BIW4-24	Building Laws and Legal Regulations	Schach

Content and Course Goals	The objective of the module is to provide students with advanced knowledge of private and public building law as well as other legally relevant topics. Further subjects included are collective bargaining law, labor law and building and construction politics. The main focus regarding public law covers the most important public building laws like the Federal German Building Code, the Saxon Building Regulations, laws for the protection of historical buildings, the natural ground and water supply as well as the construction site ordinance and the real estate agents and developer ordinance. After passing this module, the students will be able to assess typical legal problems of construction management and to react appropriately. They will have the competency to handle construction projects and building contracts, including remuneration, liability, warranty and acceptance, in compliance with jurisdiction.
Teaching	90 hours of lecture (3 hours per week during lecture period)
Classification	Within the consecutive study program of civil engineering: This module is a required module of the main studies for the study specializations Construction Management and "Building, Energy, Management". For all other study specializations, especially Construction Engineering, it is an elective module of the main studies. Within the postgraduate program of civil engineering: This module is a required module for the study specializations Construction Management and "Building, Energy, Management". For all other study specializations, especially Construction Engineering, it is an elective module.
Prerequisites	Competencies gained in the module Public Building Law (BIW2-10) are required.
Examination	Credits are acquired by successfully passing the module examination. The examination consists of a written test (120 minutes).
Credits and Grading	8 credits can be acquired. The grade of the module results from the grade of the written test.
Work Load	The total work load amounts to 240 hours.
Duration and Frequency	The duration of the module is 2 semesters. The module is offered every academic year, starting in winter semester.

Number of module	**Name of module**	**Lecturer**
BIW4-25	Software in Construction Management	Schach

Content and Course Goals	The objective of the module is to provide students with skills in the computer-aided planning, realization and billing of a construction project. Based on a case study, they will learn how to use commercial construction management software. After passing this module, the students will be able to use up-to-date construction management software in the most important phases of a construction project. They will gain competency in the computer-aided compilation of bills of quantities, item specification, estimating, work execution estimating and project costing as well as break even analysis, cost and activity accounting, time scheduling and billing of construction projects. Students will understand the structure of an integrated cost and time controlling and will know how scheduling and calculation software can be profitably combined. In addition with fundamental understanding of the causes, results and documentation of flaws in the construction progress, they will be able to conduct computer-aided claim-management.
Teaching	30 hours of lecture (1 hour per week during lecture period) 60 hours of exercises (2 hours per week during lecture period) Exercises will be carried out partly as lectured seminars and partly as hands-on group seminars using provided computer equipment.
Classification	Within the consecutive study program of civil engineering: This module is an elective module of the main studies, especially for the study specializations Construction Engineering, Construction Management and "Building, Energy, Management". Within the postgraduate program of civil engineering: This module is an elective module, especially for the study specializations Construction Engineering, Construction Management and "Building, Energy, Management".
Prerequisites	Competencies gained in the modules Basic Knowledge of Construction Management (BIW2-06) and Basics of Project Planning (BIW3-05) are required.
Examination	Credits are acquired by successfully passing the module examination. The examination consists of a written test (90 minutes). Mandatory prerequisite for the examination: - an assignment (80 hours)
Credits and Grading	8 credits can be acquired. The grade of the module results from the grade of the written test.
Work Load	The total work load amounts to 240 hours.
Duration and Frequency	The duration of the module is 2 semesters. The module is offered every academic year, starting in winter semester.

Number of module	**Name of module**	**Lecturer**
BIW4-26	Finishing Works and Building Services	**Schach**, Jehle, Richter

Content and Course Goals	In the part Finishing Works the students get extensive knowledge in the field of turn-key-projects, especially the knowledge of specific finishing trades like plastering, tile setting and dry constructions. Furthermore the lecture provides information about the used materials, different manufacturing processes, typical design and construction mistakes and practical steps for quality assurance. In addition the lecture deals with general information about delimitation of performances, incidental works, special attendance and billing after VOB/C. In the part Building Services the students learn important interdisciplinary connections for understanding the multiple character of building and running buildings. Therefore the lecture provides knowledge in meteorological, physiological and room air hygienically basics, energy-saving constructions, heating systems, ventilation systems, air condition, room airstreams, smoke extraction, gas plants, flue gas systems, water supply and sewage technologies. The lectures in Finishing Trades and Building Services belong to the module.
Teaching	90 hours of lecture (3 hours per week during lecture period)
Classification	Elective module to be taken during the specialized study period of Construction and Site Management.
Prerequisites	none
Examination	The credits are acquired after the passed module examination. The examination consists of a test (90 minutes). The test is offered every examination period.
Credits and Grading	8 credits. The mark of the module is the mark of the test.
Work Load	Total expenditures: 240 hours for lectures including preparatory and follow-up work, preparation for exams.
Duration and Frequency	2 semesters. The module is offered every academic year, starting in winter semester.

Number of module	**Name of module**	**Lecturer**
BIW4-27	Concrete and Prefabricated Constructions	Jehle
Content and Course Goals	In the part Concrete Constructions the students learn the design of formwork and formwork systems, quality criteria's for reinforcement works and specific processes in construction works on sites. The production of concrete, the transportation, the placing of fresh concrete and the concrete curing are also represented in the lectures. Another emphasis beside information about exposed concrete, cement gun concrete, self-compacting concrete, underwater concrete or the making of waterproof concrete are typical concrete damages, the causes and their repair procedures. Finally the students should acquire the skills to realize the influences of concrete production und concrete processing to the quality and durability of concrete structures. The skills are later on the basics for the designing and execution phase. In the part Prefabricated Constructions the students learn the basics of designing, construction, manufacturing and erection of prefabricated units. Furthermore the lecture deals with the typology of prefabricated units, framed structures, elements for multi-storey-buildings and halls, prefabricated units for facades and roofs, dimensional tolerances, special aspects of structural performance and stiffing, constructively design of system points, fastening technologies, organisation and internal procedures in precasting plants, technologies of transportation and erection, quality assurance, cost estimating and marketing. The lectures Basics in Technologies of Concrete Structures, Selected Topics in Technologies of Concrete Structures and Prefabricated constructions belong to the module.
Teaching	75 hours of lecture (2,5 hours per week during lecture period) 15 hours of exercises (0,5 hour per week during lecture period)
Classification	Elective module to be taken during the specialized study period of Construction and Site Management.
Prerequisites	Because of overlapping of contains and qualifications it is not possible to gather credits on module BIW 4-12 and on module BIW4-27.
Examination	The credits are acquired after the passed module examination. The examination consists of a test (120 minutes). The test is offered every examination period. Prerequisite for the examination is an acknowledged assignment in Selected Topics in Technologies of Concrete Structures.
Credits and Grading	8 credits. The mark of the module is the mark of the test.
Work Load	Total expenditures: 240 hours for lectures and exercises including preparatory and follow-up work, preparation for exams and assignment. Time for assignment: 50 hours during the semester.
Duration and Frequency	2 semesters. The module is offered every academic year, starting in winter semester.

Number of module	**Name of module**	**Lecturer**
BIW4-28	Special Topics in Construction Business Management	Schach

Content and Course Goals	The objective of the module is to provide students with advanced knowledge of the components and tasks of accounting, the basics of business accounting including balancing and profit-and-lost accounting in construction companies as well as special knowledge of construction management accounting with Cost Codes, Cost Centres and performances and results accounting. Special topics in cost estimation with focus on the calculative consideration of special quantities (e.g. contingency item, alternative item etc.) are discussed. The module provides furthermore knowledge in special topics of corporate management based on expert experiences presented by executive managers of industry companies on several subjects like controlling in turnkey construction, quality management or human resources management. After passing this module, students will be able to understand the systematic of accounting and balancing. In the field of construction management accounting, they will be capable to assess the results of different kinds of allocation. They will be able to independently compile and calculate claims and to conduct a break even analysis. Based on the imparted knowledge in Operations Research, students are able to identify typical problems and to solve them with suitable approaches. Students will also have a thorough understanding of controlling, quality management and human resources management.
Teaching	75 hours of lecture (2,5 hours per week during lecture period) 15 hours of exercises (0,5 hour per week during lecture period)
Classification	Within the consecutive study program of civil engineering: This module is an elective module of the main studies, especially for the study specialization Construction Management. Within the postgraduate program of civil engineering: This module is an elective module, especially for the study specialization Construction Management. (The parallel choice of module BIW4-77 is not possible.)
Prerequisites	Competencies gained in the module Basic Knowledge of Construction Management (BIW2-06) are required.
Examination	Credits are acquired by successfully passing the module examination. The examination consists of a written test (120 minutes).
Credits and Grading	8 credits can be acquired. The grade of the module results from the grade of the written test.
Work Load	The total work load amounts to 240 hours.
Duration and Frequency	The duration of the module is 2 semesters. The module is offered every academic year, starting in winter semester.

Number of module	**Name of module**	**Lecturer**
BIW4-29	Project Development	**Schach**, Jehle

Content and Course Goals	The objective of the module is to provide students with basic knowledge of the financing of private and public construction projects. It focuses especially on operative and strategic relations used by financial institutions, on the importance of feasibility studies for international projects and real estate valuations. The module will also deal with construction economics including the influence of construction and site planning on costs and cost monitoring. After passing this module, students will have a profound understanding of the manifold avoidable proprietor's risks. Guided by a supervisor, they will be able to minimize these risks by employing complex measurements of time, quality and cost controlling. They will have the competency to coordinate the great amount of information and data from technology, economy and legislation. With respect to legal concerns, they will be able to account for the special characteristics of national and international contracts for real estate, infrastructure as well as provision and disposal services in all phases of construction planning.
Teaching	75 hours of lecture (2,5 hours per week during lecture period) 15 hours of exercises (0,5 hour per week during lecture period)
Classification	Within the consecutive study program of civil engineering: This module is an elective module of the main studies, especially for the study specializations Construction Management and "Building, Energy, Management". Within the postgraduate program of civil engineering: This module is an elective module, especially for the study specializations Construction Management and "Building, Energy, Management".
Prerequisites	Competencies gained in the module Basic Knowledge of Construction Management (BIW2-06) are required.
Examination	Credits are acquired by successfully passing the module examination. The examination consists of 1. a written test (120 minutes) and 2. an assignment (80 hours) with a colloquium on project development and construction economics.
Credits and Grading	8 credits can be acquired. The grade of the module results from the weighted arithmetic mean value calculated from both the written test (weighting factor 2) and the assignment with colloquium (weighting factor 1).
Work Load	The total work load amounts to 240 hours.
Duration and Frequency	The duration of the module is 2 semesters. The module is offered every academic year, starting in winter semester.

Number of module	**Name of module**	**Lecturer**
BIW4-30	Corporate Real Estate Management	Schach

Content and Course Goals	The module focuses on different approaches that allow companies owning a stock of real estates and buildings to systematically organize their corporate real estate management. Main topics in the field of Facility Management (FM) are Commercial FM, Technological FM, Infrastructural FM and floor space management. After passing this module, students will be able to assess different strategies with respect to their particular advantages and disadvantages. Furthermore, students will be able to use common CAFM-Software (Computer Aided Facility Management) in FM planning.
Teaching	60 hours of lecture (2 hours per week during lecture period) 30 hours of exercises (1 hour per week during lecture period)
Classification	Within the consecutive study program of civil engineering: This module is an elective module of the main studies, especially for the study specializations Construction Management and "Building, Energy, Management". Within the postgraduate program of civil engineering: This module is an elective module, especially for the study specializations Construction Management and "Building, Energy, Management".
Prerequisites	None
Examination	Credits are acquired by successfully passing the module examination. The examination consists of 1. a written test (90 minutes) and 2. an assignment (60 hours) with a colloquium on corporate real estate management.
Credits and Grading	8 credits can be acquired. The grade of the module results from the weighted arithmetic mean value calculated from both the written test (weighting factor 2) and the assignment with colloquium (weighting factor 1).
Work Load	The total work load amounts to 240 hours.
Duration and Frequency	The duration of the module is 2 semesters. The module is offered every academic year, starting in winter semester.

Number of module	**Name of module**	**Lecturer**
BIW4-31	Special Topics of Construction Management	Schach

Content and Course Goals	The objective of the module is to provide students with basic knowledge of Accident Prevention Regulations and the Construction Site Ordinance. Other main topics are strategic corporate management, communication and negotiating. After passing this module, students will have a profound knowledge of the measurements which must be taken by the proprietor in order to enforce safety and health protection at the construction site. They will be able to use basic techniques and skills required for successful communication and negotiating. In addition, they will have knowledge of business and human resources planning, customer orientation and risk management.
Teaching	60 hours of lecture (2 hours per week during lecture period) 30 hours of exercises (1 hour per week during lecture period)
Classification	Within the consecutive study program of civil engineering: This module is an elective module of the main studies, especially for the study specializations Construction Engineering and Construction Management. Within the postgraduate program of civil engineering: This module is an elective module, especially for the study specializations Construction Engineering and Construction Management.
Prerequisites	None
Examination	Credits are acquired by successfully passing the module examination. The examination consists of 1. a written test (90 minutes) concerning safety and health protection, the construction site ordinance as well as strategic corporate management in construction industry and 2. an assignment (45 hours) with a colloquium on the construction site ordinance. Mandatory prerequisite for the written test: - participation in the seminar "Communicating/Negotiating"
Credits and Grading	8 credits can be acquired. The grade of the module results from the weighted arithmetic mean value calculated from both the written test (weighting factor 2) and the assignment with colloquium (weighting factor 1).
Work Load	The total work load amounts to 240 hours.
Duration and Frequency	The duration of the module is 2 semesters. The module is offered every academic year, starting in winter semester.

Number of module	**Name of module**	**Lecturer**
BIW4-32	Selected Topics in Construction Methods	Jehle

Content and Course Goals	In the module the students get knowledge in important automation systems in the fields of earthworks, civil engineering, tunnelling and building constructions. Therefore the lecture provides basics in measuring, controlling and regulating, mechatronics and cybernetics as well as the latest developments in constructions technologies like laser and the use of automation of formwork. In the field of mechanics and techniques of construction plants the students will be qualified to dispose decisions about constructively and using-oriented solutions for machinery like technical basic knowledge about the plant requirements, technical working of specific assembly units and maintenance. In the field of mechanisation in construction different representatives of the construction plant industry as well as of construction equipment service provider's present news and ongoing developments in industry. Trends in design and development are exemplified on practical applications. Technologies, arising economical aspects and calculation of profitability are also part of the lecture. The lectures Automation in Construction, Mechanics and Techniques of Construction Plants and Mechanisation in Constructions belong to the module.
Teaching	75 hours of lecture (2,5 hours per week during lecture period) 15 hours of exercises (0,5 hour per week during lecture period)
Classification	Elective module to be taken during the specialized study period of Construction and Site Management.
Prerequisites	none
Examination	The credits are acquired after the passed module examination. The examination consists of a test (120 minutes). The test is offered every examination period.
Credits and Grading	8 credits. The mark of the module is the mark of the test.
Work Load	Total expenditures: 240 hours for lectures and exercises including preparatory and follow-up work, preparation for exams.
Duration and Frequency	2 semesters. The module is offered every academic year, starting in winter semester.

Number of module	**Name of module**	**Lecturer**
BIW4-33	Software Systems	Scherer

Content and Course Goals	The module comprises the conception of integrated software systems, the development of databases and the integration of external software components. Key aspects are practical methods of system development, conception, structuring and application of databases as well as conception of interfaces. After completion of the module the students have skills in requirements analysis, formalisation of information processes and flows as well as the design of system architecture, meta-data structure and software specifications. Especially they have the competence to use generally available, customary software tools and standardised data structures. Furthermore the students can design the database structure using established database systems, implement databases using standard tools, conceive interfaces, data converter and filter integrate external webservices. After completion of the module the students are qualified to design and develop an integrated information system that meet both the requirements of a construction project and the usage of existing proprietary software.
Teaching	45 hours of lecture (1,5 hours per week during the lecture period) 45 hours of exercises (1,5 hours per week during the lecture period)
Classification	Within the undergraduate diploma course in civil engineering: Elective module to be taken during the main studies period, especially for study specializations in Construction Management and Computational Engineering Within the graduate diploma course in civil engineering: Elective module, especially for study specializations in Construction Management and Computational Engineering
Prerequisites	
Examination	One assignment (work load 40 hours) and a corresponding colloquium
Credits and Grading	8 credits. Module grade is based on the grading of the assignment and the colloquium.
Work Load	Total work load: 240 hours.
Duration and Frequency	This module is offered every academic year beginning in the winter semester and continuing for two semesters (winter – summer)

Number of module	**Name of module**	**Lecturer**
BIW4-34	Urban Utility Systems	Werner

Content and Course Goals	The module deals with special topics of urban utility systems. The lectures focus generally on pipeline building and in detail with pipeline-bound energy supply. Students will be able to design different kinds of pipes, perform mathematical calculation methods and apply building technologies as well as deal with safety and quality management in pipeline construction. The module is completed with basics of designing sanitary utilities in buildings.
Teaching	60 hours of lecture (2 hours per week during lecture period) 30 hours of exercises (1 hour per week during lecture period)
Classification	Elective module to be taken during the specialized study period of urban engineering.
Prerequisites	Good knowledge of fundamentals including primary study modules in Infrastructure Planning (BIW2-07) and Urban Water Management (BIW3-08).
Examination	One written exam (180 min). Pre-requisites for examination: 2 accepted assignments in Pipeline Statics (25 h) and Underground Constructions (15 h).
Credits and Grading	8 credits. Module grade is given based on the grade from the exam.
Work Load	240 hours of lectures and exercises including preparatory and follow-up work, one assignment and preparation for the colloquium.
Duration and Frequency	The module is offered every academic year beginning Winter semester and continuing for 2 semesters (Winter – Summer)

Number of module	**Name of module**	**Lecturer**
BIW4-35	Rehabilitation Management	Werner

Content and Course Goals	The module provides an overview for the management of urban utility systems like water supply or waste water disposal networks. This includes the exploration and evaluation of asset condition as well as other tools for economical and technical network management. Forecasting of future rehabilitation need by applying network deterioration models is the basic for strategic network rehabilitation. Another important part deals with rehabilitation technologies, focussing on trenchless methods. Students will learn to develop an effective network rehabilitation management. They must be able to detect, evaluate and forecast asset deterioration
Teaching	60 hours of lecture (2 hours per week during lecture period) 30 hours of exercises (1 hour per week during lecture period)
Classification	Elective module to be taken during the specialized study period of urban engineering.
Prerequisites	Good knowledge of fundamentals including the required module of specialized studies in Urban Water Management (BIW3-08).
Examination	One written exam (120 min) and 1 assignment (40 h) with corresponding colloquium.
Credits and Grading	8 credits. Module grade is given based on the weighted average of the grades from exam and assignment, where the exam grade has the weight 2 and the assignment grade the weight 1.
Work Load	240 hours of lectures and exercises including preparatory and follow-up work, one assignment and preparation for the colloquium.
Duration and Frequency	The module is offered every academic year beginning Winter semester and continuing for 2 semesters (Winter – Summer)

Number of module	**Name of module**	**Lecturer**
BIW4-36	Town Planning	**Wellner**, Ahrens, Schellenberg, Werner
Content and Course Goals	Content of the module are basic principles of urban development and as a combination of supra-local planning and departmental planning. After completing the course, the students are able to recognize and understand the connections between the land utilization and technical development and to apply this in terms of planning services within a formal and informal town planning process.	
Teaching	75 hours of lecture (2,5 hours per week during lecture period) 30 hours of exercises (1 hour per week during lecture period)	
Classification	Required module for the students with the specialization traffic and constructive civil engineering.	
Prerequisites	Fundamental knowledge from the module "Infrastructure (BIW2-07)", "Traffic Engineering (BIW3-07)" and "Urban Water Supply (BIW3-08)".	
Examination	The credits are offered on the basis of an oral examination of 15 min and an assignment of 60 h including a colloquium in urban development.	
Credits and Grading	8 credits.	
Work Load	240 hours of lecture and exercises including preparatory and follow-up work.	
Duration and Frequency	Offered every academic year (begin of the module is the winter semester).	

Number of module	**Name of module**	**Lecturer**
BIW4-38	Urban Transport	Ahrens

Content and Course Goals	The module focuses on methods, approaches and the planning process of urban integrated mobility planning. Interdependencies with spatial planning, environmental protection, economical development and other disciplines are considered. The range of strategies and measures includes infrastructure, engineering, economical measures, information, organizational measures, police measures and enforcement. Practical examples will be introduced. Of special interest are theories and methods to calculate transport demand and performance within the complex urban framework. With the knowledge of the module, students will be able to analyze and forecast urban transport with quantitative methods. They will have special applied competences for the design of urban spaces and be able to develop them in projects. The students will be trained to present their results and plans in public.
Teaching	45 hoers of lecture (3 hours per week during lecture period) 45 hours of exercises (3 hours per week during lecture period)
Classification	Basic studies in Civil Engineering, elective module in main studies, especially for specialized studies in "Urban Engineering" (Stadtbauwesen und Verkehr).
Prerequisites	Required are the skills learned in the module "Infrastructure Planning" (BIW2-07) Pre-qualification is: One assignment with about 30 hours in "Urban space design". Students earn credit points, when they pass the module exam. The exam consists of a written test (120 min).
Examination	Written test (120 min)
Credits and Grading	8 credits. The grade for the module results from the test.
Work Load	240 hours of lectures and exercises including preparatory and follow up work, one assignment and preparation for the test
Duration and Frequency	This module is offered every academic year beginning Winter Semester and continuing for two semesters (Winter-Spring/Summer)

Number of module BIW4-39	**Name of module** Traffic Engineering	**Lecturer** **Maier**, König
Content and Course Goals	The module deals with dimensioning and evaluation procedures for road traffic infrastructure as well as the system properties of planning and management of urban and regional public transport. The students possess knowledge about the principles of traffic flow and are able to use these in the context of evaluating and dimensioning road traffic facilities. The students have learnt about how driving behaviour can be influenced by appropriate facilities and measures as well as the different possibilities to improve traffic flow and safety in certain situations. In the field of public transport the students have basic knowledge of the system properties of the planning and management of urban and regional transport. The module focuses on the development, evaluation and realisation of solutions for selected operational situations.	
Teaching	60 hours of lecture (2 hours per week during lecture period) 30 hours of exercises (1 hour per week during lecture period)	
Classification	Graduate course in civil engineering: Compulsory optional module during graduate studies, especially for major in [Stadtbauwesen] and [Verkehr]. Postgraduate course in civil engineering: Compulsory optional module during [Fachstudium], especially for major in [Stadtbauwesen] and [Verkehr].	
Prerequisites	The skills taught in the modules [Grundlagen der Technischen Mechanik(BIW1-03)], [Weiterführende Technische Mechanik (BIW1-04)] and [Lineare Differentialgleichungen und Stochastik (BIW1-06)] are required.	
Examination	Credit points are gained by passing the module exam. The module exam consists of: 1. Written exam (90 min) in road traffic engineering and 2. Oral exam (group examination, 45 min per two students at a time) in public transport.	
Credits and Grading	The module is worth 8 credit points. The module grade is calculated as the arithmetical mean of both exams.	
Work Load	The total amount of work adds up to 240 hours.	
Duration and Frequency	2 semesters. The module is offered annually, beginning in winter semester.	

Number of module	**Name of module**	**Lecturer**
BIW4-40	Road Traffic Safety	**Maier**, Lippold

Content and Course Goals	The module deals with the safety of road traffic facilities, particularly with regard to the influence of planning, design and management. The students possess detailed knowledge of the fundamental terms of traffic safety, are able to carry out accident analyses and have the ability to judge traffic safety in practical design. Relevant safety deficits can be identified and suggestions for possible solutions can be made. Furthermore the students are able to report and discuss the results as well as the methodical background of safety-related research work. Finally the students are able to implement adequate measures in order to prevent traffic accidents.
Teaching	60 hours of lecture (2 hours per week during lecture period) 60 hours of exercises (2 hours per week during lecture period) All lectures and courses are held as Block seminars.
Classification	Graduate course in civil engineering: Compulsory optional module during graduate studies, especially for major in [Stadtbauwesen] and [Verkehr]. Graduate course in civil engineering: Compulsory optional module during graduate studies, especially for major in [Stadtbauwesen] and [Verkehr].
Prerequisites	The skills taught in the module […(BIW3-07)] are required. Sound knowledge of the current guidelines (RAL, RASt, RAA) is necessary.
Examination	Credit points are gained by passing the module exam. The module exam consists of a written exam (90 min). Prerequisite for the exam: - assignment amounting to 60 hours
Credits and Grading	The module is worth 8 credit points. The module grade results from the exam grade.
Work Load	The total amount of work adds up to 240 hours.
Duration and Frequency	2 semesters. The module is offered annually, beginning in winter semester.

Number of module	**Name of module**	**Lecturer**
BIW4-41	Road Design	Lippold

Content and Course Goals	This module deals with the diverse correlations of collateral conditions during the process of road planning and road design, especially regarding environmental protection, economic efficiency, road safety, traffic law, and road operation. The focus is on the system driver – vehicle - road and, based on this, on road network design, geometry of road fringe and cross section, and road junction design. Furthermore, selected topics of particular practical importance are integrated, e.g. road furniture, drainage, organization, financing, balancing processes regarding safety and environmental protection. Important parts of the latter are the requirements of pollution protection, especially noise protection including calculation of noise pollution and design of noise protection facilities. Students will come to know the entire process of road planning and road design from planning of requirements to a design ready for building. They acquire the ability to carry out road planning and will learn about the interfaces to surveying and other branches of traffic construction, e.g. bridge construction. Students will be able to use the CAD systems CARD/1 and VESTRA.
Teaching	45 hours of lecture (1,5 hours per week during lecture period) 45 hours of exercises (1,5 hours per week during lecture period)
Classification	Basic course of civil engineering: elective module during main studies. Specialized studies of civil engineering: elective module.
Prerequisites	Knowledge acquired in modules BIW2-07 and BIW3-07.
Examination	Assignment (30 hours) on road design. Assignment (30 hours) on CAD in road construction. Exam (180 minutes).
Credits and Grading	8 credits. Module grade is given based on the grading of the exam.
Work Load	240 hours.
Duration and Frequency	This module is offered every academic year beginning Winter Semester and continues for two semesters.

Number of module	**Name of module**	**Lecturer**
BIW4-42	Pavement Construction and Maintenance	Wellner

Content and Course Goals	Provide students with detailed knowledge of behaviour of pavement materials, pavement design approaches and pavement maintenance and rehabilitation methods. This module is designed to overview the behaviour of materials used in pavement structures. The topics include more than the behaviour of pavement materials with the goal of achieving a broad understanding of pavement design approaches and construction methods with specific emphasis on the interaction of climatic and loading conditions of the pavements. The course is designed to give students detailed knowledge about pavement modelling and several pavement structural design methods as well as pavement life prediction approaches. Subjects of the module will include an introduction to pavement maintenance and rehabilitation techniques. Following this, test methods for measuring the pavement surface properties, the analysis and interpretation of these test results within the scope of pavement maintenance and rehabilitation methods will be covered. The student will learn concepts to develop the most reliable and cost effective rehabilitation alternatives for existing flexible and rigid pavements.
Teaching	60 hours of lecture (2 hours per week during lecture period) 30 hours of exercises (1 hour per week during lecture period)
Classification	Elective module to be taken during the specialized study period of traffic.
Prerequisites	Knowledge from the basic studies in civil engineering, the module "Infrastructure (BIW2-07)" and the module "Traffic Engineering (BIW3-07)"
Examination	Each module examination consists of a written examination (180 min) and a preliminary assignment.
Credits and Grading	8 credits. Credit points for each module examination
Work Load	240 hours of lecture and exercises including preparatory and follow-up work.
Duration and Frequency	Offered every academic year (begin of the module is the winter semester).

Number of module	**Name of module**	**Lecturer**
BIW4-43	Pavements and Environment	**Wellner**, Lippold

Content and Course Goals	Provide students with detailed knowledge of interaction between the geometric design of roads and the pavement construction with all influence factors like environmental sustainability (traffic noise, harmful substances as well as safety aspects). The first of the two courses is dealing with the environmental and safety aspects in pavement design and construction. The geometric design component is concerned with road equipment, environmental aspects and highway operation, as well as planning law procedures. Tutorials include assignments that are related to the lecture material. In general, the assignment is designed to give students an introduction how to use scientific literature efficiently and to help student to prepare and give an oral presentation about one scientific topic.
Teaching	45 hours of lecture (1,5 hours per week during lecture period) 30 hours of exercises (1 hour per week during lecture period) 15 hours of seminar (0,5 hour per week during lecture period)
Classification	Elective module to be taken during the specialized study period of traffic.
Prerequisites	Knowledge from the basic studies in civil engineering, the module "Infrastructure (BIW2-07)" and the module "Traffic Engineering (BIW3-07"
Examination	Examination consists of a written examination (120 min) and a preliminary assignment of 60 hours.
Credits and Grading	8 credits.
Work Load	240 hours of lecture and exercises including preparatory and follow-up work.
Duration and Frequency	Offered every academic year (begin of the module is the winter semester).

Number of module	**Name of module**	**Lecturer**
BIW4-44	Railway Infrastructure	Fengler

Content and Course Goals	The module provides knowledge and methods of the planning and design of railway infrastructure. Students will learn the essentials and methods of functional planning and system design of the open line and of railway stations as well as of geometrical route design, track design and layout of passenger/goods railway facilities. They are familiar with the development of railway infrastructure on the base of transportational and operational requirements, taking system interfaces and other technological fields of the railway system into account. Students are able to conceive and solve planning tasks of designing open lines and stations and of track layouts, also by using software tools.
Teaching	60 hours of lecture (2 hours per week during lecture period) 30 hours of exercices (1 hours per week during lecture period)
Classification	Academic degree in civil engineering: Elective module of main studies, especially for the specialized study period of urban development and transportation Postgraduate studies in civil engineering: Elective module of special studies, especially for the specialized study period of urban development and transportation
Prerequisites	Skills are assumed, as it can be earned by the modules "Planning of Infrastructure" (BIW2-07) and "Traffic Facility Construction" (BIW3-07).
Examination	The credits are aquired by an oral examination (45 min). Prerequisites: - one assignment on the planning of railway stations - one assignment on the planning of railway lines The assignments have an overall workload of 80 hours.
Credits and Grading	8 credits, Module grade is given based on the grading of the oral examination.
Work Load	240 hours of lecture and exercices including preparatory and follow-up work, two assignments
Duration and Frequency	This module is offered every academic year beginning Winter Semester and continuing for two semesters (Winter – Spring/Summer).

Number of module	**Name of module**	**Lecturer**
BIW4-45	Railway Construction	Fengler

Content and Course Goals	The module provides knowledge and methods of the construction of permanent way of railways as well as its application in the field of track design. Students will learn the essentials of the construction of tracks and turnouts including their static and dynamic behaviour and its modeling and calculation. They are familiar with the process of superstructure deterioration and with the assessment and correction of damages in order to minimize lifecycle costs. Students are able to understand, analyze, calculate and apply diverse types of construction and to assess them regarding their long-term behavior to be expected.
Teaching	60 hours of lecture (2 hours per week during lecture period) 30 hours of exercices (1 hour per week during lecture period) The exercices are calculation exercices (ex-cathedra) and group exercices in part.
Classification	Academic degree in civil engineering: Elective module of main studies, especially for the specialized study period of structural engineering as well as urban development and transportation Postgraduate studies in civil engineering: Elective module of special studies, especially for the specialized study period of structural engineering as well as urban development and transportation
Prerequisites	Skills are assumed, as it can be earned by the modules "Planning of Infrastructure" (BIW2-07) and "Traffic Facility Construction" (BIW3-07).
Examination	The credits are aquired by an oral examination (45 min). Prerequisites: - one assignment on track dynamics - one assignment on maintenance of superstructure - one assignment on track design The assignments have an overall workload of 80 hours.
Credits and Grading	8 credits, Module grade is given based on the grading of the oral examination.
Work Load	240 hours of lecture and exercices including preparatory and follow-up work, three assignments
Duration and Frequency	This module is offered every academic year beginning Winter Semester and continuing for two semesters (Winter – Spring/Summer).

Number of module	**Name of module**	**Lecturer**
BIW4-46	River Engineering and Waterway Engineering	Stamm
Content and Course Goals	The module's content is the training of rivers by means of technical and semi-natural measures under consideration of the river's hydrological and morphological characteristics. In particular the principles of longitudinal and transversal river profiling, the concepts of river regulation, semi-natural river development and the location dependent applicability of biological measures will be discussed with special regard to morphodynamical aspects. Furthermore the module focuses on typical facilities along waterways and their design principles considering navigational requirements. Germany's federal waterway network, state of the art technologies for transportation and handling of cargo in selected inland ports and seaports and intermodal logistics will be introduced to the students. After a successful completion of the module the students have sophisticated knowledge in analysing the complex hydromorphological behaviour of rivers. They will have advanced skills in designing water intake and water release structures, in engineering measures for torrent control and for flood protection. Moreover students will gain fundamental knowledge in waterway engineering, in particular with regard to the determination of design criteria for waterway facilities, for the dimensioning of bank protection in canal construction and for the design of locks and ship lifts.	
Teaching	60 hours of lecture (2 hours per week during the lecture period) 30 hours of exercises (1 hour per week during the lecture period)	
Classification	Undergraduate Civil Engineering Course: required module to be taken during the specialized study period of hydraulic and environmental engineering. Elective module for other specialized study periods, especially in specialized study period of construction engineering. Postgraduate Civil Engineering Course: required module to be taken during the specialized study period of hydraulic and environmental engineering. Elective module for specialized study period especially in specialized study period of construction engineering.	
Prerequisites	Good knowledge of fundamentals including study modules in mechanics (BIW1-04), soil mechanics and foundation engineering (BIW2-03), basics of hydromechanics and hydraulic engineering (BIW2-08) and dam engineering and hydroelectric power engineering (BIW3-09).	
Examination	Two written examinations (90 min. each) pre-requirement: two assignments (30 hours each)	
Credits and Grading	8 credits. Module grade is given based on the grade point average of the examinations in River Engineering and Waterway Engineering.	
Work Load	240 hours of lecture and exercises including preparatory and follow-up work, two assignments and preparation for the examinations.	
Duration and Frequency	This module is offered every academic year beginning in the Winter Semester and continuing in Spring/Summer Semester.	

Number of module	**Name of module**	**Lecturer**
BIW4-47	Flow Modelling	Aigner

Content and Course Goals	The module covers the fundamentals of numerical and physical flow modelling in hydraulic engineering. The Navier-Stokes equations, derived from the fundamental equations of fluid flow, can be analysed using numerical modelling, in particular through the use of the Reynolds-averaged Navier-Stokes equation (RANS) to model turbulent flow. Alongside this the different methods used to determine eddy viscocity are introduced through the various methods and tools provided by 3D modelling. Meanwhile the physical modelling element of the course introduces students to the principal practical testing methods used in hydraulic engineering. In addition to this dynamic similarity, dimensional analysis, and the methods of scaling up model results to full scale applications will be introduced, as well as the measuring devices and programs used in the laboratory and in the field. Throughout the module students will experience the meaningful application of fluid modelling from an engineer's point of view. They will experience the newest measuring technology, carry out hydraulic testing of a model as well as present, interpret and understand the model data and extrapolate their experimental results to full scale settings. In short the module consists of the teaching of the material application of numerical and laboratory flow modelling.
Teaching	7th semester: 30 hours of lecture and 15 hours of exercises in numerical flow modelling 8th semester: 15 hours of lecture and 30 hours of exercises in laboratory flow modelling
Classification	Elective module in main studies, particularly for study specialisation in Hydrodynamic Engineering and Environmental Studies. The module is offered each academic year and starts in the winter semester.
Prerequisites	Engineering Mechanics Part 2 (BIW1-04) and a good knowledge of finite element hydrodynamics from Basics of Hydromechanics and Hydraulic Engineering (BIW2-08) and Fluid Mechanics (BIW3-10).
Examination	Credits will be awarded for passing the module test. The module test consists of: 1) Assignment work (40 hrs work), with a colloquium on numerical flow modelling offered every year. 2) Assignment work (40 hrs work), with a colloquium on laboratory flow modelling offered every year.
Credits and Grading	8 Credits. The module grade is based on the arithmetic average of the grades from the two assessed tests.
Work Load	Total workload 240 hrs of lectures, exercises, preparatory and follow up work, preparation for tests and assignments. Assignment working time: 80 hrs while the university is in session and also partially during the semester break at the end of the 7th semester.
Duration and Frequency	2 Semester

Number of module	**Name of module**	**Lecturer**
BIW4-48	Coastal Engineering and Coastal Defense, Software Application in Hydraulic Engineering	Carstensen
Content and Course Goals	The first part of this module provides an overview of coastal engineering, coastal management and coastal defense structures. Students will learn the basics of wave theory, analytical and numerical methods to determine wave dimensions and wave forces. This module includes design and calculation of flood- and coastal defense structures, as well as structural design of offshore structures. The primary areas of the second part are the software applications for the structural design in hydraulic engineering and geodetic information systems. The course contains classroom computer exercises, which introduce the software and its capabilities. Students will learn essentials of applying common numerical methods to determine design parameters in hydraulic engineering. This includes the finite elements-, finite difference or finite volume method. The participants have to be able to use commercial software for the determination of multidimensional flow parameters. Preparation, visualization and administration of measured (data bases) and calculated values are further topics of this part of the module.	
Teaching	60 hours of lecture (2 hours per week during the lecture period) 30 hours of exercises (1 hour per week during the lecture period)	
Classification	Elective module, which can be taken during the specialized study period of hydraulic and environmental engineering.	
Prerequisites	Good knowledge of fundamentals including primary study modules in dams and hydro power stations (BIW3-09), mechanics (BIW1-04), basics of hydromechanics and hydraulic engineering (BIW2-08) and soil mechanics and foundation engineering (BIW2-03), as well as required modules of specialized studies in hydraulic and environmental engineering.	
Examination	Two oral/multimedia-based examinations (45 min. each) pre-requirement: two assignments (30 hours each)	
Credits and Grading	8 credits. Module grade is given based on the grade point average of the examinations in Coastal Engineering and Coastal Defense as well as Software Application in Hydraulic Engineering.	
Work Load	240 hours of lecture and exercises including preparatory and follow-up work, two assignments and preparation for the examinations.	
Duration and Frequency	This module is offered every academic year beginning in the Winter Semester and continuing for two semesters (Winter Spring/Summer).	

Number of module	**Name of module**	**Lecturer**
BIW4-49	Renewables, Maritime Energy	Graw

Content and Course Goals	This module contains the tasks connected to the electricity-production with renewables (including the climate discussions) and as one illustration the special problems related to the use of maritime energy as the source and will debate the technical basics and the circumstances for the realisation. Absolving this module students will have special interdisciplinary knowledge about renewables concerning potential, technologies and problems. They will be able to solve on their own partial problems of the task to produce energy from maritime sources.
Teaching	45 hours of lecture (1,5 hours per week during lecture period) 45 hours of exercises (1,5 hours per week during lecture period)
Classification	Elective module to be taken during the specialized study period.
Prerequisites	
Examination	Two assignments with corresponding colloquium.
Credits and Grading	8 credits. The module grade is the mean of the grading of the two examinations.
Work Load	Total work load is 240 hours
Duration and Frequency	Two semester, this module is offered every academic year beginning Winter Semester.

Number of module	**Name of module**	**Lecturer**
BIW4-50	Selected Chapters Hydraulic Engineering	Stamm

Content and Course Goals	The content of this lecture are special themes with practical relevance like rehabilitation of sealings, spillways or dam installations, analysis of arch dams, creation and application of special concretes in hydraulic engineering, constructive and operative measures of structure observation or the technical and geo-hydraulic basics of drilled wells as well as the hydraulic design of pumping stations and pipeline systems. The students have the ability to detect and assess structural, functional and operational difficulties of hydro-engineering structures early. They possess in-depth knowledge to conceive goal- and application-oriented problem solving in consideration of special structural requirements.
Teaching	60 hours of lecture (2 hours per week during the lecture period) 30 hours of exercises (1 hour per week during the lecture period)
Classification	Undergraduate Civil Engineering Course: elective module, which can be taken during the main studies, especially in specialized study period of hydraulic and environmental engineering. Postgraduate Civil Engineering Course: elective module especially in specialized study period of hydraulic and environmental engineering.
Prerequisites	Good knowledge of fundamentals including primary study modules in mechanics (BIW1-04), soil mechanics and foundation engineering (BIW2-03), basics of hydromechanics and hydraulic engineering (BIW2-08) and dam engineering and hydroelectric power engineering (BIW3-09).
Examination	One written examination (90 min.) pre-requirement: one assignment (60 hours)
Credits and Grading	8 credits. Module grade is given based on the grade point of the examination.
Work Load	240 hours of lecture and exercises including preparatory and follow-up work and preparation for the oral examination.
Duration and Frequency	This module is offered every academic year beginning in the Winter semester and continuing in Spring/Summer semester.

Number of module	**Name of module**	**Lecturer**
BIW4-51	Hydrology and Water Quality	**Schmitz**, Fischer

Content and Course Goals	A successful completion of this module provides the competence of interpreting hydrologic time series especially data on high and low flow regimes on the basis of a sound statistical analysis. As well, the students will have a solid understanding of the probabilistic behavior of hydrologic phenomena and will be enabled to apply current methods for determining average recurrence intervals of extreme hydrologic events. A distinct focus is set on the data analysis in the context of resolution and quality and consistency. Alternative methods for obtaining design parameters for hydraulic structures with a special consideration of data quality and quantity also form an important subject within this module. Besides the techniques for dealing with extreme flood events, the important area of low flow and draughts is also an important topic. This not only includes the most relevant phenomena of arid zone hydrology but also the evaluation of common parameters characterizing low flow phenomena using current methods/models. Along these lines, the background of low flow regimes is analyzed. Additionally, further aspects of the engineering hydrology are discussed, as e.g. design of flood retention reservoirs. A brief overview into rainfall runoff modeling and some basic techniques are also provided within the course. Students also will learn the basics of field data collection and the assessment of water quality, balancing of the dissolved and non-dissolved matter and prerequisite process engineering studies for the design of water treatment facilities. Students will be finally become acquainted with hydrographical, territorial, trophical, chemical and hygienically relevant criteria and be able to classify water bodies according to water quality indices.
Teaching	60 hours of lecture (2 hours per week during lecture period) 30 hours of exercises (1 hour per week during lecture period).
Classification	Elective module to be taken during the specialized study period of hydraulic engineering and environment.
Prerequisites	Moduls BIW2-08 and BIW3-09
Examination	2 Assignments: 1.: Assignment of Hydrology (30 h); 2.: Assignment of Water Quality (30 h) (to successfully complete the assignments is the precondition for the accreditation for the respective written exam) 2 Exams: 1.: Written Exam Hydrology, 2.: Written Exam Water Quality
Credits and Grading	8 credits. Module grade is given based on the grading of the written exams.
Work Load	240 hours of lecture and exercises, including preparatory and follow-up work plus work for the assignments.
Duration and Frequency	This module is offered every academic year, beginning Winter Semester and continuing for two semesters (Winter to Spring/Summer)

Number of module	**Name of module**	**Lecturer**
BIW4-52	Concrete in Hydraulic Structures and Steel Hydraulic Structures	**Mechtcherine**, Häußler-Combe, Stroetmann
Content and Course Goals	Module content is the technology of concrete in hydraulic construction for new structures, for the restoration of existing structures, and for special structures and equipment of concrete, reinforced concrete, and steel in an hydraulic environment. On completion of the course students will have knowledge of special concretes and concrete casting procedures in hydraulic construction (submerged concrete, roller-compacted concrete, etc.), the durability prognosis and durability design for hydraulic structures, and their protection and rehabilitation. They will understand the effects of heat release during hydration, temperature stresses, external and internal tensions, crack formation and the limitation of crack width. Still further, they will master the essential constructive details of construction joints and their sealing. Students will be acquainted with the structures in special types of construction such as watertight concrete vessels and foundations, containers, canal locks, and with the standards and norms for concrete used in hydraulic construction. They will be familiar as well with the types of steel closing mechanisms in use in hydraulic construction and their particular construction and static characteristics. They will have at their disposal knowledge of the construction and calculation (static models, loading assumptions, and norms) of shutoff gates, gates for locks and water segments, and for emergency closing devices. Students will be acquainted with various types of seals, their requirements, and their loading capacities.
Teaching	75 hours of lecture (2,5 hours per week during lecture period) 15 hours of exercises (0,5 hour per week during lecture period)
Classification	In the basic *Diplom* course of study in civil engineering: Elective course in the main course of study, particularly for study specialization of construction engineering as well as hydraulic construction and environmental protection. In the intermediate course of study in civil engineering: Elective course, particularly for study specialization of construction engineering as well as hydraulic construction and environmental protection.
Prerequisites	Presupposed are the knowledge and experience gained in the modules Construction Materials (BIW1-08), Basics of Wood and Steel Construction (BIW2-04), and Reinforced Concrete Construction (BIW2-05).
Examination	The programme of examination consists of: 1. An examination (90 min) covering concrete in hydraulic construction and 2. An examination (90 min) covering the special structures of hydraulic construction and steel in hydraulic construction.
Credits and Grading	On successful completion of the module 8 credits are given, i.e., when the battery of examinations has been passed. The grade for the module is calculated as the arithmetic average of the grades on both examinations.
Work Load	The total work load is 240 hours.
Duration and Frequency	2 semesters The module is offered each year beginning in the winter semester.

Number of module	**Name of module**	**Lecturer**
BIW4-53	Hydromelioration and Groundwater	Liedl

Content and Course Goals	The module focuses on the application of drainage techniques as part of hydromelioration measures and on the quantification of dynamic flow and solute transport processes in soil water and groundwater. The students will be able to master the basics of dimensioning pipe drain systems and drainage trenches. They will know the relevant parameters needed to describe flow, solute spearing, retardation and degradation in the subsurface and are able to assess the effects of these processes on water quality by applying standard computational methods. In addition, the students will learn to cooperate in an interdisciplinary manner and to develop ecologically compatible solutions for the usage as well as for the protection of soil water and groundwater.
Teaching	60 hours of lecture (2 hours per week during lecture period) 30 hours of exercises (1 hour per week during lecture period)
Classification	elective module, in particular for the study specialization on Hydraulic Engineering and Environment
Prerequisites	good knowledge of fundamentals including primary study in mathematics, physics and hydraulics
Examination	one written examination (90 min, hydromelioration) and one assignment (60 hours) incl. colloquium (subsurface water dynamics)
Credits and Grading	8 credits. Module grade is given based on the grading of the written examination, the assignment and the colloquium.
Work Load	240 hours of lecture and exercises including preparatory and follow-up work, one assignment and preparation for the colloquium and the written examination
Duration and Frequency	This module is offered every academic year beginning Winter Semester and continuing for two semesters (Winter – Spring/ Summer).

Number of module	**Name of module**	**Lecturer**
BIW4-54	Urban Water Body Development – a Multidiscipline Approach	Graw
Content and Course Goals	This module contains the tasks connected to the construction of water bodies in urban areas, examples of known methods to solve the special problems related to the multidisciplinary work. Characterizing the different objectives on an urban water body, the students should – starting from their own discipline – define the problems and search for solutions. Absolving this module students will have special multidisciplinary competences to enable them to solve on their own partial problems of the task to develop an urban water body.	
Teaching	45 hours of lecture (1,5 hours per week during lecture period) 45 hours of exercises (1,5 hours per week during lecture period)	
Classification	Elective module to be taken during the specialized study period.	
Prerequisites		
Examination	Two assignments with corresponding colloquium.	
Credits and Grading	8 credits. The module grade is the mean of the grading of the two examinations.	
Work Load	Total work load is 240 hours	
Duration and Frequency	Two semester, this module is offered every academic year beginning Winter Semester.	

Number of module	**Name of module**	**Lecturer**
BIW4-56	Ecology in Construction – the Related Technology	**Mechtcherine**, Haller, Curbach, Wellner

Content and Course Goals	Content of the module is construction using renewable materials, structural maintenance, environmental compatibility and recycling of construction materials, and the planning of sustainable structural engineering. On completion of the module students will have a deepened understanding of the use of wood and wood products in construction with emphasis on environment-conserving production and processing technologies. They will have mastered the basics of environmentally friendly building maintenance practices and will be able to assess the environmental compatibility of construction materials from the points of view of their production, use, and recycling. Further, they will be acquainted with environment-conserving production and recycling technologies for mass products in construction, including asphalt. Students will be acquainted with processing techniques for construction waste and the reuse of the materials so prepared. Beyond that they will be familiar with the particularities of sustainable construction planning, production, transport, installation, and the required ecologically relevant certifications, with concrete examples.
Teaching	90 hours of lecture (3 hours per week during lecture period)
Classification	In the basic civil engineering *Diplom* course of study: Elective course in the main course of study, in particular for study specialization of constructive engineering construction, hydraulic construction and environmental protection In the intermediate civil engineering course of study: Elective course, particular for study specialization of constructive engineering construction, hydraulic construction and environmental protection
Prerequisites	Presupposed are the knowledge and experience gained in the modules Construction Materials (BIW1-08), Basic drafting (BIW2-01), and Steel and Wood Construction and the Application of Fracture Mechanics (BIW3-03).
Examination	1. An examination (90 min) in construction using renewable construction materials, the conservation of structures, and the environmental compatibility and 2. An examination (90 min) in recycling of construction materials und in sustainable structure planning.
Credits and Grading	8 credits are given on successful completion of the module, i.e., when the battery of examinations has been passed. The grade for the module is calculated as the arithmetic average of the grades on the two examinations.
Work Load	The total work load is 240 hours.
Duration and Frequency	The module is offered each year beginning in the winter semester.

Number of module	**Name of module**	**Lecturer**
BIW4-57	Construction Ecology - Soil	**Herle**, Ullrich

Content and Course Goals	This module treats fundamentals of hydrologic investigations, environmental engineering and environmental geology. Upon completion of this module the students have basic knowledge of the regeneration of groundwater as well as of properties of aquifers. Building on that they understand exploration procedures, the construction of observation wells, groundwater sampling and monitoring. The students will be proficient in the basic concepts of environmental issues in geotechnical engineering, especially concerning lining and stability of landfills and slopes in open pit mining. Furthermore they will be able to plan biological and sustainable geotechnical construction methods and understand the concepts of geothermal energy. In addition the students will see into environmental geology including the complex interactions between geological processes and human habitats, environmental geology and land use regulation, ultimate nuclear waste disposal, exploration and remediation of contaminations caused by underground mining and the primacy of geological processes against human activities.
Teaching	75 hours of lecture (2,5 hours per week during lecture period) 15 hours of exercises (0,5 hour per week during lecture period)
Classification	Elective module to be taken during the period of main studies, especially for the study specializations construction, hydraulic and environmental engineering.
Prerequisites	Knowledge of the content of modules BIW1-10 (environmental science) and BIW2-03 (soil mechanics and foundation engineering).
Examination	(1) One assignment (30 hours) in general hydrogeology. (2) One assignment (30 hours) in environmental geotechnics as prerequisite for the participation in the written exam environmental geotechnics and environmental geology (90 min).
Credits and Grading	8 credits. Module grade is given based on the grading of the assignment (1) (weight 1/3) and the written exam (2) (weight 2/3).
Work Load	240 hours of lecture and exercises including preparatory and follow-up work and two assignments.
Duration and Frequency	This module is offered every academic year beginning Winter Semester and continuing for two semesters (Winter – Spring/Summer).

Number of module	**Name of module**	**Lecturer**
BIW4-58	Building Ecology - Energy	Weller

Content and Course Goals	Savings in energy at the building construction is an important technical as well as formative challenge for the future. This affects similar architects and civil engineers. Energy efficient building construction exists of measures for savings in energy and the use or regenerating energies, besides technical possibilities for an efficient use of energy. For the establishment of new buildings as well as for the renovation of existing buildings energy concepts are developed in relation to the building kind. Based on the outside climate and the always changing interior climate, different possibilities of design, construction and building materials are discussed to minimize the energy demands of buildings. Another main focus of the lecture is to give the student an idea of the new technical aspects and the assessment of energy. The structural analysis of existing building constructions and those which have to be erected will be discussed based on standards, guidelines and instructions. The student should be given the ability to affect the energy demand of a building with the help of new materials, new constructions and new modern technical issues for buildings. The module includes the lecture of building ecology - energy.
Teaching	60 hours of lecture (2 hours per week during lecture period) 30 hours of exercises (1 hour per week during lecture period)
Classification	Elective course in specialized studies
Prerequisites	Good knowledge of the base studies.
Examination	Credit points are gained with passing the module examinations module examinations consist of: assignment (80 h) and a corresponding colloquium
Credits and Grading	8 credits. Module grade is given based on the grading of the assignment and the colloquium.
Work Load	240 h of lectures and exercises including preparatory and follow up work, one assignment and preparation for the colloquium.
Duration and Frequency	This modulus is offered every academic year beginning Winter Semester and continuing for two semesters.

Number of module	**Name of module**	**Lecturer**
BIW4-59	Ecology in Civil Engineering - Infrastructure	**Wellner**, Werner, Lippold
Content and Course Goals	Content of the module are the environmental effects of traffic related and urban infrastructure projects as well as surface water run off management. After completing the module the students will be able to design compensation measures for negative environmental effects of traffic. This will include the capturing and evaluation of these effects and measures to avoid and mediate these effects. In addition to this, the students will gain knowledge to design and analysis surface water run off systems.	
Teaching	45 hours of lecture (1,5 hours per week during lecture period) 45 hours of exercises (1,5 hours per week during lecture period)	
Classification	Elective module to be taken during especially during the specialized study period of hydraulic engineering and environment.	
Prerequisites	Knowledge from the module "Infrastructure (BIW2-07)", "Traffic Engineering (BIW3-07)" and "Urban Water Supply (BIW3-08)".	
Examination	The credits are offered on the basis of a written examination of 90 min, an assignment of 30 h including a colloquium in infrastructure and environment and an assignment of 30 h including a colloquium in environmental aspects in geometric pavement design.	
Credits and Grading	8 credits.	
Work Load	240 hours of lecture and exercises including preparatory and follow-up work.	
Duration and Frequency	Offered every academic year (begin of the module is the winter semester).	

Number of module	**Name of module**	**Lecturer**
BIW4-60	Instruments of Ecological Engineering	**Haller**, Gruhler, Scherer

Content and Course Goals	The module covers methods for the assessment of the ecological impact of structural measures. After the completion of the module the students understand the basics of environmental management, environmental sustainability, law and information systems. By means of examples from housing construction and infrastructure they can analyse material flows and make up a balance and assessment on the city level. The students recognize the complex spatial and temporal relations of environmental information systems and are able to recognize and describe them for large areas with the help of comprehensive data of different quality and granularity. The students also know the basics of environmental law and possess methods and instruments to carry out environmental impact assessments.
Teaching	75 hours of lecture (2,5 hours per week during lecture period) 15 hours of exercises (0,5 hour per week during lecture period)
Classification	In the diploma course in civil engineering: Elective module of main studies, especially for study specialization in structural engineering and in hydraulic and environmental engineering In the postgraduate course in civil engineering: Elective module, especially for study specialization in structural engineering and in hydraulic and environmental engineering
Prerequisites	Knowledge and skills acquired in the modules Building Materials (BIW1-08), Environmental Sciences (BIW1-10) and Construction Informatics Fundamentals (BIW1-07).
Examination	The credits are acquired by passing the module examination. The module examination consists of a written examination (150 minutes) in environmental management, environmental impact assessment, environmental information systems; as well as an assignment with colloquium (60 hours) in one of the three subjects mentioned.
Credits and Grading	8 credits. The module grade is the weighted arithmetic mean of the grades of both examination parts; part 1 contributing twice and part 2 contributing once.
Work Load	The work load totals to 240 hours.
Duration and Frequency	2 semesters. The module is offered in every academic year and starts in the winter semester.

Number of module	**Name of module**	**Lecturer**
BIW4-61	River Restoration	Stamm

Content and Course Goals	The content of this lecture is amongst others reservoir operational management for reservoirs with multiple functions, control of complex water resource management systems with multi-criteria demands, water resource management framework planning, ecological aspects of hydraulic engineering especially in hydropower utilization and storage of rivers. Students will learn the technical relevancy and impact of the European authority, especially the EU Water Framework Directive (WFD) for surface water and its application. They have extensive system analytical competence about target-oriented, optimised development of surface water as well as the ability to assess the sustainability of possibilities of water management and the utilization of surface water. Students possess in-depth knowledge of analysis, assessment and planning of water bodies considering technical nature protecting aspects. This includes all water bodies (surface water and groundwater). They are able to use their methodical knowledge of groundwater management regarding the amount and the quality of water in practice. They know the parameters of groundwater reservoirs and elements of exploration of groundwater reservoirs. Students will therefore have an extensive comprehension for processes concerning flow and transport phenomena of groundwater as well as of the interaction between surface and aquifers.
Teaching	60 hours of lecture (2 hours per week during the lecture period) 30 hours of exercises (1 hour per week during the lecture period)
Classification	Undergraduate Civil Engineering Course: elective module, which can be taken during the main studies, especially in specialized study period of hydraulic and environmental engineering. Postgraduate Civil Engineering Course: elective module especially in specialized study period of hydraulic and environmental engineering.
Prerequisites	Good knowledge of fundamentals including primary study modules in mechanics (BIW1-04), soil mechanics and foundation engineering (BIW2-03), basics of hydromechanics and hydraulic engineering (BIW2-08) and dam engineering and hydroelectric power engineering (BIW3-09).
Examination	One oral examination (30 min.)
Credits and Grading	8 credits. Module grade is given based on the grade point of the oral examination.
Work Load	240 hours of lecture and exercises including preparatory and follow-up work and preparation for the oral examination.
Duration and Frequency	This module is offered every academic year beginning in the Winter Semester and continuing for one semester (Spring/Summer).

Number of module BIW4-62	**Name of module** Numerical Models in Geotechnical Engineering	**Lecturer** Herle
Content and Course Goals	This module treats numerical modelling in geotechnical engineering. Upon completion of this module the students understand the mathematical description of the mechanical behaviour of soils by means of different constitutive equations. They will be able to judge advantages and disadvantages of particular soil models and to reproduce the observed behaviour of soils using numerical element tests on the computer. The students will be able to apply numerical methods and modern FE software for the solution of practical geotechnical boundary value problems and to establish numerical approaches for different geotechnical tasks.	
Teaching	60 hours of lecture (2 hours per week during lecture period) 30 hours of exercises (1 hour per week during lecture period, guided computer work)	
Classification	Elective module to be taken during the period of main studies, especially for the study specializations construction and computational engineering.	
Prerequisites	Knowledge of the content of module BIW2-03.	
Examination	One assignment (50 hours) and a corresponding colloquium.	
Credits and Grading	8 credits. Module grade is given based on the grade of the assignment and the colloquium.	
Work Load	240 hours of lecture and exercises including preparatory and follow-up work, one assignment and preparation for the colloquium.	
Duration and Frequency	This module is offered every academic year beginning Winter Semester and continuing for two semesters (Winter – Spring/Summer).	

Number of module	**Name of module**	**Lecturer**
BIW4-63	Computational Fluid Dynamics	Aigner

Content and Course Goals	The equations of motion in Computational Fluid Dynamics are derived from the transport balance occurring within control volumes and the stress and deformation conditions acting upon individual elements of flow, including vorticity. This is combined with the introduction of turbulence theory as well as the formation of the Reynolds equations and the averaged equations for contaminant and energy transportation. The meaning and the structure of turbulence models as additional equations for the description of flow phenomena will also be explained, as well as the introduction of basic vector analysis and tensor notation. An accompanying exercise handles the basis of discretising partial differential equations and solves simple problems using finite differentiation, drawing upon the use of both simple variables (speed, pressure) and complex variables such as the stream function. Another component of the course is an introduction to the computer program "ANSYS CFX Academic Teaching Kit". Furthermore the module calls for the combination of the knowledge that was theoretically acquired within the scope of the exercises with Geodetic information systems as well as the determination of multi-dimensional flow parameters with the help of conventional software resolution, in which the finite element, finite volume and finite difference models are implemented. The Module is part of the course program for the Computational Fluid Mechanics study area.
Teaching	60 hours of lecture (2 hours per week during lecture period) 30 hours of exercises (1 hour per week during lecture period) Exercises in the computer pool.
Classification	Elective module in main studies, particularly applicable for a study specialisation in Computational Engineering The module is offered each academic year, starting in the Winter Semester
Prerequisites	A good knowledge of Structural Engineering IT (G7 & GF9) and Foundations of Technical Hydromechanics and Hydraulic Engineering (BIW2-08) Textbooks, scripts and sample test papers with model answers will be provided for the module.
Examination	Credits will be awarded for passing the module assessment. The module assessment consists of: A 90 minute exam paper offered at each testing period. The Preliminary test is a recognised assignment.
Credits and Grading	8 Credits. The module score is the score from the exam paper.
Work Load	Total Workload: 240 hours of lectures, exercises, preparatory and follow up work, preparation for tests and assignments. Assignment working time: 30 hours each semester inside and outside of teaching time.
Duration and Frequency	2 Semesters.

Number of module	**Name of module**	**Lecturer**
BIW4-64	Computational Engineering in Structural Glass	Weller
Content and Course Goals	The scientific and constructional bases of the Computational Engineering for structural glass and constructions consisting of steel and glass are given in view of the security drafts and security proofs in the constructive civil engineering work. This especially applies to the numerical simulation of the load-carrying capacity and residual load-carrying capacity of components of glass. Thermally prestressed glasses as well as laminated glasses and laminated safety glasses are described numerically. In addition, the valid and future procedures are introduced to calculation and design for mechanically fixed glasses, glued glazing and whole glass constructions. The results of the theoretical analysis are explained and verified with the help of experimental testing. Qualification purpose is beside the knowledge to the security draft for calculating and sizing constructions of glass the secure handling with non-regulated building products and designs from the building material glass. The module includes the lectures of the field of Computational Engineering in structural glass.	
Teaching	60 hours of lecture (2 hours per week during lecture period) 30 hours of exercises (1 hour per week during lecture period)	
Classification	Elective course in main study period, especially for the specialization Computational Engineering. A parallel selection of the modules BIW4-18 and BIW4-73 is not possible.	
Prerequisites	Good knowledge of the modules of the base studies	
Examination	Credit points are gained with passing the module examinations Module examinations consist of: Written examination 120 min Prerequisites: Assignment (40 hours) followed by a colloquium	
Credits and Grading	8 credits. Module grade is given based on the grading of the exam	
Work Load	240 hours for lectures and exercises including preparatory and follow-up work, preparation for exams and assignments	
Duration and Frequency	The module is offered every academic year, starting in the winter semester and continuing for two semesters.	

Number of module	**Name of module**	**Lecturer**
BIW4-65	Computational Engineering for Concrete Structures	Häußler-Combe
Content and Course Goals	This module provides an overview of the application of numerical methods and other computer-based methods of analysis of reinforced concrete structures. This includes special material properties of concrete (failure, damage, plasticity, load-induced anisotropy); crack formation (smeared, discrete, cohesive); and the use of steel reinforcing. Each of these constituent components is presented with respect to modeling and discretization. Appropriate solution methods for nonlinear systems and applications for problems of reinforced concrete, especially under extraordinary actions such as impact and explosions, is yet another primary area of this module's focus. Students will learn the essentials of applying numerical methods to reinforced concrete structures and should be able to choose appropriate models, methods of solution, as well as to apply suitable programs. They must be able to correctly interpret results and recognize the limits imposed by the methods applied.	
Teaching	60 hours of lecture (2 hours per week during lecture period) 30 hours of exercises (1 hour per week during lecture period)	
Classification	Elective module to be taken during the specialized study period of computational engineering.	
Prerequisites	Good knowledge of fundamentals including primary study modules in mathematics, mechanics and structural analysis, as well as required modules of specialized studies in computational engineering.	
Examination	One assignment and a corresponding colloquium.	
Credits and Grading	8 credits. Module grade is given based on the grading of the assignment and the colloquium.	
Work Load	240 hours of lecture and exercises including preparatory and follow-up work, one assignment and preparation for the colloquium.	
Duration and Frequency	This module is offered every academic year beginning Winter Semester and continuing for two semesters (Winter – Spring/Summer).	

Number of module	**Name of module**	**Lecturer**
BIW4-66	Numerical Dynamics	**Kaliske**, Schneider, Herle

Content and Course Goals	Contents of the module are analytical and numerical methods of the treatment of interaction problems in the Civil Engineering. The students know at the end of the module the general concept of weighted residuals shown by the heat conducting problem, the treatment of singularities, the BEM in the soil and fluid dynamics, dual Reciprocity Method and Infinite Elements. They are able to treat the coupled interaction of different media such as elastic structure, soil, fluid and temperature fields. Optimal procedures are available with the FE method and the BE method for open and closed integration domains. The students know basic equations of continuum dynamics, typical analytical solutions, wave types, radiation damping, cut-off frequency, cone model, layer resonance, soil structure interaction and wave propagation. At the end of the module, the students own detailed knowledge and competence on the solution of specific dynamic tasks of structural design
Teaching	45 hours of lecture (1,5 hours per week during lecture period) 45 hours of exercises (1,5 hours per week during lecture period)
Classification	The knowledge of the basic studies (BIW1-01 to BIW1-11) is prerequisite.
Prerequisites	In the basic diploma course of Civil Engineering: - electoral duty module in the main study, in particular for the Structural Engineering and Computational Engineering In the postgraduate study course of Civil Engineering: - electoral duty module in the main study, in particular for the Structural Engineering and Computational Engineering
Examination	Credits are acquired if the module examination is passed. The module examination consists of: - 1st examination (oral, 30 min, individual test) on Boundary Element Method - 2nd examination (oral, 30 min, individual test) on Interaction Problems - 3rd examination (oral, 30 min, individual test) on Soil Dynamics Prerequisite for the exam: - course work of 20 hours for the examination – Boundary Element Method - course work of 20 hours for the oral examination – Interaction Problems - course work of 20 hours for the oral examination – Soil Dynamics
Credits and Grading	8 credits can be earned in this module. The grade of the module is determined by the arithmetic mean value of the grades of the exams of all three parts.
Work Load	The total work load amounts to 240 hours.
Duration and Frequency	The duration of the module is 2 semester. The module is offered every academic year, starting in winter semester.

Number of module	**Name of module**	**Lecturer**
BIW4-67	Nondeterministic Methods in Structural Analysis	Kaliske

Content and Course Goals	Contents of the module are important basics of the non-deterministic structural analysis, safety prediction and risk assessment. The students know at the end of the module reasons of data uncertainty, methods of data analysis, mathematical models for the description of data uncertainty (stochastic models, fuzzy models, fuzzy-stochastic models), numerical methods (stochastic and fuzzy-stochastic finite elements) and process simulations for loads, damages, modifications and rehabilitations. They understand time series analysis for deterministic and uncertain data, model-based prediction strategies (e.g. ARMA), model free prediction strategies (e.g. neuronal networks), cluster methods, methods for the risk assessment and risk analysis as well as risk management. At the end of the module, the students own detailed knowledge and competence on the solution of demanding tasks of structural design under application of nondeterministic numerical computational models.
Teaching	60 hours of lecture (2 hours per week during lecture period) 30 hours of exercises (1 hour per week during lecture period)
Classification	The knowledge from modules Statics (BIW2-02) and Basics of Structural Analysis (BIW3-01) is prerequisite.
Prerequisites	In the basic diploma course of Civil Engineering: - electoral duty module in the main study, in particular for Structural Engineering and Computational Engineering In the postgraduate study course of Civil Engineering: - electoral duty module in the main study, in particular for Structural Engineering and Computational Engineering
Examination	Credits are acquired if the module examination is passed. The module examination consists of: - 1st examination (oral, 30 min, individual test) on Nondeterministic Structural Analysis - 2nd examination (oral, 30 min, individual test) on Safety Prediction and Risk Assessment Prerequisite for the exam: - course work of 40 hours for the 1st examination – Nondeterministic Structural Analysis - course work of 40 hours for the 2nd examination – Safety Prediction and Risk Assessment
Credits and Grading	8 credits can be earned in this module. The grade of the module is determined by the arithmetic mean value of the grades of the exams of both parts.
Work Load	The total work load amounts to 240 hours.
Duration and Frequency	The duration of the module is 2 semester. The module is offered every academic year, starting in winter semester.

Number of module	**Name of module**	**Lecturer**
BIW4-68	Selected Topics of Discretization Methods, CAE	Häußler-Combe
Content and Course Goals	This module provides advanced topics of approximation of fields within discretization methods and their combination with solid mechanics, fluid mechanics and fluid-structure interaction. The module covers error types in discretization and solution of discretized systems, error estimation and adaptivity. Alternative approaches for interpolation and approximation are demonstrated in this context. This includes mesh-based interpolation and meshfree approximation. These basics of numerical methods are applied with Lagrangian frames for solid structures, Eulerian frames for fluid structures and arbitrary Lagrangian-Eulerian frames (ALE) for fluid-structure interactions and large deformations of solids. Students will learn the essentials of applying advanced numerical methods to complex systems and should be able to choose appropriate models, methods of solution, as well as to apply suitable programs. They should be able to correctly interpret results and recognize the limits imposed by the methods applied.	
Teaching	60 hours of lecture (2 hours per week during lecture period) 30 hours of exercises (1 hour per week during lecture period)	
Classification	Elective module to be taken during the specialized study period of computational engineering.	
Prerequisites	Good knowledge of fundamentals including primary study modules in mathematics, mechanics and structural analysis, as well as required modules of specialized studies in computational engineering.	
Examination	One assignment and a corresponding colloquium.	
Credits and Grading	8 credits. Module grade is given based on the grading of the assignment and the colloquium.	
Work Load	240 hours of lecture and exercises including preparatory and follow-up work, one assignment and preparation for the colloquium.	
Duration and Frequency	This module is offered every academic year beginning Winter Semester and continuing for two semesters (Winter – Spring/Summer).	

Number of module	**Name of module**	**Lecturer**
BIW4-69	Simulation and Monitoring of Engineering Systems	Scherer
Content and Course Goals	The module comprises courses on the topics 'System Simulation' and 'Data and Information Analysis'. After completion of the module the students have the knowledge about numerical and computational methods for the simulation of dynamic systems and about various approaches for the application of distributed computing. Furthermore, they have knowledge of the basic methods for data analysis, data reduction, Fourier, principal axis and wavelet analysis. The module imparts fundamental knowledge on Information and Data Mining Methods that enable the students to correctly interpret the behaviour of an engineering system in order to identify damage and complex damage inter-relationships, system malfunctioning and system gaps, and establish appropriate risk management procedures. After completion of the module the students have the skills for multidisciplinary conceptualisation, control and monitoring of dynamic processes, and the definition of appropriate interfaces for their modularisation.
Teaching	45 hours of lecture (1,5 hours per week during the lecture period) 45 hours of exercises (1,5 hours per week during the lecture period)
Classification	Within the undergraduate diploma course in civil engineering: Elective module to be taken during the main studies period, especially for study specializations in Structural Engineering and Computational Engineering Within the graduate diploma course in civil engineering: Elective module, especially for study specialization in Structural Engineering and Computational Engineering
Prerequisites	Competences acquired in modules of the base studies (BIW1-01 to BIW1-11) and module BIW3-13
Examination	One assignment (work load 40 hours) and a corresponding colloquium
Credits and Grading	8 credits. Module grade is based on the grading of the assignment and the colloquium.
Work Load	Total work load: 240 hours.
Duration and Frequency	The module is offered every academic year beginning in the winter semester and continuing for two semesters (winter – summer)

Number of module	**Name of module**	**Lecturer**
BIW4-70	Model-Based Working	Scherer

Content and Course Goals	The module comprises courses on the topics 'System and Product Modelling' and 'Process Modelling'. After completion of the module the students have the capabilities to structure and manage complex construction projects concerning design and project management and to design appropriate organisational and processing structures for co-operation and information management, and develop appropriate Risk Management plans. The module imparts knowledge about contemporary modelling methods, object-oriented data structures and the conceptualisation of meta schemas and hierarchical schemata, and about interoperability approaches based on methods for model mapping, matching and merging. Furthermore the students have knowledge of methods for formal object-oriented system description, formation of sub-systems and consistency checking, and their realisation on the basis of numerical and logical algorithms. The students are also able to model project processes and process flows, including the complementary information management processes, and their formal representation.
Teaching	45 hours of lecture (1,5 hours per week during the lecture period) 45 hours of exercises (1,5 hours per week during the lecture period)
Classification	Within the undergraduate diploma course in civil engineering: Elective module to be taken during the main studies period, especially for study specializations in Structural Engineering, Construction Management and Computational Engineering Within the graduate diploma course in civil engineering: Elective module, especially for study specializations in Structural Engineering, Construction Management and Computational Engineering
Prerequisites	Competences acquired in modules of the base studies (BIW1-01 to BIW1-11) and module BIW3-13
Examination	One assignment (work load 40 hours) and a corresponding colloquium
Credits and Grading	8 credits. Module grade is based on the grading of the assignment and the colloquium.
Work Load	Total work load: 240 hours.
Duration and Frequency	The module is offered every academic year beginning in the winter semester and continuing for two semesters (winter – summer)

Number of module	**Name of module**	**Lecturer**
BIW4-72	Sustainable Building	Weller

Content and Course Goals	The contents of this module include the general behavioural characteristics of various types of building materials and their specific behaviour when used in complex construction configurations. More specifically, this module provides for the examination of material behaviour throughout the entire life cycle of a structure - from the production and actual fabrication of the building components through structural use up and until the point when the disposal or recycling of the material/component parts occurs. Specific emphasis is placed on the current status of statutory engineering standards and relevant certifications utilized within the European Union and Germany to certify building component parts as meeting innovative energy requirements. Additionally, efforts from around the world to establish appropriate planning guidelines and recommendations for sustainable development for both new construction and redevelopment undertakings will be taken into consideration, and examples, such as the U.S. environmental certification process used under the LEED (Leadership in Energy ad Environmental Design) program, will be covered.
Teaching	60 hours of lecture (2 hours per week during lecture period) 30 hours of exercises (1 hour per week during lecture period)
Classification	Required module in main Studies for the specialization GEM. Elective course in main study period for all other specializations, especially KI
Prerequisites	Knowledge of the contents of the modules BIW2-12, BIW2-13 as well as BIW2-14.
Examination	Credit points are gained with passing the module examinations Module examinations consist of: Assignment (80 hours) followed by a colloquium
Credits and Grading	8 credits. Module grade is given based on the grading of the assignment and the colloquium.
Work Load	240 hours for lectures and exercises including preparatory and follow-up work, preparation for assignments and colloquium.
Duration and Frequency	The module is offered every academic year, starting in the winter semester and continuing for two semesters.

Number of module	**Name of module**	**Lecturer**
BIW4-73	Glass Facades	Weller

Content and Course Goals	The module covers the design and construction of modern building envelopes made of glass. The main focus lies on the appropriate use of the brittle and challenging material for windows, glass facades, glass roofs and even structural elements as well as their dimensioning and detailing. Particular attention is put on the material properties of glass, its manufacturing and processing, especially the key parameters influencing its functionality and optical quality. In this context available products and special glazing applications are introduced. A comprehensive part about building legislations for glass comprises current standards, guidelines and design methods as well as experimental tests for glass constructions, with regard to non regulated glass elements and structures. Beyond, the module focuses on the fracture pattern of different glass types, typical failure scenarios and the diagnosis of defects or failure. The structural design, dimensioning and the detailing of typical glass application is a another major part of the module. Contents are vertical and overhead glazing, glass as a safety barrier, security glazing, load bearing glass members and structurally bonded glass. Upon successful completion of the module the student will be able to perform the structural design and detailing of glass members of the building envelope.
Teaching	60 hours of lecture (2 hours per week during lecture period) 30 hours of exercises (1 hour per week during lecture period)
Classification	Elective course in main study period, especially for the specialization GEM. A parallel selection of the modules BIW4-18 and BIW4-64 is not possible.
Prerequisites	Good knowledge of the modules of the base studies as well as the module BIW2-13
Examination	Credit points are gained with passing the module examinations Module examinations consist of: Written examination 120 min Prerequisites: Assignment (40 hours) followed by a colloquium
Credits and Grading	8 credits. Module grade is given based on the grading of the exam
Work Load	240 hours for lectures and exercises including preparatory and follow-up work, preparation for exams and assignments
Duration and Frequency	The module is offered every academic year, starting in the winter semester and continuing for two semesters.

Number of module	**Name of module**	**Lecturer**
BIW4-74	Special Themes of Building Climatology and Building Energy Technology	**Grunewald**, Richter

Content and Course Goals	Content of this module is the hygrothermal assessment of construction details, the development of building physical building models and the energetically optimisation of building designs and building facilities for heating and cooling under consideration of an optimal energy management. A second key point is the use of renewable energy like solar and geothermal energy as well as the control of the dynamic air-, heat and moisture behaviour. At the end of this module the students should know the potential of numerical simulation methods. Thereby they have knowledge for the main system of the building (and there parts respectively) with its energetically interaction among each other and with the surrounding. They should be able to assess whole building designs regarding of its optimal energy use and sustainable climate right build activity.
Teaching	60 hours of lecture (2 hours per week during lecture period) 30 hours of exercises (1 hour per week during lecture period)
Classification	Elective module to be taken during the specialized study of building energy management.
Prerequisites	The knowledge of the topics from modules building construction (BIW1-01), building physics (BIW1-02), building materials (BIW1-08) and basics of building climatology and building energy technology (BIW2-14) is required.
Examination	One examination (120 min)
Credits and Grading	8 credits. Module grade is given based on the result of the examination.
Work Load	240 hours
Duration and Frequency	2 semester

Number of module	**Name of module**	**Lecturer**
BIW4-75	Green Building Design	Weller

Content and Course Goals	This module presents a holistic and interdisciplinary approach to the environmentally sensitive and energy efficient design of sustainable building that is grounded in the fundamentals of building performance - building climate control, architectural sciences and physics, as well as building services engineering. Planning methodologies and practical dimensioning and specifications are developed and emphasized based on the interpretation of dynamic modelling simulation techniques used in which energy usage and consumption are minimized while human comfort levels are simultaneously maximized. Elemental aspects of the integration of the building envelope with HVAC (heating, ventilation and air conditioning) systems, as well as the use of natural light, complement this module.
Teaching	60 hours of lecture (2 hours per week during lecture period) 30 hours of exercises (1 hour per week during lecture period)
Classification	Elective course in main study period especially for the specialization KI.
Prerequisites	Knowledge of the contents of the modules BIW2-12, BIW2-13 as well as BIW2-14.
Examination	Credit points are gained with passing the module examinations Module examinations consist of: Assignment (80 hours) followed by a colloquium
Credits and Grading	8 credits. Module grade is given based on the grading of the assignment and the colloquium.
Work Load	240 hours for lectures and exercises including preparatory and follow-up work, preparation for assignments and colloquium.
Duration and Frequency	The module is offered every academic year, starting in the winter semester and continuing for two semesters.

Number of module	**Name of module**	**Lecturer**
BIW4-76	Finishing Works and Building Services B	Jehle

Content and Course Goals	The module Finishing Works and Building Services B provides extensive knowledge about the field of turnkey construction. This contains information about typical finishing crafts, like for example finery and screed, flagging, gas concrete or studworks. Besides the comprehension of the used materials various working techniques will be discussed. The students should be able to identify scarcities early during the process and start steps to assure quality. Furthermore the students get to know details about the delimitation of works ("Leistungen"), auxiliary works ("Nebenleistungen") and additional works ("besondere Leistungen") as well as the accounting according to the VOB/C. In the topic of Building Systems Technology the most important parts like lighting, control of heating, ventilation and air condition, access control, shading including all sensors and actors will be presented. There will be an introduction into the networks of buildings and the existing standards of information technology (WLAN, EIBUS). The lecture will be supported by examples and practical demonstrations in the laboratory. The teaching bases on the life cycle of value creation and includes the design and the facility management.
Teaching	60 hours of lecture (2 hours per week during lecture period) 30 hours of exercises (1 hour per week during lecture period)
Classification	Elective module to be taken during the specialized study period of Construction and Site Management.
Prerequisites	Knowledge in the modules of the 2nd and 3rd year of studies connected to the specialization.
Examination	The credits are acquired after the passed module examination. The examination consists of a test (90 minutes). The test is offered every examination period.
Credits and Grading	8 credits. The mark of the module is the mark of the test.
Work Load	Total expenditures: 240 hours for lectures and exercises including preparatory and follow-up work and preparation for exams.
Duration and Frequency	2 semesters. The module is offered every academic year, starting in winter semester.

Number of module	**Name of module**	**Lecturer**
BIW4-77	Business Management	Schach

Content and Course Goals	The objective of the module is to provide students with knowledge of the components and tasks of accounting, the basics of business accounting including balancing and profit-and-lost accounting in construction companies as well as special knowledge of construction management accounting. A further main topic is the thorough discussion of construction management and the corresponding tasks and functions of a site manager which result from regional building regulations as well as from the regulations within the construction company. The module deals furthermore with subjects of business management, organization and human resources management. After passing this module, students will be able to understand the systematic of accounting and balancing. In addition, they will be capable to assess managerial functions at constructions sites and in business departments. They will have the competency to develop structured and scientifically based solutions for different tasks in the field of construction management. Students will also have a thorough understanding of controlling, quality management and human resources management.
Teaching	60 hours of lecture (2 hours per week during lecture period) 30 hours of exercises (1 hour per week during lecture period)
Classification	Within the consecutive study program of civil engineering: This module is an elective module of the main studies, especially for the study specialization "Building, Energy, Management". Within the postgraduate program of civil engineering: This module is an elective module, especially for the study specialization "Building, Energy, Management". (The parallel choice of modules BIW4-23 or BIW4-28 is not possible.)
Prerequisites	Competencies gained in the modules of the base studies of the study specialization GEM (BIW2-01 to BIW2-06, BIW2-10 and BIW2-12 to BIW2-15) are required.
Examination	Credits are acquired by successfully passing the module examination. The examination consists of 1. a written test (90 minutes) and 2. an assignment (80 hours) with colloquium reflecting the content of "Seminar für Baubetriebswesen".
Credits and Grading	8 credits can be acquired. The grade of the module results from the weighted arithmetic mean value calculated from both the written test (weighting factor 2) and the assignment with colloquium (weighting factor 1)
Work Load	The total work load amounts to 240 hours
Duration and Frequency	The duration of the module is 2 semesters. The module is offered every academic year, starting in winter semester.

4.2.5 Required modules for specialized studies

Number of module	**Name of module**	**Lecturer**
BIW4-71	Vocational Oriented Common Qualifications	Schneider
Content and Course Goals	The completion of the module provides students with vocationally oriented common qualifications. There are different fields to choose from as for instance negotiation and presentation skills, self-development, assessment centre, contract law, specific law, language and civilisation, foreign languages, company foundation, liability, knowledge management or globalisation.	
Teaching	The module comprises 120 hours of lectures (a total of 8 hours per week during lecture period). Teaching methods correspond to §8 of the study regulations for the diploma course in civil engineering. The required number of courses is to be selected from the AQUA-catalogue that will be announced by the faculty in the beginning of the semester. This catalogue will also indicate the necessary examinations.	
Classification		
Prerequisites	The module is a required module in the main studies of the basic diploma course in civil engineering and a required module in the postgraduate study course in civil engineering.	
Examination	The credits are acquired by passing the module examination. The module examination consists of the ungraded course credits indicated in the AQUA catalogue of the faculty of civil engineering.	
Credits and Grading	8 credits can be earned in this module. The module is passed if all partial performances were passed otherwise the module is failed.	
Work Load	The total work load amounts to 240 hours.	
Duration and Frequency	The module is offered in the winter semester of every academic year and lasts three semesters.	

Number of module	**Name of module**	**Lecturer**
BIW5-01	Project Work	Weller, Jehle, Wellner, Stamm, Kaliske, Schach

Content and Course Goals	Object of the project work are content and methodical questions from the fields of the main study period which are academically worked on under the instructions, of the in each case responsible university teacher, and are applied to concrete problems. This can happen as a single work or as a team work but the single contributions have to be recognizable and must be valuable. The setting of the tasks and the processing can also worked on in vote with a practice partner beyond the college. In this case the practice partner is involved in the assessment of the exam achievements. By the project work the candidate should learn to apply the acquired knowledge, abilities and skills if possible independently, individually or in the team, to a concrete setting of tasks and to produce a documentation in understandably working steps and to bring them up as a result for discussion in a seminar. Furthermore the project work can also prove the ability in the interdisciplinary teamwork and in particular the ability in the development, conversion and presentation of own concepts. This module includes the project work itself and a seminar in which the projects are presented and discussed.
Teaching	32 hours seminar offered as block course at the end of the semester
Classification	Compulsory module for all specializations in the main study period.
Prerequisites	Good knowledge of the modules of the third and fourth study year according to the specialisation required
Examination	Credit points are acquired with passing the module examinations. Module examinations consist of a project work.
Credits and Grading	26 credits The grade of the module is equal to the grade of the project work
Work Load	780 hours for project work, preparation and presentation
Duration and Frequency	This module is offered every academic year in the Winter Semester and lasts 1 semester.

4.3 MSC Programme in Advanced Computational and Civil Engineering Structural Studies (ACCES), Descrition of the modules

Number of module	**Name of module**	**Lecturer**
BIWE-01	Design of Concrete Structures	Curbach
Content and qualification aim	Content of the module: The module offers an introduction to maintenance principles of bridge and building administrations. Inspection, Investigation, testing and condition assessment of existing reinforced concrete structures are covered in these lectures. A separate part of lessons concerns about load tests and structural monitoring of reinforced concrete structures. The recalculation of old buildings and bridges is covered, as well advanced calculation methods in order to estimate available load bearing reserves of the section or the structure. Special strengthening methods of reinforced concrete and their calculation models are explained. These methods are strengthening of crosssections with Shotcrete, steel lamellae, fiber reinforced polymer or textile reinforced concrete as well as structural strengthening with post tensioning or Infilling and bracing techniques. The participants should be empowered to assess existing reinforced concrete structures and to design and calculate necessary remedial activities of these structures.	
Type of course	2 hours of lectures, 1 hour of exercise per week	
Requirements for study		
Practical use of the module	Elective module in the Master's course Advanced Computational and Civil Engineering Structural Studies.	
Requirements for the award of credits	Credits are awarded, if the module examination is successfully passed. The examination is parted in a theoretical part (30min) and in a part, where calculated solution should be provided (30min). The examination is offered in every examination period.	
Credits and grades	4 credits can be acquired for this module. The grade is the grade of the written examination.	
Frequency of module	The module is offered every academic year (summer semester).	
Work load	The workload is 120 working hours.	
Duration of the module	1 semester	
Recommended literature	Fib bulletin 17: Management, maintenance and strengthening of concrete structures	

Number of module BIWE-02	**Name of module** Design of Masonry Structures	**Lecturer** Jäger
Content and qualification aim	Content of the Module: • Building materials of masonry structures, types of masonry, characteristics • Load bearing and deformation behaviour and material laws for description • Modelling and analyses of masonry structures and problems (Engineering methods, numerical analyses, static and dynamic actions on masonry structures) • Design and verification models • Verification concepts and methods (semiprobabilistic safety concept, reliability of failure and the verification of the safety index, existing structures, insitu testing) • advanced chapters of structural masonry (nonlinear behaviour and stability problems, failure mechanism, behaviour and verification under earthquake loads, fire action and modelling) • Codes and verification methods internationally compared • experimental methods (testing of materials and building elements, scaled models, static and dynamic loading, evaluation of test results) and their application • assessment and strengthening of existing buildings (principles, , building pathology, analyses, evaluation and enhancement of load bearing capacity) After finishing the module successfully the student has the competence to solve standard tasks as well as special engineering problems and questions of masonry structures in the engineering practice, research and development. He has also capabilities to assess existing masonry structures, to evaluate the damages and is able to improve them.
Type of course	2 hours of lectures, 1 hour of exercise per week
Requirements for study	Good knowledge from modules Building Materials (BIWO-01), Continuum Mechanics (BIWO-02) and Energy Methods, Finite Element Method (BIWO-03) or from equivalent courses, the occupancy of the elective modules BIWE-09 and BIWE-10 could be very helpful but is not a prerequisite
Practical use of the module	Elective module in the Master's course Advanced Computational and Civil Engineering Structural Studies.
Requirements for the award of credits	The credits are awarded, if the module examination is successfully passed. The module examination consists of a written examination (120 min), offered in every examination period.
Credits and grades	4 credits can be acquired for this module. The grade is the grade of the written examination
Frequency of module	The module is offered every academic year (summer semester).
Work load	The workload is 120 working hours.
Duration of the module	1 semester
Recommended literature	Jäger, W. et al.: Structural Masonry. Manuscipt. TU Dresden 2009 Jäger, W. : Historic Masonry. WITpress Southampton 2009

Number of module	**Name of module**	**Lecturer**
BIWE-03	Timber and Lightweight Structures	Stroetmann, Haller

Content and qualification aim	Content of the module: • Mechanical and physical basics of timber and its derivates and their consequences for the construction • Situation of resources and transformation processes of raw wood for timber structures • Wood modification • Timber joints and structural behaviour • Composite structures with concrete, fibres and textiles • Selected examples of wooden buildings outline the current state of timber construction and its special features • Historical timber structures, reconstruction and rehabilitation • Stability, fatigue and service strength of steel constructions • Wired steel constructions – types of wire and fasteners; design, construction and assessment • Structures made of textile membrane und plastic foils combined with steel construction elements • Exercises After having finished the module successfully, the student knows about the design, construction and calculation of timber and light weight structures.
Type of course	2 hours of lectures, 1 hour of exercise per week
Requirements for study	Knowledge in steel and timber materials, basics of analysis and constructions of steel structures and geometrical and physical nonlinear analysis.
Practical use of the module	The module is an elective compulsory module in the Master's course Advanced Computational and Civil Engineering Structural Studies.
Requirements for the award of credits	The credits are awarded, if the module examination is successfully passed. The module examination consists of: - a written examination (150 min), offered in every examination period
Credits and grades	4 credits can be acquired for this module. The grade is the grade of the written examination.
Frequency of module	The module is offered every academic year (summer semester).
Work load	The workload is 120 working hours.
Duration of the module	1 semester
Recommended literature	

Number of module BIWE-04	**Name of module** Advanced Geotechnical Analysis	**Lecturer** Herle
Content and qualification aim	Content of the module: • Fundamental effects of the mechanical soil behaviour • Constitutive models for soils • Tools for numerical analysis of geotechnical problems • Soil improvement methods and design • Slope stability • Modelling of shallow and deep foundations • Retaining structures and deep excavations • Underpinning of existing structures After finishing the module successfully the student has an advanced knowledge for the analysis of geotechnical tasks.	
Type of course	2 hours of lectures, 1 hour of exercise per week	
Requirements for study	The basic knowledge of elementary soil mechanics is assumed.	
Practical use of the module	Optional module in the Master's course Advanced Computational and Civil Engineering Structural Studies.	
Requirements for the award of credits	The credits are awarded, if the module examination is successfully passed. The module examination consists of: -a written examination (120 min), offered in every examination period Pre-requisites for the examinations: • All assignments should be neatly submitted. • At least 80 % of the assignments should be accurate.	
Credits and grades	4 credits can be acquired for this module. The grade is the grade of the written examination.	
Frequency of module	The module is offered every academic year (summer semester).	
Work load	The workload is 120 working hours consisting of 90 hours for lectures and exercises including preparatory and follow-up work, preparation for exams and assignments and 30 hours for assignment during lecturing period.	
Duration of the module	1 semester	
Recommended literature		

Number of module BIWE-05	**Name of module** Structural Use of Glass	**Lecturer** Weller
Content and qualification aim	Content of the module: • Aspects of Facade Engineering • Mechanical and physical principles of annealed and prestressed glass • Safety concept in structaral use of glass • Introduction in glass design • Numerical simulation of glass • Numerical Simulation of mechanical and adhesively bonded glass connections • Exercises in glass design and numerical simulations After having finished the module successfully the student has deepened knowledge in structural use of glass.	
Type of course	2 hours of lectures, 1 hour of exercise per week	
Requirements for study		
Practical use of the module	Elective module in the Master's course Advanced Computational and Civil Engineering Structural Studies	
Requirements for the award of credits	The credits are awarded, when the module examination is successfully passed. The module examination consists of: -written examination (60 min), offered in every examination period.	
Credits and grades	4 credits can be acquired for this module. The grade is the grade of the written examination.	
Frequency of module	The module is offered every summer term.	
Work load	The workload is 120 working hours.	
Duration of the module	1 semester.	
Recommended literature	• The Institution of Structural Engineers: Structural use of glass in buildings. ISBN 1 874 266 5147. • Schittich et al: Glass construction manual. ISBN 3 764 381 221	

Number of module BIWE-06	**Name of module** Resilience during Extreme Events	**Lecturer** Graw
Content and qualification aim	Content of the module: • Objectives of hazard studies and public acceptance of risks • Stochastic methods, failure statistics and risk • Physical background, hydraulic and geotechnical properties of models and application conditions • Identification of variables and processes • Hazard prognosis, risk deduction, vulnerability reduction and resilience • Application to case studies in hydraulic engineering and geotechnics • Numerical calculations using hydromechanics and geotechnical software	
Type of course	30 academic hours lectures, 15 academic hours exercises	
Requirements for study	Basic knowledge in hydraulic engineering and geotechnics.	
Practical use of the module	Elective module in the Master's course Advanced Computational and Civil Engineering Structural Studies.	
Requirements for the award of credits	The credits are awarded, if the module examination is successfully passed. The module examination consists of: -an oral examination, offered in every examination period	
Credits and grades	4 credits can be acquired for this module. The grade is the grade of the oral examination.	
Frequency of module	The module is offered every academic year.	
Work load	The workload is 120 working hours.	
Duration of the module	1 semester	
Recommended literature		

Number of module BIWE-07	**Name of module** Computational Building Physics	**Lecturer** Grunewald
Content and qualification aim	Content of the module: • Indoor Climate Design o Human comfort and indoor air quality, pollutants o Environmental and indoor loads, user behaviour o Thermal protection in summer time and in hot climates • Coupled Heat, Air and Moisture Transfer in Building Envelope Systems o Hygrothermal dimensioning of construction details o Durability aspects, Assessment of damage potentials and protective measures o Protection of cultural valuables in the built environment • Whole Building Energy & Hygrothermal Simulations o Building physical building model development o Passive and active measures to buffer energy and moisture in constructional systems o Energetic optimization of buildings with regard to their environment After having finished the module successfully the student is able to apply commonly used and in-house computational models in the fields above.	
Type of course	2 hours of lectures, 1 hour of exercise per week	
Requirements for study	Sufficient and applicable knowledge in the basics of building physics and capabilities in understanding of transport phenomena in air spaces and porous building materials.	
Practical use of the module	Elective module in the Master's course Advanced Computational and Civil Engineering Structural Studies. It builds up on the obligatory modules BIWO-01 to BIWO-05.	
Requirements for the award of credits	The credits are awarded, if the module examination is successfully passed. The module examination consists of: -a written examination (180 min), offered in every examination period.	
Credits and grades	4 credits can be acquired for this module. The grade is the grade of the written examination.	
Frequency of module	The module is offered every academic year.	
Work load	The workload is 120 working hours.	
Duration of the module	1 semester	
Recommended literature	For programm downloads und literature check: http://www.bauklimatik-dresden.de/ http://www.eere.energy.gov/buildings/energyplus/ http://www.designbuilder.co.uk/	

Number of module BIWE-08	**Name of module** Multiscale Mechanics	**Lecturer** Zastrau
Content and qualification aim	Content of the module: • Multiscale modeling of composites and materials with defects and cracks • Representative Volume Elements (RVE) and unit cells • Homogenization and localization (scale transition/scale bridging) • Hierarchical and simultaneous multiscale methods • Averaging techniques • Voigt/Reuss approximations and Hashin/Shtrikmann bounds • Micromechanical solution by Eshelby • Effective field and effective medium approximation • Introduction in numerical homogenization procedures with homogeneous, periodic and mixed boundary conditions After having finished the module successfully the student knows about the multiscale modeling of composite materials and materials with defects and cracks using analytical models and approximation approaches.	
Type of course	2 hours of lectures, 1 hour of exercise per week	
Requirements for study	Good knowledge in mathematics and tensor calculus. Successful participation in continuum mechanics (module BIWO-02) or equivalent courses.	
Practical use of the module	Elective module in the Master's course Advanced Computational and Civil Engineering Structural Studies.	
Requirements for the award of credits	The credits are awarded, if the module examination is successfully passed. The module examination consists of: -an assignment with colloquium, offered in every academic year	
Credits and grades	4 credits can be acquired for this module. The grade is the grade of the examination.	
Frequency of module	The module is offered every academic year (summer semester).	
Work load	The workload is 120 working hours.	
Duration of the module	1 semester	
Recommended literature	• H.J. Böhm: A Short Introduction to Basic Aspects of Continuum Micromechanics • S. Nemat-Nasser, M. Hori: Micromechanics – Overall Properties of Heterogeneous Materials	

Number of module	**Name of module**	**Lecturer**
BIWE-09	Computational Dynamics and Safety Concepts	Kaliske, Graf
Content and qualification aim	Content of the module: Computer-oriented structural dynamical analysis: • Single degree of freedom system in time-and frequency domain • Multi degree of freedom system, natural vibrations, modale superposition • Substructuring and condensation techniques • Numerical simulation in time domain, central-difference-method, Newmark-method, analysis of time integration methods • Continous systems • Applications, earthquake analysis, systems identification Safety of structures, safety forecasting and risk assessment: • Limit states and failure of structures • Concepts for description of data uncertainty and safety • Level 3-Analysis: random vectors, integral formulas for probability of failure, relation between failure of system and of elements, Level 2-Analysis: relation between probability of failure and reliability index, 1^{st}, 2^{nd} order reliability theory; Level 1-Analysis (semi-probabilistic): kinds of partial coefficients for safety, usual sizes of partial coefficients of safety in the codes • Time series for certain and uncertain data • Model-based and model-free forecasting strategies • Methods of risk analysis and risk assessment After having finished the module successfully the student knows about the solution of dynamical and safety problems of structures by application of advanced computational methods.	
Type of course	2 hours of lectures, 1 hour of exercise per week	
Requirements for study	Good knowledge from mathematics, continuum mechanics, energy and finite element methods.	
Practical use of the module	Elective module in the Master's course Advanced Computational and Civil Engineering Structural Studies.	
Requirements for the award of credits	The credits are awarded, if the module examination is successfully passed. The module examination consists of: -a written examination (120 min), offered in every examination period	
Credits and grades	4 credits can be acquired for this module. The grade is the grade of the written examination.	
Frequency of module	The module is offered every academic year (summer semester).	
Work load	The workload is 120 working hours.	
Duration of the module	1 semester	
Recommended Literature	Clough, Penzien: Dynamics of Structures, McGraw-Hill. Argyris, Mlejnek: Dynamics of Structures, North-Holland. Meskouris: Structural Dynamics, Ernst & Sohn.	

Number of module BIWE-10	**Name of module** Modelling and Simulation in Pavement Engineering	**Lecturer** Wellner/Werkmeister, Kaliske
Content and qualification aim	Module content: • Basic knowledge about the input parameter for the pavement design process (traffic loading, climatic conditions, material properties) • Modelling of the pavement conditions: - temperature gradients, calculation models to determine relevant temperature gradients, comparison to measured data in the field - Modelling of the tire-pavement interaction under consideration of the vehicle properties, comparison to field measurements • Modelling of the deformation behaviour of the materials used in pavements (unbound granular materials, asphalt, concrete) • Modelling of the layer bond conditions of flexible pavements • Design of a numerical simulation model: material performance, element approaches, structural model, multi-physics • Numerical multi-physical structural analysis • Numerical calculations • Validation of the laboratory test results using the results of largescale field tests After having finished the module successfully the student has deepened knowledge in analytical and numerical methods to model and simulate the pavement performance.	
Type of course	2 hours lectures, 1 hour tutorial per week	
Requirements for study	Basic knowledge in mathematics and mechanics/statics is required.	
Practical use of the module	Elective module in the Master's course Advanced Computational and Civil Engineering Structural Studies.	
Requirements for the award of credits	The credits are awarded, when the module examination is successfully passed. The module examination consists of: -accepted assignment, -written examination (120 min), offered in every examination period.	
Credits and grades	4 credits can be acquired for this module. The grade is the grade of the written examination.	
Frequency of module	The module is offered every summer term.	
Work load	The work load is 120 working hours.	
Duration of the module	1 semester.	
Recommended literature	Highways, The Location, Design, Edited by C. A. O'Flaherty, 2002, ISBN 0 7506 5090 7 Design and Performance of Road Pavements, D. and P. Croney, ISBN 0 07 014451 6	

Number of module BIWO-01	**Name of module** Building Materials	**Lecturer** Mechtcherine
Content and qualification aim	Content of the module: • Microstructure and chemical composition of building materials • Physical and mechanical properties of construction materials (timber, steel, concrete, masonry), durability of construction materials • Materials for strengthening and repair (polymers, polymer modified mortar/concrete, fibre reinforced polymer-based composites, shotcrete) • High performance cement-based composites for new construction and rehabilitation (self-compacting concrete, fibre reinforced concrete, textile reinforced concrete, ultra-high performance concrete) • Modelling and numerical simulation of concrete-like materials in the fresh state (incl. simulation of mixing, transportation, placing and compaction) • Modelling the deformation and cracking behaviour of cement-based materials; fracture mechanics of concrete; numerical simulation of the crack development due to thermal and hygral changes After having finished the module successfully the student knows about the microstructure and properties of construction and repair materials as well as about some basics for their modelling and numerical simulation.	
Type of course	4 hours of lectures, 2 hours of exercises per week	
Requirements for study		
Practical use of the module	Obligatory module in the Master's course Advanced Computational and Civil Engineering Structural Studies. Basics for elective module BIWE-01 - BIWE-10.	
Requirements for the award of credits	The credits are awarded, if the module examination is successfully passed. The module examination consists of: -a written examination (180 min), offered in every examination period	
Credits and grades	8 credits can be acquired for this module. The grade is the grade of the written examination.	
Frequency of module	The module is offered every academic year (winter semester).	
Work load	The workload is 240 working hours.	
Duration of the module	1 semester	
Recommended literature		

Number of module BIWO-02	**Name of module** Continuum Mechanics, Tensor Calculus	**Lecturer** Zastrau
Content and qualification aim	Content of the module: • Introduction to tensor algebra and tensor fields • Analysis of deformation and motion – kinematics, strains, objectivity • Balance laws, stress and field equations – mass, momentum, moment of momentum, energy, entropy • Principles of rational continuum mechanics – material theory, constitutive equations • Hyperelasticity • Initial-boundary-value problems • Variational principles After having finished the module successfully the student knows about the necessary manipulations of vectors and tensors, i.e. tensor calculus, needed in the context of continuum field theories. Furthermore the modul is focused on the concepts of continuum mechanics and the pertinent variational principles.	
Type of course	4 hours of lectures, 2 hours of exercises per week	
Requirements for study	Good knowledge in mathematics.	
Practical use of the module	Elective module in the Master's course Advanced Computational and Civil Engineering Structural Studies.	
Requirements for the award of credits	The credits are awarded, if the module examination is successfully passed. The module examination consists of: -an assignment (60 hours) with colloquium, offered in every academic year	
Credits and grades	8 credits can be acquired for this module. The grade is the grade of the examination.	
Frequency of module	The module is offered every academic year (winter semester).	
Work load	The workload is 240 working hours.	
Duration of the module	1 semester	
Recommended literature	• M. Itskov: Tensor Algebra and Tensor Analysis for Engineers • G. A. Holzapfel: Nonlinear Solid Mechanics: A Continuum Approach for Engineering	

Number of module BIWO-03	**Name of module** Energy Methods, FEM	**Lecturer** Kaliske
Content and qualification aim	Content of the module: • Introduction into calculus of variations • Minimal principle of potential energy • Approximative solution according to Ritz and Galerkin • Energetic stability criteria and their application • Hamilton's law, Hamilton's principle • Lagrange-equations, application to stationary and non stationary vibrations • Minimal principle of complementary energy • Displacement form of FEM • Generalized variational principles and hybrid finite elements • Geometrically nonlinear FEM • Physically nonlinear FEM • Numerical simulation of fracture After having finished the module successfully the student has deepened knowledge about energy methods which are basis for the finite element method as well as about linear and nonlinear finite element method itself.	
Type of course	4 hours of lectures, 2 hours of exercises per week	
Requirements for study	Basic knowledge in mathematics and mechanics is required.	
Practical use of the module	Obligatory module in the Master's course Advanced Computational and Civil Engineering Structural Studies. Basics for elective module BIWE-01 - BIWE-10.	
Requirements for the award of credits	The credits are awarded, when the module examination is successfully passed. The module examination consists of: - assignment with different parts of which 80% have to be accepted, - written examination (120 min), offered in every examination period.	
Credits and grades	8 credits can be acquired for this module. The grade is the grade of the written examination.	
Frequency of module	The module is offered every academic year (winter term).	
Work load	The workload is 240 working hours.	
Duration of the module	1 semester.	
Recommended literature	Chandrupatla, Belegundu: Introduction to Finite Elements in Engineering, Prentice-Hall. Zienkiewicz, Taylor: The Finite Element Method, Butterworth-Heinemann.	

Number of module BIWO-04	**Name of module** Software Engineering	**Lecturer** Scherer
Content and qualification aim	To provide students with the knowledge of basics in software engineering for computational engineering, in particular complex software system design, data structures and numerical algorithms for continuous mathematics The module is divided into two parts: Software systems covers: • System capturing and system architecture • Formal representation of systems • Relational and object-oriented data structures • Object-oriented modeling of complex engineering systems • Communication and data exchange • User interfaces • Application for integrated engineering systems for monitoring and control Numerical methods covers: • Construction and analysis of algorithms to solve continuous mathematical problems • Direct methods to compute the exact solution to a problem in a finite number of steps at unlimited computer precision • Iterative methods to compute approximations that converge to the exact solution • Solution of linear and non-linear equations, systems of equations and eigenvalue problems • Numerical integration, interpolation, and regression • Implementation of the algorithms in software applications	
Type of course	2 hours of lectures, 2 hours of exercises per week	
Prerequisites for study	none	
Practical use of the module	Obligatory module in the Master's course Advanced Computational and Civil Engineering Structural Studies.	
Requirements for the award of credits	The credit points are offered on the basis of a written examination (120 min) conducted in each term.	
Credits and grades	4 credit points The grade is the grade of the written examination.	
Frequency of module	The module is offered every academic year in the winter semester.	
Work load:	The worklowad is 240 hours of lecture and tutorials, including preparation and assessment, preparation for examinations, and credits. The time expenditure consists of 30 hours within the time of the lectures.	
Duration of the module	1 semester	
Recommended literature:	Eastman Charles M. (Chuck Eastman), Building Product Models, CRC Press, 1999 Schenk Douglas, Wilson Peter, Information Modelling the EXPRESS Way, Oxford University Press 1994 Draft Federal Information Processing Standards Publication 183. Announcing the Standard for Integration Definition for Function Modeling (IDEF0), National Institute of Standards and Technology, Gaithersburg, US, 1993 December 21, http://www.idef.com/pdf/idef0.pdf IEEE Std 1320.1-1998. IEEE Standard for Functional Modeling Language—Syntax and Semantics for IDEF0. ISBN 0-7381-0340-3, New York: IEEE, June 1998, http://ieeexplore.ieee.org/iel4/6054/16180/00749110.pdf	

Number of module BIWO-05	**Name of module** Mentoring	**Lecturer** Kaliske
Content and qualification aim	Content of the module: • Individual and group discussions concerning study competence, study organization and the solution of problems in view of study contents. This module is meant to improve studying ability, to comply with the stand period of study and to prevent university dropouts, guidance on independent learning, early diagnosis and consequent removal of learning obstructions and the development of competency in scientific working methods.	
Type of course	2 hours of tutorial	
Requirements for study		
Practical use of the module	Obligatory module in the Master's course Advanced Computational and Civil Engineering Structural Studies.	
Requirements for the award of credits	The credits are awarded, if the module examination is successfully passed. The module examination consists of: - a report upon a mentoring session which has been approved by the mentor in charge	
Credits and grades	2 credits can be acquired for this module. The module is evaluated with "passed" or "failed".	
Frequency of module	The module is offered every academic year (winter semester).	
Work load	The workload is 60 working hours.	
Duration of the module	1 semester	
Recommended literature		

Number of module BIWO-06	**Name of module** Mentoring	**Lecturer** Kaliske
Content and qualification aim	Content of the module: • Individual and group discussions concerning study competence, study organization and the solution of problems in view of study contents. This module is meant to improve studying ability, to comply with the stand period of study and to prevent university dropouts, guidance on independent learning, early diagnosis and consequent removal of learning obstructions and the development of competency in scientific working methods.	
Type of course	2 hours of tutorial	
Requirements for study		
Practical use of the module	Obligatory module in the Master's course Advanced Computational and Civil Engineering Structural Studies.	
Requirements for the award of credits	The credits are awarded, if the module examination is successfully passed. The module examination consists of: -a report upon a mentoring session which has been approved by the mentor in charge	
Credits and grades	2 credits can be acquired for this module. The module is evaluated with "passed" or "failed".	
Frequency of module	The module is offered every academic year (summer semester).	
Work load	The workload is 60 working hours.	
Duration of the module	1 semester	
Recommended literature		

Number of module BIWO-07	**Name of module** Case Studies	**Lecturer** Kaliske
Content and qualification aim	Content of the module: • specialized topics in computational modelling and structural design which are presented by lectures or experts from outside the university. Typically 4 hours per topic. After having finished the module successfully the student knows about typical applications of computational modeling and means of structural strengthening.	
Type of course	4 hours of lectures	
Requirements for study		
Practical use of the module	Obligatory module in the Master's course Advanced Computational and Civil Engineering Structural Studies. Knowledge from modules BIWO-01 – BIWO-07 and BIWS-01 - BIWS-07 is brought into reality and deepened by practical application. Each student chooses one of the presented lectures to write a report on it.	
Requirements for the award of credits	The credits are awarded, if the module examination is successfully passed. The module examination consists of: - a written report, offered in every examination period - a final discussion (15 minutes) based on the written report, offered in every examination period	
Credits and grades	6 credits can be acquired for this module. The grade is the grade of the written report including the final discussion.	
Frequency of module	The module is offered every academic year as blocked lecture in the beginning of winter semester.	
Work load	The workload is 180 working hours.	
Duration of the module	1 semester	
Recommended literature		

Number of module BIWO-08	**Name of module** Project	**Lecturer** Kaliske
Content and qualification aim	Object of the project work are content and methodical questions from the fields of the main study period which are academically worked on under the instructions, of the in each case responsible university teacher, and are applied to concrete problems. This can happen as a single work or as a team work but the single contributions have to be recognizable and must be valuable. The setting of the tasks and the processing can also worked on in vote with a practice partner beyond the college. In such instance, the practice partner is involved in the assessment of the exam achievements. Through the project work the candidate should learn to apply the acquired knowledge, abilities and skills if possible independently, individually or in the team, to a concrete setting of tasks and to produce a documentation in understandably working steps and to bring them up as a result for discussion in a seminar. Furthermore the project work can also prove the ability in the interdisciplinary teamwork and in particular the ability in the development, conversion and presentation of own concepts. This module includes the project work and a project seminar in which the projects are presented and discussed.	
Type of course	Project work Presentation in project seminar as blocked lecture at the end of the semester.	
Requirements for study	Successful completion of at least 5 modules out of the elective modules BIWE-01 bis BIWE-10.	
Practical use of the module	Obligatory module in the Master's course Advanced Computational and Civil Engineering Structural Studies.	
Requirements for the award of credits	The credits are awarded, if the module examination is successfully passed. The module examination consists of: - the project work, offered in every examination period - project seminar, offered in every examination period	
Credits and grades	24 credits can be acquired for this module. The total grade is the weighted average of the grades of the project work and the project seminar. The grade of the project work is weighted with 21 and the grade of the project seminar with 3.	
Frequency of module	The module is offered every academic year (winter semester).	
Work load	The workload is 720 working hours.	
Duration of the module	1 semester	
Recommended literature		