Module Compendium *

Master Programme
Hydro Science and Engineering

Effective since October 2024

* This is no legally binding document. Only the German module descriptions are legally binding.

Module Number	**Module Name**	**Professor in Charge**
MHSE 1	Statistics	Dr. Petzold
Contents and qualification aims	Descriptive statistics, discrete and continuous probability distributions, parameter estimation, statistical modelling, confidence intervals, hypothesis testing, parametric and nonparametric resampling tests, and introduction to variance analysis, correlation and regression analysis. Aims of qualification are the development of skills and abilities for problem-oriented work using statistical methods and operations including selected software.	
Module character	2 hours of lectures per week 1 hour of tutorial per week (partly as block course)	
Prerequisite of attendance	Basic knowledge of mathematics for engineers, in particular solving of equation systems, differential and integration calculus and probability methods, computer aided skills in spreadsheet calculation and basic knowledge of a programming environment	
Applicability	The module is compulsory for the Master Course Hydro Science and Engineering.	
Prerequisite to achieve credit points	Having passed the module exam. The module exam is a written examination (90 minutes).	
Credit points and grades	The module earns 5 cr. The grade for the examination equals the module grade.	
Frequency of the module	The module is offered annually in winter term.	
Work load	The work load is 150 hours.	
Duration of the module	The module takes one term.	

Module Number	Module Name	Professor in Charge
MHSE02	Climatology and Hydrology	Prof. Mauder
Contents and qualification aims	The module transports fundamentals on basic processes in the atmosphere and hydrosphere. Energy budget and water budget are physically analysed including radiation, precipitation, evapotranspiration, surface and subsurface runoff as well as relevant water and energy storages. The climate of the boundary layer is derived from site characteristics as well as radiation, energy and water balances. The boundary layer climate of several land use types is introduced exemplarily. Another main focus is the macro climate and its variability. The students critically analyse meteorological and hydrological information (data, forecasts and consulting) and are able to apply their knowledge for water supply management tasks like development, dimensioning, and management. The students have available the proficiency of relevant processes in atmosphere and hydrosphere, as well as of methods of observation and modelling. This implies basic principles, and estimation technologies for all components of the water cycle.	
Module character	4 hours of lectures per week	
Prerequisite of attendance	Basic knowledge in physics and mathematics	
Applicability	The module is compulsory for the Master Course Hydro Science and Engineering.	
Prerequisite to achieve credit points	Having passed the module exam. The module exam consists of 2 written examinations (90 minutes each).	
Credit points and grades	The module earns 5 cr. The average of the grades for the examinations equals the module grade.	
Frequency of the module	The module is offered annually in winter term.	
Work load	The work load is 150 hours.	
Duration of the module	The module takes one term.	

Module Number	Module Name	Professor in Charge
MHSE03	Geodesy	Prof. Wanninger
Contents and qualification aims	The module provides an introduction to the various aspects of geodetic techniques including sensor technology and collection, administration, and visualization of spatial information in hydro science. The students know the most important geodetic techniques of data acquisition and data processing. They are able to select appropriate geodetic techniques for certain applications.	
Module character	2 hours of lectures per week 1 hour of tutorial per week	
Prerequisite of attendance	Basic knowledge of mathematics, statistics, and physics.	
Applicability	The module is one of three elective compulsory modules in the Master´s Degree Program Hydro Science and Engineering, two of which must be chosen.	
Prerequisite to achieve credit points	Having passed the module exam. The module exam is a written examination (90 minutes).	
Credit points and grades	The module earns 5 cr. The grade for the examination equals the module grade.	
Frequency of the module	The module is offered annually in winter term.	
Work load	The work load is 150 hours.	
Duration of the module	The module takes one term.	

Module Number	Module Name	Professor in Charge
MHSE04	Soils	Prof. Kalbitz
Contents and qualification aims	The module focuses on basics of soil science with special emphasis on soil geology, hydrogeology, physical, chemical and biological soil properties, soil development and classification of soils as well as principles of the geologic and geotechnical relationships concerning unconsolidated and solid rock in deeper layers. The theoretical knowledge will be completed by regional and applied aspects for agriculture, forestry and water management. The students are proficient in fundamental aspects of soils to assess soils relating to their chemical and physical characteristics.	
Module character	2 hours of lectures per week 1 hour of practical training per week	
Prerequisite of attendance	Basic knowledge in geology, physics and chemistry	
Applicability	The module is one of three elective compulsory modules in the Master´s Degree Program Hydro Science and Engineering, two of which must be chosen.	
Prerequisite to achieve credit points	Having passed the module exam. The module exam is a written examination (90 minutes).	
Credit points and grades	The module earns 5 cr. The grade for the examination equals the module grade.	
Frequency of the module	The module is offered annually in winter term.	
Work load	The work load is 150 hours.	
Duration of the module	The module takes one term.	

Module Number	Module Name	Professor in Charge
MHSE05	Hydromechanics	Prof. Pohl
Contents and qualification aims	The physical characteristics of water will be discussed, starting with the hydrostatics and the mainly steady hydrodynamics with emphasis on the principles of conservation of energy, mass and momentum, pipe hydraulics, open channel hydraulics. The students are able to answer hydromechanical questions in engineering: - identification of hydromechanical problems in engineering - quantitative solution of hydromechanical problems - knowledge application for dimensioning and design of hydraulic structures and devices and to scientific problems	
Module character	2 hours of lectures per week 1 hour of tutorial per week	
Prerequisite of attendance	Knowledge in physics, higher mathematics	
Applicability	The module is one of three elective compulsory modules in the Master´s Degree Program Hydro Science and Engineering, two of which must be chosen. The contents are coordinated to module MHSE06 - Hydraulic Engineering.	
Prerequisite to achieve credit points	Having passed the module exam. The module exam is a written examination (90 minutes).	
Credit points and grades	The module earns 5 cr. The grade for the examination equals the module grade.	
Frequency of the module	The module is offered annually in winter term.	
Work load	The work load is 150 hours.	
Duration of the module	The module takes one term.	

Module Number	Module Name	Professor in Charge
MHSE06	Hydraulic Engineering	Prof. Stamm
Contents and qualification aims	On the basis of knowledge about natural watercourses hydraulic structures for flood protection (levees, water retention reservoirs) and for use of water (weirs, dams, water power stations) are discussed with respect to water management, ecological and economic aspects. Environmentally friendly structures, sustainability and renewable energies are dealt with emphasis. In addition navigation engineering systems are introduced. The students have knowledge about the design, operation and calculation of hydraulic structures.	
Module character	2 hours of lectures per week 1 hour of tutorial per week 1 hour of practical training per week	
Prerequisite of attendance	Knowledge in physics and higher mathematics	
Applicability	The module is one of three elective compulsory modules in the Master´s Degree Program Hydro Science and Engineering, two of which must be chosen. The content of the module is linked to module MHSE05 - Hydromechanics.	
Prerequisite to achieve credit points	Having passed the module exam. The module exam is a written examination (90 minutes). A positively evaluated term paper (30 hours) has to be handed-in.	
Credit points and grades	The module earns 5 cr. The grade for the written examination equals the module grade.	
Frequency of the module	The module is offered annually in winter term.	
Work load	The work load is 150 hours.	
Duration of the module	The module takes one term.	

Module Number	**Module Name**	**Professor in Charge**
MHSE 07	Ecology	Dr. Pietzarka
Contents and qualification aims	Purpose and perception of ecology as a pure and applied science, its hierarchy of living systems and the ecosystem concept are introduced: physical and chemical determinants of biosphere and its parts; evolution and co-evolution of organisms and biosphere - effect of environmental conditions on individuals and populations as well as bioavailability and applicability of resources; demographic processes (growth, birth, death, migration, life cycles), intra- und inter-specific competition, coexistence and mutualism as well as interaction and regulation in food webs; fluxes of energy, matter and information between organisms, populations and ecosystems; biodiversity in different spatial and temporal scales; global change and sustainability in ecology The students have skills to understand causalities and effects due to fast changes of dynamic balances within populations, communities and the entire biosphere. They are able to identify capacities and limitations of control, utilisation, conservation, and regeneration of populations and ecosystems.	
Module character	2 hours of lectures per week 1 hour of tutorial per week 1 hour of practical training per week	
Prerequisite of attendance	Advanced knowledge in physics, chemistry and biology	
Applicability	The module is one of three elective compulsory modules in the Master´s Degree Program Hydro Science and Engineering, two of which must be chosen.	
Prerequisite to achieve credit points	Having passed the module exam. The module exam consists of a presentation and either a written examination (90 minutes) or a written term paper (50 hours).	
Credit points and grades	The module earns 5 cr. The module grade is generated with 25% presentation and 75% written examination or term paper.	
Frequency of the module	The module is offered annually in winter term.	
Work load	The work load is 150 hours.	
Duration of the module	The module takes one term.	

Module Number	**Module Name**	**Professor in Charge**
MHSE 08	Hydrochemistry	Prof. Stolte
Contents and qualification aims	Characteristics of water and aqueous solutions, absorption and desorption, acid-alkali-reactions, chemical precipitation, redox reactions, chelate formation, and coupled equilibrations The students have profound knowledge about the main hydrochemical processes within natural and technical cycles. They are able to apply physiochemical laws for basic hydrochemical computations.	
Module character	2 hours of lectures per week 1 hour of practical training per week	
Prerequisite of attendance	Basic knowledge in chemistry	
Applicability	The module is one of three elective compulsory modules in the Master´s Degree Program Hydro Science and Engineering, two of which must be chosen.	
Prerequisite to achieve credit points	Having passed the module exam. The module exam is a written examination (90 minutes). Preparatory requirement to the exam is the protocol of the practical training.	
Credit points and grades	The module earns 5 cr. The grade for the examination equals the module grade.	
Frequency of the module	The module is offered annually in winter term.	
Work load	The work load is 150 hours.	
Duration of the module	The module takes one term.	

Module Number	Module Name	Professor in Charge
MHSE09	Study Project Integrated Water Resources Management (IWRM)	N.N.
Contents and qualification aims	For water problems integrative solutions are needed with the participation of different technical disciplines (Integrated Water Resources Management IWRM). In the module problems out of possibly all disciplines of Hydro Science and Engineering are worked on. Therefore individual study projects might be supervised by more than one teacher. Additionally project management and presentation techniques are demonstrated as well as proper reporting. Students learn to act as a team and to solve a complex problem by proper handling of individual tasks. The task of the study project may be e.g. the restoration of the water supply of an urban area, the planning of a water management structure (dam, barrage), or the calculation of the water balance of a river catchment. The students are able to implement their knowledge in engineering and natural sciences. Scientific creativity to contribute to the project is encouraged. The complex application of the acquired knowledge is practised. Central qualification aims are the definition of a problem, the work on a defined problem and report on progress and final outcome by oral presentations and written reports. The students have skills to supervise projects self dependently and are prepared to hold other management functions.	
Module character	1 hour of lectures per week, 1 hour of exercise course per week, 4 hours of practical training per week, self study	
Prerequisite of attendance	Basic knowledge in hydrosciences, civil engineering, and computer sciences; advanced knowledge in mathematics and statistics	
Applicability	The module is compulsory for the Master Course Hydro Science and Engineering.	
Prerequisite to achieve credit points	Having passed the module exam. The module exam consists of 2 presentations and the project work (100 hours).	
Credit points and grades	The module earns 10 cr. The module grade is calculated from the grades achieved for the presentations (25% each) and the project work (50%).	
Frequency of the module	The module is offered each semester.	
Work load	The work load is 300 hours.	
Duration of the module	The module takes one term.	

Module number	Module name	Professor in Charge
MWW26	Integrated Water Resources Management I	Prof. Krebs
Qualification aims	Students will learn how to analyse and evaluate complex problems of the management as well as of the optimization of water resources. Case studies are used to develop approaches that are adapted to regional conditions.	
Contents	Integrated water resources management (IWRM) is a process which promotes the coordinated development and management of water, land and other related resources and the various impacts. It presupposes an interdisciplinary understanding of scientific, technical, economic, social and corresponding aspects. The module conveys concepts of the IWRM. In a series of lectures, the different methodological and thematic aspects of IWRM, action plans and case studies are presented in which water is a resource, a habitat and/or a landscape element. Approaches to system analysis and modelling of natural and technical water systems and their interactions are taught. But also social, economic, political and institutional framework conditions as well as approaches to capacity development are highlighted. By discussion sessions, a planning and management game as well as examples of use the mediated knowledge is applied and deepened.	
Teaching and learning methods	3 hours of lectures per week and self-study The language of instruction is English.	
Prerequisite for attendance	Basic knowledge in hydrology, meteorology, ground water management, urban drainage and system analysis	
Applicability	The module is an optional module for the Master Courses Hydrology, Water Management, Hydrobiology, and Hydro Science and Engineering whose election mode is regulated under section 27 subsection 3 of the respective Examination Regulation.	
Prerequisite to achieve credit points	Having passed the module exam; it consists of a written examination (90 minutes).	
Credit points and grades	The module earns 5 cr. The module grade equals the grade of the written examination.	
Frequency of the module	The module is offered each summer term.	
Work load	The work load is 150 hours.	
Duration of the module	The module takes one term.	

Module number	Module name	Professor in Charge
MWW27	Integrated Water Resources Management II	Prof. Krebs
Qualification aims	The students acquire the ability to analyse complex problems of the management and optimization of water resources. At the study tour they will learn about a water resource conflict from the perspective of the involved actors. For the exercise, the knowledge of modelling is developed, in addition, the knowledge about scientific writing is deepened and applied.	
Contents	Integrated water resources management (IWRM) is a process which promotes the coordinated development and management of water, land and other related resources and the various impacts. Based on the knowledge of the module IWRM I (MWW26) the challenges and solutions of IWRM are demonstrated and applied. A study tour lasting several days addresses the effects of a water resource conflict from the perspective of various decision-makers and stakeholders. In doing so, a management and planning game resp. will deepen the understanding of the actors involved. In the exercise, a systematic approach is developed for a model-based decision-making process in IWRM. For this purpose, a simulation model for a water resource conflict is set up, calibrated and applied for the comparison of scenarios and action alternatives. On the basis of the modelling results, a separate sub-question is deepened as well as and evaluated and processed for the term paper as a scientific article.	
Teaching and learning methods	2 hours of exercises per week, 2.1 hours of excursion (3 days) and self-study The language of instruction for the module in English.	
Prerequisite for attendance	The competencies acquired in or equivalent to the IWRM I module (MWW26) are assumed.	
Applicability	The module is an optional module for the Master Courses Hydrology, Water Management, Hydrobiology, and Hydro Science and Engineering whose election mode is regulated under section 27 subsection 3 of the respective Examination Regulation.	
Prerequisite to achieve credit points	Having passed the module exam. The module exam consists of a term paper (80 hours) and a report of the study tour (50 hours).	
Credit points and grades	The module earns 5 cr. The module grade is calculated from the grades achieved for the term paper (factor 4) and the report (factor 1).	
Frequency of the module	The module is offered annually in the winter term.	
Work load	The work load is 150 hours.	
Duration of the module	The module takes one term.	

Modul Number	**Modul Name**	**Professor in Charge**
MHSE 10	International Water Issues (Internationale Wasserprobleme)	Prof. Krebs
Qualification aims	The students get to know the situation of different countries and may reflect about their own experiences. Piece by piece they may develop a global view and learn to manage their knowledge and make decisions.	
Contents	The module improves the information and the knowledge exchange among the students. Professionals and scientists from academic institutions and consulting agencies present recent developments in water related issues. The students prepare term papers about water specific problems of their home countries and present the contents orally. The topics may concern the general aspects of the situation of water supply, i.e. the hydrologic regime, the type of climate including climate change, state of water supply, condition of waste water management, management of floods and water related natural damages (e.g. landslides, tsunamis). The students have the possibility to introduce projects and organisations where they participated or to which they contribute now.	
Teaching form	3 hours of seminar per week	
Pre-requisite of attendance	Basic knowledge in hydrosciences, regional water management and hydrology.	
Usage	The module is an optional module for the Master Course Hydro Science and Engineering whose election mode is regulated under section 27 subsection 3 of the Examination Regulations.	
Pre-requisite to achieve credit points	Having passed the module exam. The module exam consists of a seminar paper (20 hours) and a presentation.	
Credit points and marks	The module earns 5 cr. The module grade is calculated from the grades achieved for the seminar paper (40%) and the presentation (60%).	
Frequency of the module	The module is offered each summer semester.	
Workload	The workload is 150 hours.	
Duration of the module	The module takes 1 term.	

Module Number	Module Name	Professor in Charge
MHSE11	Circular Economy	Prof. Dornack
Contents and qualification aims	Circular economy is a model of sustainable economic development which aims at environmental protection and prevention through conservation, reusing and recycling of resources, in order to minimize pollution from the source and reduce overall waste per unit output. Circular economy not only targets waste disposal, it also involves the transformation into sustainable economic activity of industrial organisation, urban infrastructure, environmental protection, technological paradigms, and social welfare distribution. The students improve their knowledge about the relevant mass fluxes. They are able to evaluate these fluxes using up to date evaluation techniques (e.g. ecological balances).The students possess system understanding of global change through integrative reflection of global mass flow of goods and quality of recycling.	
Module character	2 hours of lectures per week 1 hour of tutorial per week	
Prerequisite of attendance	Basic knowledge in physics, chemistry and mathematics	
Applicability	The module is one of 17 optional modules for the Master Course Hydro Science and Engineering whose election mode is regulated under section 27 subsection 3 of the Examination Regulations.	
Prerequisite to achieve credit points	Having passed the module exam. The module exam consists of a presentation and a term paper (60 hours).	
Credit points and grades	The module earns 5 cr. The module grade is calculated from the grades achieved for the presentation (30%) and the term paper (70%).	
Frequency of the module	The module is offered annually in summer term.	
Work load	The work load is 150 hours.	
Duration of the module	The module takes one term.	

Module Number	Module Name	Professor in Charge
MHSE12	Watershed Management I	Dr. Grundmann
Contents and qualification aims	The module will develop the students' competence for integrated watershed management. Using irrigation farming as an example the problem and the process of management will be introduced and discussed. Methods of data collection and analysis, of determination and forecast of supplies as well as methods to obtain water demand are introduced. The fundamentals of development and application of methods to dimension and simulate reservoirs and flood protection measures are explained. Need and concepts of integrated flood protection are discussed. Decision support systems are imparted to aggregate the single elements of watershed management. The students know the main procedures and tools for integrative watershed management (data acquisition, analysis, forecast, dimensioning, simulation) regarding balancing between demand and supply using typical control elements as dam and absorption reservoirs.	
Module character	2 hours of lecture per week 1 hour of tutorial per week	
Prerequisite of attendance	Advanced knowledge in hydrology, hydraulic engineering, and statistics	
Applicability	The module is one of 17 optional modules for the Master Course Hydro Science and Engineering whose election mode is regulated under section 27 subsection 3 of the Examination Regulations.	
Prerequisite to achieve credit points	Having passed the module exam. The module exam consists of a written examination (90 minutes).	
Credit points and grades	The module earns 5 cr. The grade for the written examination equals the module grade.	
Frequency of the module	The module is offered annually in summer term.	
Work load	The work load is 150 hours.	
Duration of the module	The module takes one term.	

Module Number	**Module Name**	**Professor in charge**
MHSE 33	Urban Water Management	Prof. Peter Krebs isi@mail.zih.tu-dresden.de
Qualification aims	The students are able to describe and optimise important processes of the urban water system, layout and design infrastructure of water supply and wastewater disposal, and to evaluate the impacts for the affected water body.	
Content	The module overviews the systems of urban water management, including methods for extracting raw water, drinking water treatment and distribution, wastewater und rainwater collection and transport (urban hydrology) as well as wastewater and sludge treatment. The main aspects of the module include dimensioning, operation and optimisation of water supply and wastewater systems. Water pollution, raised by wastewater disposal, is characterised as the target of optimisation. The mechanisms of pollution with organic matter and nutrients are described. Additional approaches for integrated optimisation of the operation are discussed, taking into account the interaction between the subsystems.	
Teaching and learning methods	3 hours of lecture per week, 1 hour of practical training per week, and self-study	
Prerequisites of attendance	Basic knowledge of mathematics, hydrobiology, hydrochemistry, and hydromechanics are required.	
Applicability	The module is an optional module for the Master Course Hydro Science and Engineering whose election mode is regulated under section 27 subsection 3 of the Examination Regulations. The module is required for the module Modelling of Wastewater Systems.	
Prerequisites to achieve credit points	The credit points are achieved by passing the module exam. The module exam consists of a term paper with a duration of 90 minutes.	
Credit points and grades	The module earns 5 credit points. The module grade equates to the exam grade.	
Frequency of the module	The module is offered each summer term.	
Workload	The workload is 150 hours.	
Duration of the module	The module takes one term.	

Module Number	Module Name	Professor in Charge
MHSE14	Flood Risk Management I	Prof. Mauder
Contents and qualification aims	Risk management of flood events requires complex, integrated approaches. The module therefore focuses on the understanding of relevant physical processes during and after flood events. The module provides information about several process parts such as development, pathways, and receptor areas. An introduction to first measures and instruments for societal governance are finally considered and practical examples are discussed. A flash flood is analysed as an example flood type in a case study workshop. The students know the fundamental elements of the flood risk system and are able to determine risk as a negative consequence of hazard and vulnerability.	
Module character	2 hours of lectures per week 3 hours of tutorial per week 4,2 hours of excursion (6 excursion days - study tour)	
Prerequisite of attendance	Basic knowledge in meteorology, hydrology, mathematical statistics, and hydraulic engineering	
Applicability	The module is one of 17 optional modules for the Master Course Hydro Science and Engineering whose election mode is regulated under section 27 subsection 3 of the Examination Regulations. The skills acquired in this module are necessary to take part in module MHSE23 - Flood Risk Management II.	
Prerequisite to achieve credit points	Having passed the module exam .The module exam consists of a written examination (90 minutes), a seminar paper (20 hours) and the excursion documentation (20 hours).	
Credit points and grades	The module earns 10 cr. The module grade is generated from the grades of the written examination with 50%, the term paper with 30% and the record with 20%.	
Frequency of the module	The module is offered annually in summer term.	
Work load	The work load is 300 hours.	
Duration of the module	The module takes one term.	

Module Number	Module Name	Professor in Charge
MHSE16	Aquatic Ecology and Ecotoxicology	Prof. Berendonk
Contents and qualification aims	The module includes contents as tasks and principles of water protection, physical, chemical and biological load components, basics of determination and valuation of dissolved matter (natural, anthropogenic, xenobiotic), demands of analytical quality control, methods and strategies of ecotoxicology concerning the evaluation of environmental chemicals and of the state of water bodies, decision tools for management, planning and prediction of water body condition. The students are able to link the different parts of their hydroecological, analytical and ecotoxicological knowledge concerning river and lake protection as well as management of water quality and water condition.	
Module character	3 hours of lectures per week 1 hour of practical training per week	
Prerequisite of attendance	Basic knowledge in ecology and about the structure and function of lakes as well as processes of metabolisms in lakes	
Applicability	The module is one of 17 optional modules for the Master Course Hydro Science and Engineering whose election mode is regulated under section 27 subsection 3 of the Examination Regulations.	
Prerequisite to achieve credit points	Having passed the module exam. The module exam consists of a written examination (90 minutes) and a presentation.	
Credit points and grades	The module earns 5 cr. The module grade is calculated from the grades achieved for the written examination (30%) and the presentation (70%).	
Frequency of the module	The module is offered annually starting in summer term.	
Work load	The work load is 150 hours.	
Duration of the module	The module takes two terms.	

Module Number	**Module Name**	**Professor in Charge**
MHSE17	Climate Change	Prof. Mauder
Contents and qualification aims	The module includes climate changes and their interaction with atmospheric trace matters and vegetation. Global change makes demands to all natural resources (soil, water, air), where e.g. the water supply and its use are dependent on natural and economical requirements. Climate change is exemplarily shown to explain the use of limited resources in the light of a changing world. Its understanding requires knowledge about the earth-atmosphere system. The module focuses on the state of the art of climate research (data, methods and results) including the feedback with the hydrosphere and biosphere. The evolution of the paleoclimate and the recent climate change are used to illustrate the different climate parameters. The presentations of the students complete the programme. The students improve their knowledge about system understanding of climate change by integrative treatment of climatic processes. They are able to explain complex relationships and develop a reliable conflict understanding of questions relevant to natural resources in connection with climate.	
Module character	2 hours of lectures per week, 2 hours of seminar per week, self study	
Prerequisite of attendance	Basic knowledge in meteorology, hydrology, physics, chemistry, and mathematics	
Applicability	The module is an optional module for the Master Course Hydro Science and Engineering whose election mode is regulated under section 27 subsection 3 of the Examination Regulations.	
Prerequisite to achieve credit points	Having passed the module exam. The module exam consists of a presentation and written examination (90 minutes).	
Credit points and grades	The module earns 5 cr. The module grade is calculated from the grades achieved for the presentation (50%) and the written examination (50%).	
Frequency of the module	The module is offered annually in summer term.	
Work load	The work load is 150 hours.	
Duration of the module	The module takes one term.	

Modul number	**Modul name**	**Responsible lecturer**
MHYWI05	Statistical Learning for Earth System Sciences	Prof. Dr. Jakob Zscheischler Jakob.zscheischler@tu-dresden.de
Qualification objectives	Students know the basic concepts of statistical learning. They can explain and apply the differences between various approaches to statistical learning. Furthermore, they can implement these concepts in the programming language R and apply them to new problems.	
Contents	Contents of the module are the basic concepts of statistical learning: regression, classification, dimensionality reduction, bias and variance trade-off as well as multiple testing. Further contents are the discussion and consolidation of the concepts presented as well as their application to datasets from the Earth system sciences.	
Teaching and learning methods	2 hours of lecture per week, 1 hour of exercise per week, self-study. The courses are held in English.	
Prerequisites for participation	Knowledge of mathematics, statistics and probability theory at the bachelor level is required.	
Applicability	The module is a compulsory elective module in the Master's degree programs Hydro Science and Engineering and Hydrology, which must be selected in compliance with the annex to the relevant Examination Regulations.	
Requirements for earning credit points	Credit points are earned when the module examination is passed. The module examination consists of a term paper equating to 30 hours. The examination language is English.	
Credit points and grades	Participants can earn five credit points for this module. The module grade corresponds to the grade of the examination.	
Module frequency	The module is offered each summer semester.	
Workload	The workload comprises a total of 150 hours.	
Module duration	The module comprises one semester.	

Module Number	Module Name	Professor in Charge
MHSE18	Soil Water	Prof. Orlowski
Contents and qualification aims	In the module fundamentals of soil physics and soil hydrology are provided and the impact of soil properties and land use on the soil water budget and its components is presented involving budget simulations. In addition, the close relationship between soil properties, soil water budget and crop yield is highlighted. Measures to regulate the soil water budget are presented. The impacts of the soil on surface runoff, tendency for salinisation and water erosion as well as measures of their reduction are discussed. The presented topics are deepened within tutorials and practical training, where tasks like sampling, measurement of groundwater levels, and determination of hydraulic conductivities are carried out. The students are able to measure and describe hydrological processes in soils. They apply basic calculation and evaluation methods, estimate the impact of landuse and simulate water and matter fluxes in soils using Soil-Vegetation-Atmosphere-Models.	
Module character	2 hours of lectures per week 1 hour of tutorial per week 1 hour of practical training per week	
Prerequisite of attendance	Advanced knowledge in soils	
Applicability	The module is one of 17 optional modules for the Master Course Hydro Science and Engineering whose election mode is regulated under section 27 subsection 3 of the Examination Regulations.	
Prerequisite to achieve credit points	Having passed the module exam. The module exam consists of an oral presentation and a written examination (90 minutes).	
Credit points and grades	The module earns 5 cr. The module grade is calculated from the grades achieved for the oral presentation (30%) and the written examination (70%).	
Frequency of the module	The module is offered annually in winter term.	
Work load	The work load is 150 hours.	
Duration of the module	The module takes one term.	

Module Number	Module Name	Professor in Charge
MHSE 29	Ground Water	Prof. Hartmann
Qualification aims	The students are able to identify flow and transport processes in soil and groundwater, to apply basic calculation and evaluation methods and to understand the operation of numerical solution techniques.	
Contents	In the module basic hydrogeological and geohydraulic knowledge is provided which can be used to quantify flow processes and transport of matter in soils and aquifers and can be applied to water management and quality issues. An introduction to the structure of the subsurface, the definition of its characteristic hydrogeological parameters and the quantitative description of relevant processes is given.	
Module character	2 hours of lectures per week 2 hour of tutorial per week	
Prerequisite of attendance	none	
Applicability	The module is one of 17 optional modules for the Master Course Hydro Science and Engineering whose election mode is regulated under section 27 subsection 3 of the Examination Regulations.	
Prerequisite to achieve credit points	Having passed the module exam. The module exam consists of a written examination (90 minutes).	
Credit points and grades	The module earns 5 cr. The grade for the examination equals the module grade.	
Frequency of the module	The module is offered annually in winter term.	
Work load	The work load is 150 hours.	
Duration of the module	The module takes one term.	

Module Number	Module Name	Professor in Charge
MHSE20	Hydrodynamics	Prof. Pohl
Contents and qualification aims	The module includes nonstationary water flow under pressure and with free surface as well as special problems in hydromechanics as potential flow, density flow, and eco-hydraulic questions. The students are able to identify nonstationary and hydromechanic questions. They use the appropriate approach to model the included processes and to describe them qualitatively and quantitatively. The students have the knowledge to solve hydromechanical problems independently and to deal with their tasks in an interdisciplinary context. The students take part in lectures, lab demonstrations, and hydraulic experiments and such complete their knowledge about methods and procedures for experimental hydraulics.	
Module character	1 hour of lectures per week 1 hour of tutorial per week 2 hours of practical training per week	
Prerequisite of attendance	Basic knowledge of physics and higher mathematics	
Applicability	The module is one of 17 optional modules for the Master Course Hydro Science and Engineering whose election mode is regulated under section 27 subsection 3 of the Examination Regulations.	
Prerequisite to achieve credit points	Having passed the module exam. The module exam consists of a term paper (40 hours).	
Credit points and grades	The module earns 5 cr. The grade for the examination equals the module grade.	
Frequency of the module	The module is offered annually in winter term.	
Work load	The work load is 150 hours.	
Duration of the module	The module takes one term.	

Module Number	Module Name	Professor in Charge
MHSE21	Watershed Management II	Prof. Stamm
Contents and qualification aims	Main contents are the fundamentals of software application to quantify hydrologic, hydraulic, and sedimentary processes at the scale of watersheds. Based on the acquired analytical competences in the fields of water balance, runoff in open channels, transport of sediments and hydrologic data analysis the module focuses on the application of recent model approaches for basic examples. That includes the fundamentals of GIS tools for the handling of hydrologic and hydraulic data. The students are able to understand and simulate the complex interactions between land use and water use, run-off dynamics and morphology within a watershed.	
Module character	1 hour of lecture per week 2 hours of practical training per week	
Prerequisite of attendance	Advanced knowledge in hydrology, hydraulic engineering, and statistics	
Applicability	The module is one of 17 optional modules for the Master Course Hydro Science and Engineering whose election mode is regulated under section 27 subsection 3 of the Examination Regulations.	
Prerequisite to achieve credit points	Having passed the module exam. The module exam consists of a term paper (60 hours).	
Credit points and grades	The module earns 5 cr. The grade for the examination equals the module grade.	
Frequency of the module	The module is offered annually in winter term.	
Work load	The work load is 150 hours.	
Duration of the module	The module takes one term.	

Module Number	Module Name	Professor in charge
MHSE 34	Modelling of Wastewater Systems	Prof. Peter Krebs isi@mail.zih.tu-dresden.de
Qualification aims	The students are familiar with model approaches and are able to apply them by using and software packages and interpreting the results. By working on a case study in working groups, students are enabled to apply the methods and they are capable of dealing with modelling independently.	
Content	The module includes an overview of modelling approaches and simulation tools for urban wastewater systems. In particular, this module will focus on rain-runoff process in urban areas, the flow and transport in sewer systems, retrofitting solutions for stormwater management, biological wastewater treatment, and transport and conversion processes in rivers. In the exercise, the impacts of decentralized rainwater management are analysed. For this purpose, a simulation urban drainage model is set-up, calibrated and applied for the comparison of various scenarios and stormwater management alternatives.	
Teaching and learning methods	2 hours of lecture per week, 2 hour of practical training per week, and self-study	
Prerequisites of attendance	Basic knowledge of mathematics, hydrobiology, hydrochemistry and hydromechanics as well as basics of wastewater systems, wastewater and sludge treatment are required. The modules require the competences achieved in the module Urban Water Management.	
Applicability	The module is an optional module for the Master Course Hydro Science and Engineering whose election mode is regulated under section 27 subsection 3 of the Examination Regulations.	
Prerequisites to achieve credit points	The credit points are achieved by passing the module exam. The module exam consists of a written examination with a duration of 75 hours.	
Credit points and grades	The module earns 5 credit points. The module grade equates to the exam grade.	
Frequency of the module	The module is offered each winter term.	
Workload	The workload is 150 hours.	
Duration of the module	The module takes one term.	

Module Number	Module Name	Professor in Charge
MHSE23	Flood Risk Management II	Prof. Schanze
Contents and qualification aims	To develop and interpret management strategies for flood risk reduction demands an extensive risk management and complex transdisciplinary solutions. The whole of physical processes of flood events as well as the societal governance have to be considered. The integrated flood risk management consists of 3 major parts: risk analysis (material to describe the flood risk system), risk evaluation (including risk perception) and risk mitigation (with risk prevention and communication, crisis management and maintenance). The students are able to understand all relevant components of flood risk management with respect to vulnerability. They can determine a tolerable level of risk, they are able to develop and interpret management strategies and different options for flood risk reduction. Case studies of river floods and coastal floods are discussed in two flood type oriented workshops.	
Module character	2 hours of lectures per week 6 hours of tutorial per week (3 workshops with 2 hours per week each)	
Prerequisite of attendance	Knowledge of issues discussed in module MHSE14 - Flood Risk Management I.	
Applicability	The module is one of 17 optional modules for the Master Course Hydro Science and Engineering whose election mode is regulated under section 27 subsection 3 of the Examination Regulations.	
Prerequisite to achieve credit points	Having passed the module exam. The module exam consists of a written examination (90 minutes) and 2 out of 3 seminar papers (10 hours each).	
Credit points and grades	The module earns 10 cr. The module grade is generated from the written examination with 50%, and two out of three seminar papers with 25% each.	
Frequency of the module	The module is offered annually in winter term.	
Work load	The work load is 300 hours.	
Duration of the module	The module takes one term.	

Module Number	**Module Name**	**Professor in Charge**
MHSE 37	Water Quality and Water Treatment	Prof. Stolte
Contents and qualification aims	The students get to know important water pollutants and their relevance for water quality. Physico-chemical procedures to remove these materials for drinking water processing are introduced. The module complements to the module Drinking Water Supply.	
Module character	2 hours of lectures per week 2 hours of practical training per week	
Prerequisite of attendance	Basic knowledge in chemistry, especially hydrochemistry The skills acquired in the module MHSE25 - Drinking Water Supply are necessary to take part in the module.	
Applicability	The module is one of 17 optional modules for the Master Course Hydro Science and Engineering whose election mode is regulated under section 27 subsection 3 of the Examination Regulations.	
Prerequisite to achieve credit points	Having passed the module exam. The module exam consists of a non-public verbal examination of 40 minutes duration as a group exam (20 minutes per person). Preparatory requirement to the exam is a protocol of the practical training.	
Credit points and grades	The module earns 5 cr. The grade for the examination equals the module grade.	
Frequency of the module	The module is offered annually in winter term.	
Work load	The work load is 150 hours.	
Duration of the module	The module takes one term.	

Modul Number	Modul Name	Professor in Charge
MHSE25	Drinking Water Supply (Trinkwasserversorgung)	Prof. Lerch isi@mailbox.tu-dresden.de
Qualification aims	The students understand the mechanisms of important methods of drinking water treatment and distribution. They are able to compute and interpret the single steps and to dimension water distribution systems. The students know possible influences on water quality during water treatment, distribution and storage and they are able to evaluate disturbances of quality and to suggest adequate measures.	
Contents	Methods and processes of modern drinking water treatment as well as the development of constructions for drinking water distribution and their economical operation are content of the module.	
Teaching form	3 hours of lectures per week, 1 hour of practical training per week 0,5 hours excursion per week (1 half-day excursion) and self-study.	
Pre-requisite of attendance	Knowledge in hydrochemistry as well as basics in natural science and engineering of water treatment and distribution are required. The skills acquired in the module MHSE24 - Water Quality and Water Treatment are necessary to take part in the module. Literature: Sigg & Stumm (2011): Aquatische Chemie; Benjamin (2002): Water Chemistry; Stumm & Morgan (1996): Aquatic Chemistry; Stevenson (1997): Water Treatment Unit Processes; Crittenden et al. (2012): MWH's Water Treatment: Principles and Design;Hendricks (2002): Fundamentals of Water Treatment Unit Processes: Physical, Chemical, and Biological; Anonymous (National Research Council, 2006): Drinking Water Distribution Systems, Assessing and Reducing Risks;Van Zyl (2014): Operation and Maintenance of Water Distribution Systems; Mays (1999): Water Distribution System Handbook.	
Usage	The module is an optional modules for the Master Course Hydro Science and Engineering whose election mode is regulated under section 27 subsection 3 of the Examination Regulations.	
Pre-requisite to achieve credit points	Having passed the module exam. The module exam consists of a written examination (135 minutes).	
Credit points and marks	The module earns 5 cr. The grade for the written examination equals the module grade.	
Frequency of the module	The module is offered each winter semester.	
Workload	The workload is 150 hours.	
Duration of the module	The module takes 1 term.	

Module number	Module name	Professor in charge
MHSE 27	**Climate Systems and Climate Modelling**	Prof. Mauder
Contents and qualification aims	The module imparts a deeper knowledge in processes and methods to describe the components of the climate system in models, including feedback mechanisms and the consideration of all spatial scales. The module covers the following topics: Components of the climate system (characteristics, dependency on scales, feedback mechanisms), description of these components (climate system part), building and application of climate models incl. utilization of respective models (climate modelling part) The students are able to understand the complex and scale-depending relations between the individual components of the climate system. They will develop skills to describe characteristic phenomena of the climate system and to set-up and utilize selected climate models, regarding different conditions and scales.	
Teaching form	Climate Systems: 2 hours a week, lecture Climate Modelling: 1 hour a week, lecture; 1 hour a week, tutorial	
Pre-requisite of attendance	Pre-requisite of attendance: basic knowledge in the physical processes of the atmosphere and hydrosphere, good knowledge in physics and mathematics, good English level.	
Usage	The module is an optional module for the master-study in Hydro-Science & Engineering.	
Pre-requisite to achieve credit points	Successful students have to pass the module exam, which consists of a written exam (90 minutes).	
Credit points and marks	The module earns 5 cr. The module mark is identical to the exam mark.	
Frequency of the module	The module is offered each winter semester.	
Work load	The student's work load is 150 hours.	
Duration of the module	The module is finished in one semester.	
Recommended literature	Kabat, P. (ed.), 2004: Vegetation, Water, Humans and the Climate. McGuffie, K., Henderson-Sellers, A., 2013: A Climate Modelling Primer. Oke, T.R.,1987: Boundary Layer Climates.	

Module number	**Module name**	**Professor in charge**
MHSE 36	Internship Hydrosciences	Study Course Coordinator Prof. Hartmann grundwasser@mailbox.tu-dresden.de
Qualification aims	The students are able to execute tasks on their own and to put them into a bigger context. Thereby, they will also acquire basic knowledge of company or institute organisation.	
Contents	The students achieve subject-specific engineering and acquire scientific practice inside or outside of TU Dresden. Therefore, they work for at least 3 weeks e.g. in co-operating research institutes, agencies, water suppliers, associations or consulting offices in Germany or abroad or at an institute of TU Dresden.	
Teaching form	3 weeks of internship and self-study	
Pre-requisite of attendance	Good knowledge in general basics in hydro sciences	
Usage	The module is an optional module for the master course Hydro Science and Engineering whose election mode is regulated under section 27 subsection 3 of the Examination Regulations.	
Pre-requisite to achieve credit points	Successful students have to pass the module exam. The module exam consists of an internship protocol/report (30 hours).	
Credit points and marks	The module earns 5 cr. The module mark is identical to the mark of the written examination.	
Frequency of the module	The module is offered each semester.	
Work load	The work load is 150 hours.	
Duration of the module	The module takes one semester.	

Modul number	**Modul name**	**Responsible lecturer**
MHYWI02	Numerical Methods for Hydrosciences	Prof. Dr.-Ing. Bernhard Vowinckel bernhard.vowinckel@tu-dresden.de
Qualification objectives	Students are familiar with various methods for finding a numerical solution for systems of equations that cannot be solved analytically. They are also familiar with selected examples from the hydrosciences where such a problem plays a role. Students are able to apply numerical methods to selected problems in the hydrosciences themselves in order to integrate the underlying partial differential equations in space and time using software they have written themselves, to analyse this software for its solution behaviour and to present the results.	
Contents	Contents of the module are problem formulation for hydrosystems, numerical methods for integrating partial differential equations, discretisation schemes in space and time, formulation of initial and boundary conditions, interpolation methods, setting up linear systems of equations, solution algorithms for such systems of equations using self-written software, independent work on a selected problem in hydrosciences and presentation of the results.	
Teaching and learning methods	2 hours of lecture per week, 2 hours of exercise per week, self-study. The courses are held in English.	
Prerequisites for participation	Knowledge of higher mathematics and physics at the bachelor level is required.	
Applicability	The module is a compulsory elective module in the Master's degree programs Hydro Science and Engineering, Water Management and Hydrology, which must be selected in compliance with the annex to the relevant Examination Regulations.	
Requirements for earning credit points	Credit points are earned when the module examination is passed. The module examination consists of a term paper equating to 50 hours including explanation and discussion. The examination language is German or English at the student’s option.	
Credit points and grades	Participants can earn five credit points for this module. The module grade corresponds to the grade of the examination.	
Module frequency	The module is offered each winter semester.	
Workload	The workload comprises a total of 150 hours.	
Module duration	The module comprises one semester.	

Modul number	Modul name	Professor in charge
FOMT 2.3B	Communication und Conflict Management	Prof. Giessen
Qualification aims	The students are able to assess conflicts, select methods and tools for their handling, and apply them in the field. They are able to rely on ethical norms in problem handling and to lead communication processes in a democratic and participatory manner. The students are capable of guiding communication processes among stake-holder groups, as well as to conduct participatory surveys.	
Contents	Theories and concepts of verbal and nonverbal communication are introduced. Communication as social behaviour, conflicts as part of social systems and conflict solution, psychological dispositions and perception of human beings. Rhetorical rules and psychological patterns for purposeful actions and reactions when disputing about natural resources. Methods and instruments for pro-active situation-related interventions in on-going communication, negotiation, discourses and conflicts. Strategies for mediation, meta-plan moderation, as well as participation in the context of rural development. Communication with Rapid Rural Appraisal, Participatory Rural Appraisal and in field laboratories.	
Teaching form	2 hours of lecture per week, 1 hour of seminar per week, 1 hour project work per week, self-study	
Pre-requisite of attendance	Knowledge of natural forest and plantation management and nature conservation (Bachelor level). Literature: Moore, C. W. (2003) The mediation process. Updated and re-vised 3rd ed., Jossey-Bass, San Francisco. Klebert, K. et al. (2000) Winning group results. Techniques for guiding group thought and decision making processes with the moderation method. 2nd ed. Windmühle, Hamburg.	
Usage	The module is optional compulsory in the Master Course Tropical Forestry. The module is an optional module for the master course Hydro Science and Engineering whose election mode is regulated under section 27 subsection 3 of the Examination Regulations.	
Pre-requisite to achieve credit points	Successful students have to pass the module exam. The module exam consists of a project paper (1 week) and a written exam (90 minutes).	
Credit points and marks	The module earns 5 cr. The module grade results from average of the grades of the examination performances weighted as follows: project paper (67%) and the written examination performance (33%).	
Frequency of the module	The module is offered each winter semester.	
Work load	The work load is 150 hours.	

Duration of the module	The module takes one semester.
Literature	Miall, H., et al. (2011) Contemporary conflict resolution: The prevention, management and transformation of deadly conflicts, 3rd ed. Polity Press. Cambridge. Wilkenfeld, J. et al. (2005) Mediating International Crisis. Routledge, New York. Bercovitch, J. (ed) (2002) Studies in international mediation: Essays in honor of Jeffrey Z. Rubin. Macmillian, New York. Kalyvas, S. (2006) The logic of violence in civil wars. Cambridge University Press, Cambridge.