Universität Stuttgart

Modulhandbuch

Studiengang Double Masters Degrees Water Resources Engineering and Management

Prüfungsordnung: 2012

Sommersemester 2014
Stand: 25. März 2014

Universität Stuttgart
Keplerstr. 7
70174 Stuttgart

Inhaltsverzeichnis

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Zugeordnete Module:
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110 Incoming

Zugeordnete Module:

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80990	Master's Thesis WAREM

111 Compulsory Modules

Zugeordnete Module:
19330 Industrial Waste Water
50090 Environmental Fluid Mechanics I
50120 Environmental Informatics
55980 Seminar Module
55990 German Language

Modul: 50090 Environmental Fluid Mechanics I

2. Modulkürzel:	021420012	5. Moduldauer:	1 Semester
3. Leistungspunkte:	6.0 LP	6. Turnus:	jedes 2. Semester, WiSe
4. SWS:	5.0	7. Sprache:	Englisch

8. Modulverantwortlicher:	Prof.Dr.-Ing. Rainer Helmig
9. Dozenten:	• Jürgen Braun • Holger Class • Wolfgang Nowak
10. Zuordnung zum Curriculum in diesem Studiengang:	DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Incoming → Semi-Compulsory Modules DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Outgoing → Pflichtmodule DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Incoming → Compulsory Modules DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Outgoing → Pflichtmodule M.Sc. Water Resources Engineering and Management, PO 2012 → Vertiefungsmodule → Vertiefungsmodule Pflicht
11. Empfohlene Voraussetzungen:	Technical Mechanics • Introduction to the statics of rigid bodies • Introduction to elastostatics • Introduction to the mechanics of incompressible fluids Higher Mathematics • Partial differential equations • Vector analysis • Numerical integration Fundamentals of Flow Mechanics • Conservation equations for mass, momentum, energy • Navier-Stokes, Euler, Reynolds, Bernoulli equation
12. Lernziele:	Students have fundamental knowledge of flow in various natural hydrosystems and its application in civil and environmental engineering.
13. Inhalt:	The lecture deals with flow in natural hydrosystems with particular emphasis on groundwater / seepage flow and on flow in surface water / open channels. Groundwater hydraulics includes flow in confined, semi-confined and unconfined groundwater aquifers, wells, pumping tests and other hydraulic investigation methods for exploring groundwater aquifers. In addition, questions concerning regional groundwater

	management (z.B. recharge, unsaturated zone, saltwater intrusion) are discussed. Using the example of groundwater flow, fundamentals of CFD (Computational Fluid Dynamics) are explained, particularly the numerical discretisation techniques finite volume und finite difference. The hydraulics of surface water deals with shallow water equations / Saint Venant equations, unstationary channel flow, turbulence und layered systems. Calculation methods such as the methods of characteisitcs are explained. The contents are: • Potential flow and groundwater flow • Computational Fluid Dynamics • Shallow water equations for surface water • Charakteristikenmethode • Examples from civil and environmental engineering
14. Literatur:	Lecture notes: Hydromechanics, Helmig and Class Lecture notes: Ausbreitungs- und Transportvorgänge in Strömungen, Cirpka White, F.M.: Fluid Mechanics, WCB/McGraw-Hill, New York, 1999 Freeze, R.A. and Cherry J.A.: Groundwater, Prentice Hall, 1979
15. Lehrveranstaltungen und -formen:	• 500901 Lecture Environmental Fluid Mechanics I • 500902 Excersice Environmental Fluid Mechanics I
16. Abschätzung Arbeitsaufwand:	Sum 180 h
17. Prüfungsnummer/n und -name:	• 50091 Environmental Fluid Mechanics I (PL), schriftliche Prüfung, 120 Min., Gewichtung: 1.0 • V Vorleistung (USL-V), schriftliche Prüfung
18. Grundlage für ... :	
19. Medienform:	
20. Angeboten von:	

Modul: 50120 Environmental Informatics

2. Modulkürzel:	021430002	5. Moduldauer:	1 Semester
3. Leistungspunkte:	6.0 LP	6. Turnus:	jedes 2. Semester, WiSe
4. SWS:	4.0	7. Sprache:	Englisch

8. Modulverantwortlicher:	Prof.Dr.-Ing. Andras Bardossy
9. Dozenten:	Johannes Riegger
10. Zuordnung zum Curriculum in diesem Studiengang:	DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Incoming → Semi-Compulsory Modules DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Outgoing → Wahlmodule DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Incoming → Compulsory Modules DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Outgoing → Wahlmodule M.Sc. Water Resources Engineering and Management, PO 2012 → Spezialisierungsmodule M.Sc. Water Resources Engineering and Management, PO 2012 → Vertiefungsmodule → Vertiefungsmodule Wahlpflicht
11. Empfohlene Voraussetzungen:	
12. Lernziele:	Skills in Spreadsheet Calculations for Data Processing,Design, Creation, Handling and Application of Relational Database Management Systems for Environmental Issues, Creation and display of Environmental GIS data sets .Use of GIS functionalities to investigate spatial and attribute relationships
13. Inhalt:	**Information Processing & Environmental Data Management** (Excel & Access): Environmental Database Design, Relational Database Management, Data Normalization, Data Security **GIS Tools in Environmental Engineering (ArcGIS):** Basics of GIS, Data implementation, Spatial Structures and Attributes, Display of Environmental Information, Charts & Diagrams, Digitization, Spatial and Logical Queries, Data Links, Geo-Referencing, Field Calculations
14. Literatur:	Script: J. Riegger ‘Environmental Informatics’ User Handbooks for Excel, Access, ArcGIS **Getting to know ArcGIS Desktop ISBN: 9781589482609**
15. Lehrveranstaltungen und -formen:	• 501201 Lecture Environmental Data Management • 501202 Lecture GIS Tools in Environmental Engineering
16. Abschätzung Arbeitsaufwand:	Time of attendance: approx. 56 hours

	Private Study: approx. 124 hours during semester Sum: 180h
17. Prüfungsnummer/n und -name:	50121 Environmental Informatics (PL), schriftliche Prüfung, 120 Min., Gewichtung: 1.0
18. Grundlage für ... :	
19. Medienform:	
20. Angeboten von:	

Modul: 55990 German Language

2. Modulkürzel:	-	5. Moduldauer:	1 Semester
3. Leistungspunkte:	3.0 LP	6. Turnus:	unregelmäßig
4. SWS:	0.0	7. Sprache:	-

8. Modulverantwortlicher:	John Nixon
9. Dozenten:	
10. Zuordnung zum Curriculum in diesem Studiengang:	DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Incoming → Compulsory Modules
11. Empfohlene Voraussetzungen:	
12. Lernziele:	
13. Inhalt:	
14. Literatur:	
15. Lehrveranstaltungen und -formen:	
16. Abschätzung Arbeitsaufwand:	
17. Prüfungsnummer/n und -name:	55991 German Language (BSL), schriftliche Prüfung, Gewichtung: 1.0
18. Grundlage für ... :	
19. Medienform:	
20. Angeboten von:	

Modul: 19330 Industrial Waste Water

2. Modulkürzel:	021210151	5. Moduldauer:	1 Semester
3. Leistungspunkte:	6.0 LP	6. Turnus:	jedes 2. Semester, WiSe
4. SWS:	4.0	7. Sprache:	Englisch

8. Modulverantwortlicher:	Prof./Uni.Reg.deBlumenau Uwe Menzel
9. Dozenten:	• Uwe Menzel • Michael Koch
10. Zuordnung zum Curriculum in diesem Studiengang:	DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Incoming → Semi-Compulsory Modules DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Incoming → Compulsory Modules M.Sc. Water Resources Engineering and Management, PO 2012 → Spezialisierungsmodule
11. Empfohlene Voraussetzungen:	
12. Lernziele:	Students have: • a basic understanding for the problems and requirements of industrial waste water treatment • an overview of measures for production integrated environmental protection, relevant treatment methods for process water and its characterization • an overview of water analysis including sampling, the main principles of different analytical techniques and the ways to assure the quality of chemical analysis
13. Inhalt:	Fundamentals of industrial waste water treatment Determiniation of current situation possible process integrated measures measures for reuse and recirculation of water mass and concentration balance Basic elements and examples for applications to the advanced purification processes: biological waste water treatment Sampling and analytical techniques using: onsite measurements oxidation - reduction acids and bases sum parameters photometry spectrometry chromatography Analytical quality assurance
14. Literatur:	-lecture notes (approx. 400 pages) -exercisis -Lehr- und Handbuch der Abwassertechnik, 4. revised edition, volume I. GFA-Verlag St. Augustin 1994. -ATV V: Lehr- und Handbuch der Abwassertechnik, volume v: Organisch verschmutzte Abwässer der Lebensmittelindustrie, Wilhelm Ernst & Sohn Verlag, Berlin. -ATV VII: Lehr- und Handbuch der Abwassertechnik, volume VII: Industrieabwässer mit anorganischen Inhaltsstoffen, Wilhelm Ernst & Sohn Verlag, Berlin. (in each case the current edition) -Deutsche Einheitsverfahren zur Wasser-, Abwasser und Schlammuntersuchung -Standard Methods for the Examination of Water and Wastewater -Wenclawiak, Koch, Hajicostas: Quality Assurance in Analytical Chemistry. Springerverlag 2003
15. Lehrveranstaltungen und -formen:	• 193301 Lecture Treatment of Industrial Waste Water • 193302 Lecture Water Analysis and Analytical Quality Control

16. Abschätzung Arbeitsaufwand:	Time of attendance: I Treatment of Industrial Waste Water: 2 SWS = 24 hours II Water Analysis and Analytical Quality Control: 2 SWS = 24 hours Exam: 2 hours sum of attendance: 50 hours self-study: 130 hours **total: 180 hours**
17. Prüfungsnummer/n und -name:	19331 Industrial Waste Water (PL), schriftliche Prüfung, 120 Min., Gewichtung: 1.0
18. Grundlage für ... :	
19. Medienform:	power-point-presentation, blackboard and over-head projector
20. Angeboten von:	Institut für Siedlungswasserbau, Wassergüte- und Abfallwirtschaft

Modul: 55980 Seminar Module

2. Modulkürzel:	-	5. Moduldauer:	1 Semester
3. Leistungspunkte:	3.0 LP	6. Turnus:	jedes 2. Semester, WiSe
4. SWS:	0.0	7. Sprache:	Deutsch

8. Modulverantwortlicher:	Anne Weiß
9. Dozenten:	
10. Zuordnung zum Curriculum in diesem Studiengang:	DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Incoming → Compulsory Modules
11. Empfohlene Voraussetzungen:	
12. Lernziele:	
13. Inhalt:	
14. Literatur:	
15. Lehrveranstaltungen und -formen:	
16. Abschätzung Arbeitsaufwand:	
17. Prüfungsnummer/n und -name:	55981 Seminar Module (BSL), schriftliche Prüfung, Gewichtung: 1.0
18. Grundlage für ... :	
19. Medienform:	
20. Angeboten von:	

112 Elective Moduls

Zugeordnete Module:
19100 Chemistry and Biology for Environmental Engineers
50220 Groundwater and Resources Management

Modul: 19100 Chemistry and Biology for Environmental Engineers

2. Modulkürzel:	021230502	5. Moduldauer:	1 Semester
3. Leistungspunkte:	6.0 LP	6. Turnus:	unregelmäßig
4. SWS:	6.0	7. Sprache:	-

8. Modulverantwortlicher:	Univ.-Prof.Dr. Jörg Metzger
9. Dozenten:	• Jörg Metzger • Karl Heinrich Engesser • Brigitte Schwederski • Bertram Kuch • Daniel Dobslaw
10. Zuordnung zum Curriculum in diesem Studiengang:	DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Incoming → Semi-Compulsory Modules DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Outgoing → Pflichtmodule DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Incoming → Elective Moduls DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Outgoing → Pflichtmodule M.Sc. Water Resources Engineering and Management, PO 2012 → Spezialisierungsmodule M.Sc. Water Resources Engineering and Management, PO 2012 → Vertiefungsmodule → Vertiefungsmodule Wahlpflicht
11. Empfohlene Voraussetzungen:	
12. Lernziele:	**Lecture: Inorganic chem istry** The students • know the fundamental concepts of chemistry (atomic structure, periodic system, chemical formulae, stoichiometry, molecular structures) and are able to use them, • know the principle types of chemical substances and chemical reactions and can apply their knowledge to synthetic problems, • know about the most important industrial compounds, their preparation and environmental aspects in their application. **Lecture: Organic chemistry** The students

- can identify important functional groups in organic molecules

- know the main compound classes in organic chemistry and the common rules for their nomenclature

- know the most important representatives thereof and

  are able to draw their structural formulae

- know the structure and properties of important bio-molecules such as fats, carbohydrates, proteins, nucleic acids, ATP, lignin and humic acids

- know the most important reactions involved in chemical and microbial degradation of organic matter

- know summary parameters used to characterize water quality

- know the properties of bio-molecules and can explain their general function with respect to cell structures, enzymatic and immune reactions

- knows selected environmental organic contaminants (PAH, dioxins, pesticides etc.) and their properties

Lecture: Biology and ecology of water, soil and air systems

The students

- know about the relation between water, soil and air compartments and many diseases, happening especially in developing countries

- know about the reasons for break out of diseases, the structure and function of prokaryotic and eucaryotic cells as well as the methods for identification and determination of growth conditions and possible growth limitations

- comprehend microbial metabolism, energy production, release and conservation, enzyme syntheses and their regulation.

- know important events and scientists in the history of biology

- know basics in ecology of natural and artificial ('technical') ecosystems as well as selected methods to detect distorted equilibria in technical ecosystems influenced by mankind

Lecture: Technical and medical microbiology for engineers

The students

- know the most important microorganisms being active in plants treating waste water, air and contaminated soil

- know the kind of participation in purification and thus the procedures used to make them feel happy as well as the problems associated with excess biomass

- are aware of a detailed overview of the kind of medically important microorganisms and of the most relevant agents of illness met in these plants; this holds also for the compartments 'drinking water' and 'sewage sludge'.

13. Inhalt:

Lecture: Inorganic chemistry

- atomic structure: stable nuclear particles, atomic nuclei, isotopes and radioactivity, atomic spectra and the hydrogen atom, heavier atoms
- the periodic system of the elements: the sequence of elements, the electronic configuration of some elements, the periodicity of some properties
- chemical bonding: the ionic bond, the metallic bond, the covalent bond, hydrogen bonding, van der Waals forces
- quantitative Relationships and Stoichiometric Equations
- characterizing chemical reactions: the chemical equilibrium, water: the solvent, acid/base reactions, redox reactions
- descriptive part: selected chemical compounds and their preparation and properties

Lecture: Organic chemistry

- functional groups and compound classes
- classification of chemical reactions in organic chemistry
- organic bio-molecules (e.g. proteins, carbohydrates, nucleic acids, fats, humic acids, lignin): structure and function
- chemical and microbial degradation of organic matter in the environment
- summary parameters
- organic environmental contaminants

Lecture: Biology and ecology of water, soil and air systems

The following topics are presented within the lecture:

- Introduction in history of microbiology
- Important waterbased/water related diseases
- Function of microscopy of staining techniques
- Structure and function of prokaryotic cells
- Structure and function of eucaryotic cells
- Necessity and effects of microbial nutrition
- Microbial growth relations and possible limitations
- Microbial metabolism: Energy production, conservation and release
- Microbial metabolism: Enzymes syntheses and regulation.

Lecture: Technical and medical microbiology for engineers

- Important (sewage) water based /water related diseases/detection and possible countermeasures

- Important soil and air connected diseases
- (micro)biological principles in application of engineering techniques
- Implication of engineer work on ecosystems /environment protection problems

Some test systems for estimation of (bio)degradability of chemicals will be evaluated

14. Literatur:	Lecture notes pdf download of powerpoint slides for lectures Exercises as hand-out or download (pdf)
15. Lehrveranstaltungen und -formen:	• 191001 Lecture Inorganic chemistry • 191002 Lecture Organic chemistry • 191003 Lecture Biology and ecology of water, soil and air systems • 191004 Lecture Technical and medical microbiology for engineers
16. Abschätzung Arbeitsaufwand:	Time of attendance: Inorganic chemistry (Schwederski): Lecture, 1 SWS = 14 hours Organic chemistry (Metzger/Kuch): Lecture, 1 SWS = 14 hours Biology and ecology of water, soil and air systems (Engesser): Lecture, 1 SWS = 14 hours Technical and medical microbiology for engineers (Engesser): Lecture, 1 SWS = 14 hours Exercises for Chemistry and Biology for environmental engineers, 2 SWS = 28 hours Exam: 2 hours Sum of attendance: 86 hours Exercises (group work with presentations): 28 hours Self -study: 94 hours:
17. Prüfungsnummer/n und -name:	19101 Chemistry and Biology for Environmental Engineers (PL), schriftlich oder mündlich, 120 Min., Gewichtung: 1.0
18. Grundlage für ... :	
19. Medienform:	Video projector (powerpoint) presentation explanations on blackboard, group work with presentations
20. Angeboten von:	Hydrochemie und Hydrobiologie in der Siedlungswasserwirtschaft

Modul: 50220 Groundwater and Resources Management

2. Modulkürzel:	021420016	5. Moduldauer:	2 Semester
3. Leistungspunkte:	6.0 LP	6. Turnus:	jedes 2. Semester, SoSe
4. SWS:	4.0	7. Sprache:	Englisch

8. Modulverantwortlicher:	Anne Weiß
9. Dozenten:	Frieder Haakh
10. Zuordnung zum Curriculum in diesem Studiengang:	DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Incoming → Semi-Compulsory Modules DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Incoming → Elective Moduls M.Sc. Water Resources Engineering and Management, PO 2012 → Spezialisierungsmodule
11. Empfohlene Voraussetzungen:	Recommended background knowledge: Technical Mechanics Introduction to the mechanics of incompressible fluids Higher Mathematics Partial differential equations Fluid Mechanics Groundwater flow, alllication of type-curves (Theis,..)
12. Lernziele:	Students know how groundwater resources are monitored and made accessible and how they should be protected to ensure sustainability with regard ot other stakeholders within the catchment area Qualification to start working in a water supply company or in the administration (dep. Water resources management) or consulting engineers
13. Inhalt:	Methods commonly used in practice for monitoring and exploring groundwater as well as making it accessible are presented. The contents are: Function and operation of monitoring wells Examples of bore hole geophysics Monitoring networks, operation and optimisation Building and operation of extraction wells (or well systems) Vertical wells Syphoning systems for water abstraction Pumping tests (design, interpretation) Conservation of ecvidence of impacts in environment (case study) Practical application of numerical models for solving water management questions (case studies) Environmental impact assessment for a groundwater extraction (case study) Groundwater protection Protection goals Threats to groundwater Water protection zones (purpose and demarcation) Water pollution control and agriculture in water-supply areas System analysis concerning groundwater management

	Extraction optimisation taking the interests of the various stakeholders into account“
14. Literatur:	Lecture notes by F. Haakh Script (compendium) “Grundwassererschließung und Grundwasserschutz” (about 375 pages) “Practical aspects of groundwater resources management” (about 275 pages) Excercises (via Mail)
15. Lehrveranstaltungen und -formen:	• 502201 Lecture Grundwassererschließung und Grundwasserschutz • 502202 Seminar practical aspects of groundwater resources management for drinking water supply
16. Abschätzung Arbeitsaufwand:	Sum: 180h
17. Prüfungsnummer/n und -name:	• 50221 Grundwassererschließung und Grundwasserschutz (BSL), schriftliche Prüfung, 120 Min., Gewichtung: 1.0 • 50222 Practical Aspects of Groundwater Resources Management (BSL), schriftliche Prüfung, 120 Min., Gewichtung: 1.0
18. Grundlage für ... :	
19. Medienform:	
20. Angeboten von:	

Modul: 80990 Master's Thesis WAREM

2. Modulkürzel:	-	5. Moduldauer:	1 Semester
3. Leistungspunkte:	30.0 LP	6. Turnus:	jedes Semester
4. SWS:	20.0	7. Sprache:	Englisch

8. Modulverantwortlicher:	Univ.-Prof.Dr. Silke Wieprecht
9. Dozenten:	
10. Zuordnung zum Curriculum in diesem Studiengang:	DoubleM.D. Water Resources Engineering and Management, PO 2012 ➞ Chalmers ➞ Incoming DoubleM.D. Water Resources Engineering and Management, PO 2012 ➞ Mara ➞ Incoming
11. Empfohlene Voraussetzungen:	The topic of the Master Thesis can be handed out only the moment at least 78 credit points have been acquired already by the candidate. One month after 90 credit points have been acquired the candidate is supposed to start the work on his master thesis or to ask for the assignment of the topic at the latest.
12. Lernziele:	Capability to implement an independently composed project schedule for the treatment of a recent scientific problem in an international research environment. Effective scientific work in a team, enforcement of strategies internally and particularly externally. Acquire the necessary stamina to not be discouraged by unexpected problems and throwbacks in scientific projects and to finally be successful by the formulation of alternative methods of resolution. Multidisciplinarity through contacts with representatives of other fields like Chemistry, Mathematics, Informatics, etc. Obtaining the capability to discuss the own results of research in the environment of the recent international research comprehensively and to represent them in written (Master's Thesis) and oral (talk) form.
13. Inhalt:	Treatment of a recent scientific problem in an international research environment. The successful treatment of the scientific problem requires the specialisation in the related field of research and the acquisition of the necessary knowledge.
14. Literatur:	Recent literature on the topic of the scientific problem
15. Lehrveranstaltungen und -formen:	
16. Abschätzung Arbeitsaufwand:	900 h (Contact time: 900 h)
17. Prüfungsnummer/n und -name:	3999 Masterarbeit (PL), schriftliche Prüfung, Gewichtung: 1.0
18. Grundlage für ... :	
19. Medienform:	
20. Angeboten von:	

120 Outgoing

Zugeordnete Module:
121 Pflichtmodule
122 Wahlmodule

121 Pflichtmodule

Zugeordnete Module:

19100	Chemistry and Biology for Environmental Engineers
19120	Sanitary Engineering
19150	German as a Foreign Language
19310	Urban Drainage and Design of Wastewater Treatment Plants
50090	Environmental Fluid Mechanics I
50110	Requirements of Professional Life and Engineering in Practise
56000	Requirements of Professional Life and Engineering in Practise 2

Modul: 19100 Chemistry and Biology for Environmental Engineers

2. Modulkürzel:	021230502	5. Moduldauer:	1 Semester
3. Leistungspunkte:	6.0 LP	6. Turnus:	unregelmäßig
4. SWS:	6.0	7. Sprache:	-

8. Modulverantwortlicher:	Univ.-Prof.Dr. Jörg Metzger
9. Dozenten:	• Jörg Metzger • Karl Heinrich Engesser • Brigitte Schwederski • Bertram Kuch • Daniel Dobslaw
10. Zuordnung zum Curriculum in diesem Studiengang:	DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Incoming → Semi-Compulsory Modules DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Outgoing → Pflichtmodule DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Incoming → Elective Moduls DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Outgoing → Pflichtmodule M.Sc. Water Resources Engineering and Management, PO 2012 → Spezialisierungsmodule M.Sc. Water Resources Engineering and Management, PO 2012 → Vertiefungsmodule → Vertiefungsmodule Wahlpflicht
11. Empfohlene Voraussetzungen:	
12. Lernziele:	**Lecture: Inorganic chem istry** The students • know the fundamental concepts of chemistry (atomic structure, periodic system, chemical formulae, stoichiometry, molecular structures) and are able to use them, • know the principle types of chemical substances and chemical reactions and can apply their knowledge to synthetic problems, • know about the most important industrial compounds, their preparation and environmental aspects in their application. **Lecture: Organic chemistry** The students

- can identify important functional groups in organic molecules

- know the main compound classes in organic chemistry and the common rules for their nomenclature

- know the most important representatives thereof and

  are able to draw their structural formulae

- know the structure and properties of important bio-molecules such as fats, carbohydrates, proteins, nucleic acids, ATP, lignin and humic acids

- know the most important reactions involved in chemical and microbial degradation of organic matter

- know summary parameters used to characterize water quality

- know the properties of bio-molecules and can explain their general function with respect to cell structures, enzymatic and immune reactions

- knows selected environmental organic contaminants (PAH, dioxins, pesticides etc.) and their properties

Lecture: Biology and ecology of water, soil and air systems

The students

- know about the relation between water, soil and air compartments and many diseases, happening especially in developing countries

- know about the reasons for break out of diseases, the structure and function of prokaryotic and eucaryotic cells as well as the methods for identification and determination of growth conditions and possible growth limitations

- comprehend microbial metabolism, energy production, release and conservation, enzyme syntheses and their regulation.

- know important events and scientists in the history of biology

- know basics in ecology of natural and artificial ('technical') ecosystems as well as selected methods to detect distorted equilibria in technical ecosystems influenced by mankind

Lecture: Technical and medical microbiology for engineers

The students

- know the most important microorganisms being active in plants treating waste water, air and contaminated soil

- know the kind of participation in purification and thus the procedures used to make them feel happy as well as the problems associated with excess biomass

- are aware of a detailed overview of the kind of medically important microorganisms and of the most relevant agents of illness met in these plants; this holds also for the compartments 'drinking water' and 'sewage sludge'.

13. Inhalt:

Lecture: Inorganic chemistry

- atomic structure: stable nuclear particles, atomic nuclei, isotopes and radioactivity, atomic spectra and the hydrogen atom, heavier atoms
- the periodic system of the elements: the sequence of elements, the electronic configuration of some elements, the periodicity of some properties
- chemical bonding: the ionic bond, the metallic bond, the covalent bond, hydrogen bonding, van der Waals forces
- quantitative Relationships and Stoichiometric Equations
- characterizing chemical reactions: the chemical equilibrium, water: the solvent, acid/base reactions, redox reactions
- descriptive part: selected chemical compounds and their preparation and properties

Lecture: Organic chemistry

- functional groups and compound classes
- classification of chemical reactions in organic chemistry
- organic bio-molecules (e.g. proteins, carbohydrates, nucleic acids, fats, humic acids, lignin): structure and function
- chemical and microbial degradation of organic matter in the environment
- summary parameters
- organic environmental contaminants

Lecture: Biology and ecology of water, soil and air systems

The following topics are presented within the lecture:

- Introduction in history of microbiology
- Important waterbased/water related diseases
- Function of microscopy of staining techniques
- Structure and function of prokaryotic cells
- Structure and function of eucaryotic cells
- Necessity and effects of microbial nutrition
- Microbial growth relations and possible limitations
- Microbial metabolism: Energy production, conservation and release
- Microbial metabolism: Enzymes syntheses and regulation.

Lecture: Technical and medical microbiology for engineers

- Important (sewage) water based /water related diseases/detection and possible countermeasures

- Important soil and air connected diseases
- (micro)biological principles in application of engineering techniques
- Implication of engineer work on ecosystems /environment protection problems

Some test systems for estimation of (bio)degradability of chemicals will be evaluated

14. Literatur:	Lecture notes pdf download of powerpoint slides for lectures Exercises as hand-out or download (pdf)
15. Lehrveranstaltungen und -formen:	• 191001 Lecture Inorganic chemistry • 191002 Lecture Organic chemistry • 191003 Lecture Biology and ecology of water, soil and air systems • 191004 Lecture Technical and medical microbiology for engineers
16. Abschätzung Arbeitsaufwand:	Time of attendance: Inorganic chemistry (Schwederski): Lecture, 1 SWS = 14 hours Organic chemistry (Metzger/Kuch): Lecture, 1 SWS = 14 hours Biology and ecology of water, soil and air systems (Engesser): Lecture, 1 SWS = 14 hours Technical and medical microbiology for engineers (Engesser): Lecture, 1 SWS = 14 hours Exercises for Chemistry and Biology for environmental engineers, 2 SWS = 28 hours Exam: 2 hours Sum of attendance: 86 hours Exercises (group work with presentations): 28 hours Self -study: 94 hours:
17. Prüfungsnummer/n und -name:	19101 Chemistry and Biology for Environmental Engineers (PL), schriftlich oder mündlich, 120 Min., Gewichtung: 1.0
18. Grundlage für ... :	
19. Medienform:	Video projector (powerpoint) presentation explanations on blackboard, group work with presentations
20. Angeboten von:	Hydrochemie und Hydrobiologie in der Siedlungswasserwirtschaft

Modul: 50090 Environmental Fluid Mechanics I

2. Modulkürzel:	021420012	5. Moduldauer:	1 Semester
3. Leistungspunkte:	6.0 LP	6. Turnus:	jedes 2. Semester, WiSe
4. SWS:	5.0	7. Sprache:	Englisch

8. Modulverantwortlicher:	Prof.Dr.-Ing. Rainer Helmig
9. Dozenten:	• Jürgen Braun • Holger Class • Wolfgang Nowak
10. Zuordnung zum Curriculum in diesem Studiengang:	DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Incoming → Semi-Compulsory Modules DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Outgoing → Pflichtmodule DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Incoming → Compulsory Modules DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Outgoing → Pflichtmodule M.Sc. Water Resources Engineering and Management, PO 2012 → Vertiefungsmodule → Vertiefungsmodule Pflicht
11. Empfohlene Voraussetzungen:	Technical Mechanics • Introduction to the statics of rigid bodies • Introduction to elastostatics • Introduction to the mechanics of incompressible fluids Higher Mathematics • Partial differential equations • Vector analysis • Numerical integration Fundamentals of Flow Mechanics • Conservation equations for mass, momentum, energy • Navier-Stokes, Euler, Reynolds, Bernoulli equation
12. Lernziele:	Students have fundamental knowledge of flow in various natural hydrosystems and its application in civil and environmental engineering.
13. Inhalt:	The lecture deals with flow in natural hydrosystems with particular emphasis on groundwater / seepage flow and on flow in surface water / open channels. Groundwater hydraulics includes flow in confined, semi-confined and unconfined groundwater aquifers, wells, pumping tests and other hydraulic investigation methods for exploring groundwater aquifers. In addition, questions concerning regional groundwater

	management (z.B. recharge, unsaturated zone, saltwater intrusion) are discussed. Using the example of groundwater flow, fundamentals of CFD (Computational Fluid Dynamics) are explained, particularly the numerical discretisation techniques finite volume und finite difference. The hydraulics of surface water deals with shallow water equations / Saint Venant equations, unstationary channel flow, turbulence und layered systems. Calculation methods such as the methods of characteisitcs are explained. The contents are: • Potential flow and groundwater flow • Computational Fluid Dynamics • Shallow water equations for surface water • Charakteristikenmethode • Examples from civil and environmental engineering
14. Literatur:	Lecture notes: Hydromechanics, Helmig and Class Lecture notes: Ausbreitungs- und Transportvorgänge in Strömungen, Cirpka White, F.M.: Fluid Mechanics, WCB/McGraw-Hill, New York, 1999 Freeze, R.A. and Cherry J.A.: Groundwater, Prentice Hall, 1979
15. Lehrveranstaltungen und -formen:	• 500901 Lecture Environmental Fluid Mechanics I • 500902 Excersice Environmental Fluid Mechanics I
16. Abschätzung Arbeitsaufwand:	Sum 180 h
17. Prüfungsnummer/n und -name:	• 50091 Environmental Fluid Mechanics I (PL), schriftliche Prüfung, 120 Min., Gewichtung: 1.0 • V Vorleistung (USL-V), schriftliche Prüfung
18. Grundlage für ... :	
19. Medienform:	
20. Angeboten von:	

Modul: 19150 German as a Foreign Language

2. Modulkürzel:	SZ	5. Moduldauer:	1 Semester
3. Leistungspunkte:	6.0 LP	6. Turnus:	unregelmäßig
4. SWS:	8.0	7. Sprache:	-

8. Modulverantwortlicher:	John Nixon
9. Dozenten:	
10. Zuordnung zum Curriculum in diesem Studiengang:	DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Outgoing → Pflichtmodule DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Outgoing → Pflichtmodule M.Sc. Water Resources Engineering and Management, PO 2012 → Deutschkurse
11. Empfohlene Voraussetzungen:	
12. Lernziele:	
13. Inhalt:	
14. Literatur:	
15. Lehrveranstaltungen und -formen:	• 191501 Seminar German as a Foreign Language I • 191502 Seminar German as a Foreign Language II
16. Abschätzung Arbeitsaufwand:	
17. Prüfungsnummer/n und -name:	• 19151 German as a Foreign Language I (PL), schriftlich oder mündlich, Gewichtung: 1.0 • 19152 German as a Foreign Language II (PL), schriftlich oder mündlich, Gewichtung: 1.0
18. Grundlage für ... :	
19. Medienform:	
20. Angeboten von:	

Modul: 50110 Requirements of Professional Life and Engineering in Practise

2. Modulkürzel:	021410901	5. Moduldauer:	3 Semester
3. Leistungspunkte:	3.0 LP	6. Turnus:	jedes Semester
4. SWS:	2.0	7. Sprache:	Englisch

8. Modulverantwortlicher:	Anne Weiß
9. Dozenten:	
10. Zuordnung zum Curriculum in diesem Studiengang:	DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Outgoing → Pflichtmodule DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Outgoing → Pflichtmodule M.Sc. Water Resources Engineering and Management, PO 2012 → Vertiefungsmodule → Vertiefungsmodule Pflicht
11. Empfohlene Voraussetzungen:	
12. Lernziele:	• Capability to summarize a water-related topic or the investigations of a scientific, water related problem in terms of two 20 min presentations, discussion on the topic after presenting. • Ability to participate in a scientific discussion, asking questions to presenters. • Writing a summary of a visit at a technical site, condense information to a short report.
13. Inhalt:	• Treatment of a water related topic or a recent scientific problem in an international research environment. • The successful treatment of the scientific problem requires the specialisation in the related field of research and the acquisition of the necessary knowledge.
14. Literatur:	Recent literature on the water related topic/ scientific problem,.
15. Lehrveranstaltungen und -formen:	• 501101 Seminar Requirements of Professional Life and Engineering in Practise • 501102 Excursion Requirements of Professional Life and Engineering in Practise
16. Abschätzung Arbeitsaufwand:	90 h (Contact time: 70 h)
17. Prüfungsnummer/n und -name:	50111 Requirements of Professional Life and Engineering in Practise (USL), schriftliche Prüfung, Gewichtung: 1.0
18. Grundlage für ... :	
19. Medienform:	
20. Angeboten von:	

Modul: 56000 Requirements of Professional Life and Engineering in Practise 2

2. Modulkürzel:	Warem	5. Moduldauer:	1 Semester
3. Leistungspunkte:	3.0 LP	6. Turnus:	unregelmäßig
4. SWS:	0.0	7. Sprache:	-

8. Modulverantwortlicher:	Anne Weiß
9. Dozenten:	
10. Zuordnung zum Curriculum in diesem Studiengang:	DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Outgoing → Pflichtmodule DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Outgoing → Pflichtmodule
11. Empfohlene Voraussetzungen:	
12. Lernziele:	
13. Inhalt:	
14. Literatur:	
15. Lehrveranstaltungen und -formen:	
16. Abschätzung Arbeitsaufwand:	
17. Prüfungsnummer/n und -name:	56001 Requirements of Professional Life and Engineering in Practise 2 (USL), schriftliche Prüfung, Gewichtung: 1.0
18. Grundlage für ... :	
19. Medienform:	
20. Angeboten von:	

Modul: 19120 Sanitary Engineering

2. Modulkürzel:	021220012	5. Moduldauer:	1 Semester
3. Leistungspunkte:	6.0 LP	6. Turnus:	jedes 2. Semester, WiSe
4. SWS:	4.0	7. Sprache:	Englisch

8. Modulverantwortlicher:	Dr.-Ing. Klaus Fischer
9. Dozenten:	• Klaus Fischer • Heidrun Steinmetz
10. Zuordnung zum Curriculum in diesem Studiengang:	DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Outgoing → Pflichtmodule DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Outgoing → Pflichtmodule M.Sc. Water Resources Engineering and Management, PO 2012 → Vertiefungsmodule → Vertiefungsmodule Pflicht
11. Empfohlene Voraussetzungen:	
12. Lernziele:	The students have detailed knowledge about waste avoidance procedures in household and industry. Waste avoidance includes the ecology - oriented daily shopping, the substitution of contaminated materials in the industrial production as well as the Zero Emission Society. In the case of unavoidable waste fractions, the students acquire the competence to establish collection and transportation systems for these wastes, within the logistic, economic and legal frame. Main emphasis is given to the collection of recyclables. The students know the relevant factors which influence the waste amount and waste composition in general and in particular within the separate collection of recyclables. The students are acquainted with the state of the art of recycling technologies for separate collected paper, glass, metal and plastic including the pretreatment process. They have knowledge of the aerobic and anaerobic treatment and utilization of separate collected biowaste. Not avoided and recycled waste has to be treated before disposing off e.g. in a landfill site. The students possess a general knowledge of the mechanical and biological treatment technology as well as of the thermal waste treatment. They are able to evaluate the different treatment and recycling processes from an ecological and economic point of view. The students have knowledge about the most important components of the urban drainage and the basic treatment processes of wastewater. Thus they are able to compare different systems in dependence of changing boundary conditions and assess the effectiveness and pros and cons of the systems, e.g. concerning impacts on the environment, economical and operational aspects. They obtain an understanding for system connections between the urban drainage system and the wastewater treatment system as well as between the urban water system and the environment.
13. Inhalt:	Solid Waste Management: • Waste generation and waste composition • National and international regulations for waste • Waste avoidance

	• Collection and transport of waste • Separate collection of recyclables • Sorting of recyclables • Recycling technologies for paper, glass, metal, plastic • Biological treatment of waste • Waste Disposal • Ecological indicator systems Waste Water Technology: • Basics of urban drainage and municipal wastewater treatment • Quantity and Composition of Wastewater • Urban drainage systems • stormwater treatment • mechanical wastewater treatment • biological wastewater treatment • sludge treatment • natural close and ECOSAN systems
14. Literatur:	Lecture Manuscripts Solid Waste Management G. Tchobanoglous et. Al.: Handbook of solid waste management; Bilitеski, B. et.al.: Waste Management, Springer 1994 ISBN: 3-540-59210-5 Butler, D., Davies, J.W: .Urban drainage, Spon press London, Henze, M., Harremoes, J., la Coour Jansen, J., Arvin, E: Wastewater treatment. Springer Verlag Berlin
15. Lehrveranstaltungen und -formen:	• 191201 Vorlesung Solid Waste Management • 191202 Vorlesung Waste Water • 191203 Exkursion Sanitary Engineering
16. Abschätzung Arbeitsaufwand:	Time of attendance: I Solid Waste Management, lecture: 2.0 SWS = 28 hours II Waste Water: 2 SWS = 28 hours excursion: 12 hours exam: 2 hours sum of attendance: 70 hours self-study: 110 hours total: 180 hours
17. Prüfungsnummer/n und -name:	• 19121 Solid Waste Management and Waste Water Technology (PL), schriftliche Prüfung, 120 Min., Gewichtung: 1.0 • V Vorleistung (USL-V), schriftlich, eventuell mündlich
18. Grundlage für ... :	• 19310 Urban Drainage and Design of Wastewater Treatment Plants • 19330 Industrial Waste Water
19. Medienform:	
20. Angeboten von:	

Modul: 19310 Urban Drainage and Design of Wastewater Treatment Plants

2. Modulkürzel:	021210251	5. Moduldauer:	-
3. Leistungspunkte:	6.0 LP	6. Turnus:	unregelmäßig
4. SWS:	5.0	7. Sprache:	-

8. Modulverantwortlicher:	Univ.-Prof.Dr.-Ing. Heidrun Steinmetz
9. Dozenten:	
10. Zuordnung zum Curriculum in diesem Studiengang:	DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Outgoing → Pflichtmodule DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Outgoing → Pflichtmodule M.Sc. Water Resources Engineering and Management, PO 2012 → Spezialisierungsmodule M.Sc. Water Resources Engineering and Management, PO 2012 → Vertiefungsmodule → Vertiefungsmodule Wahlpflicht
11. Empfohlene Voraussetzungen:	
12. Lernziele:	
13. Inhalt:	
14. Literatur:	
15. Lehrveranstaltungen und -formen:	• 193101 Vorlesung und Übung Design of Sewer System and Stormwater Treatment • 193102 Vorlesung und Übung Design of Wastewater Treatment Plants • 193103 Seminar Case Study • 193104 Exkursion
16. Abschätzung Arbeitsaufwand:	
17. Prüfungsnummer/n und -name:	19311 Urban Drainage and Design of Wastewater Treatment Plants (PL), schriftliche Prüfung, 120 Min., Gewichtung: 1.0
18. Grundlage für ... :	
19. Medienform:	
20. Angeboten von:	

122 Wahlmodule

Zugeordnete Module:
- 15160 Water and Power Supply
- 34420 Regional and Urban Planning II
- 50120 Environmental Informatics
- 50130 Integrated Watershed Modeling
- 50190 Geohydrological Modelling I and II
- 50330 Regional and Urban Planning I

Modul: 50120 Environmental Informatics

2. Modulkürzel:	021430002	5. Moduldauer:	1 Semester
3. Leistungspunkte:	6.0 LP	6. Turnus:	jedes 2. Semester, WiSe
4. SWS:	4.0	7. Sprache:	Englisch

8. Modulverantwortlicher:	Prof.Dr.-Ing. Andras Bardossy
9. Dozenten:	Johannes Riegger
10. Zuordnung zum Curriculum in diesem Studiengang:	DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Incoming → Semi-Compulsory Modules DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Outgoing → Wahlmodule DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Incoming → Compulsory Modules DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Outgoing → Wahlmodule M.Sc. Water Resources Engineering and Management, PO 2012 → Spezialisierungsmodule M.Sc. Water Resources Engineering and Management, PO 2012 → Vertiefungsmodule → Vertiefungsmodule Wahlpflicht
11. Empfohlene Voraussetzungen:	
12. Lernziele:	Skills in Spreadsheet Calculations for Data Processing,Design, Creation, Handling and Application of Relational Database Management Systems for Environmental Issues, Creation and display of Environmental GIS data sets .Use of GIS functionalities to investigate spatial and attribute relationships
13. Inhalt:	**Information Processing & Environmental Data Management** (Excel & Access): Environmental Database Design, Relational Database Management, Data Normalization, Data Security **GIS Tools in Environmental Engineering (ArcGIS):** Basics of GIS, Data implementation, Spatial Structures and Attributes, Display of Environmental Information, Charts & Diagrams, Digitization, Spatial and Logical Queries, Data Links, Geo-Referencing, Field Calculations
14. Literatur:	Script: J. Riegger 'Environmental Informatics' User Handbooks for Excel, Access, ArcGIS **Getting to know ArcGIS Desktop ISBN: 9781589482609**
15. Lehrveranstaltungen und -formen:	• 501201 Lecture Environmental Data Management • 501202 Lecture GIS Tools in Environmental Engineering
16. Abschätzung Arbeitsaufwand:	Time of attendance: approx. 56 hours

	Private Study: approx. 124 hours during semester Sum: 180h
17. Prüfungsnummer/n und -name:	50121 Environmental Informatics (PL), schriftliche Prüfung, 120 Min., Gewichtung: 1.0
18. Grundlage für ... :	
19. Medienform:	
20. Angeboten von:	

Modul: 50190 Geohydrological Modelling I and II

2. Modulkürzel:	021430007	5. Moduldauer:	1 Semester
3. Leistungspunkte:	6.0 LP	6. Turnus:	jedes 2. Semester, WiSe
4. SWS:	4.0	7. Sprache:	Englisch

8. Modulverantwortlicher:	Prof.Dr.-Ing. Andras Bardossy
9. Dozenten:	Johannes Riegger
10. Zuordnung zum Curriculum in diesem Studiengang:	DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Outgoing → Wahlmodule DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Outgoing → Wahlmodule M.Sc. Water Resources Engineering and Management, PO 2012 → Spezialisierungsmodule
11. Empfohlene Voraussetzungen:	Contents of Geohydrology and Geoengineering
12. Lernziele:	• Setup of a Geohydrological Model • Spatial and temporal Discretization (Stability Criteria) • Adequate Transfer of Nature into a Model • Simplification of complex Geohydrological Systems • Choice of adequate Numerical Scheme • Unique Calibration of Flow and Transport • Assessment of Geohydrological Model Approaches and Model Realizations
13. Inhalt:	Geohydrological Modelling 1: Groundwater Flow, Conceptual Model, Numerical Model, Modelling of Natural Systems, Calibration Process, Sensitivity Analysis, Model Verification and Validation. Geohydrological Modelling 2: Complex & Transient Systems, 3D-Flow, Fractured Systems, Double Porosity, Advective and Dispersive Transport, Numerical Methods for Transport, Stability Criteria, Chemical Reactions, Measurement of Transport Parameters, Transport Calibration
14. Literatur:	Script: J. Riegger ‘Geohydrological Modelling’ Anderson & Woessner ‘Applied Groundwater Modelling’ Spitz & Moreno : ‘A Practical Guide to Groundwater and Solute Transport Modeling’ Freeze & Cherry: ‘Groundwater’
15. Lehrveranstaltungen und -formen:	• 501901 Lecture Geohydrological Modelling 1 • 501902 Lecture Geohydrological Modelling 2
16. Abschätzung Arbeitsaufwand:	Sum: 180h
17. Prüfungsnummer/n und -name:	• 50191 Geohydrological Modelling I and II (PL), schriftliche Prüfung, 120 Min., Gewichtung: 1.0 • 50192 Geohydrological Modelling I and II (USL), schriftliche Prüfung, Gewichtung: 1.0
18. Grundlage für ... :	

19. Medienform:

20. Angeboten von:

Modul: 50130 Integrated Watershed Modeling

2. Modulkürzel:	021430009	5. Moduldauer:	1 Semester
3. Leistungspunkte:	6.0 LP	6. Turnus:	jedes 2. Semester, SoSe
4. SWS:	4.0	7. Sprache:	Deutsch

8. Modulverantwortlicher:	Prof.Dr.-Ing. Andras Bardossy
9. Dozenten:	• Johannes Riegger • Andras Bardossy
10. Zuordnung zum Curriculum in diesem Studiengang:	DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Outgoing → Wahlmodule DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Outgoing → Wahlmodule M.Sc. Water Resources Engineering and Management, PO 2012 → Spezialisierungsmodule M.Sc. Water Resources Engineering and Management, PO 2012 → Vertiefungsmodule → Vertiefungsmodule Wahlpflicht
11. Empfohlene Voraussetzungen:	Recommended background knowledge: Basic knowledge of hydrology and geohydrology Prerequisite module: none
12. Lernziele:	**Hydrological Modeling:** Construction of models for each part in the runoff process and how these models are used and integrated in different environment management systems. **Integrated model systems for the groundwater management:** Design of hydrogeological databases, visualization of data, GIS-Operations for the groundwater and hydrological modeling, Geostatistic, stochastic modeling, Monte Carlo Methods.
13. Inhalt:	**Hydrological Modeling:** What happens to the rain? This is the basic question that needs to be addressed in order to predict the amount of discharge at a certain location in a river system at a given time. Which parts of the fate of rainfall can be determined on a physical basis, and which are still left to empirical searching? Beside the qualitative determination of e.g. the processes of evapotranspiration, infiltration, interflow etc. we also need to describe the quantities of these processes to be able to forecast e.g. flood events. Hydrological watershed modelling is fundamental to integrated water management. There are complex interactions between the elements of the environmental continuum. In order to predict future behaviour and to quantify effects of management changes, quantitative mathematical descriptions are needed. A number of advanced hydrological watershed models have been developed in the last 30 years. A few of them will be reviewed in terms of their data needs and there predictive power. The participants are encouraged to form groups and to use their selected models for the same catchment so that the different approaches are compared.

	Integrated model systems for the groundwater management: Modern integrated model systems require techniques for the efficient construction of ground water models and their integration in “Decision Support Systems” as well as strategies for the handling of uncertainties. The course will discuss the specific “GIS-Methods” that are important for the integrations of databases, the visualization of data and the calculation of spatial data like ground water recharge. Special focus is laid on GIS supported hydrological modeling of the ground water recharge and the runoff parameters as well as adequate choice of the hydrological model concepts for the calculation of the local water balance in different data situations. To handle the model uncertainties, geostatistic methods and associated stochastic modeling attempts like the “Monte Carlo Simulation” will be mentioned.
14. Literatur:	Hydrological Modeling: Beven, K.J., 2000. Rainfall-Runoff Modelling: The Primer. Wiley, 360pp. Singh, V.P. (Ed.), 1995. Computer Models of Watershed Hydrology. Water Resource Publications, Littleton, Colorado, USA.
15. Lehrveranstaltungen und -formen:	• 501301 Lecture and excercise Hydrological Modeling • 501302 Lecture and excercise Integrated model systems for the groundwater management
16. Abschätzung Arbeitsaufwand:	Sum: 180h
17. Prüfungsnummer/n und -name:	50131 Integrated Watershed Modeling (PL), schriftliche Prüfung, 150 Min., Gewichtung: 1.0
18. Grundlage für ... :	
19. Medienform:	
20. Angeboten von:	

Modul: 50330 Regional and Urban Planning I

2. Modulkürzel:	021100010	5. Moduldauer:	1 Semester
3. Leistungspunkte:	6.0 LP	6. Turnus:	jedes 2. Semester, WiSe
4. SWS:	4.0	7. Sprache:	Englisch

8. Modulverantwortlicher:	Dr.-Ing. Richard Junesch
9. Dozenten:	• Richard Junesch • Nina Gribat
10. Zuordnung zum Curriculum in diesem Studiengang:	DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Outgoing → Wahlmodule DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Outgoing → Wahlmodule M.Sc. Water Resources Engineering and Management, PO 2012 → Spezialisierungsmodule
11. Empfohlene Voraussetzungen:	
12. Lernziele:	The students understand the major challenges, objectives, strategies and instruments in spatial planning and urban development in Europe as well as in developing countries. The students are acquainted with the legal framework of comprehensive and sector planning and know the capabilities and limits of public planning as “positive” and “negative” planning.
13. Inhalt:	The course Regional Planning I covers the following topics: • Overview on current planning issues • Basic Terms of Spatial Planning • Strategies in Spatial Planning • Instruments of Spatial Planning • Performance of Plans, Assessing Plans The course Urban Planning I provides an overview on the origin of planned urban development, starting in Greece and the Roman Empire, passing through all important periods up to the 21st century. The second part introduces urbanisation processes in third world countries, planned and unplanned urban conglomerations, including Mega Cities and Global Cities.
14. Literatur:	Berke, P.R. et al. (2006): Urban Land Use Planning. Urbana/Chicago: University of Illinois Press Hall, P. (2002): Urban and Regional Planning. New York: Routledge
15. Lehrveranstaltungen und -formen:	• 503301 Lecture Regional Planning I • 503302 Lecture Urban Planning I
16. Abschätzung Arbeitsaufwand:	Time of attendance: approx. 45 hours Private Study: approx.135 hours
17. Prüfungsnummer/n und -name:	50331 Regional and Urban Planning I (PL), schriftliche Prüfung, Gewichtung: 1.0
18. Grundlage für ... :	

19. Medienform:

20. Angeboten von:

Modul: 34420 Regional and Urban Planning II

2. Modulkürzel:	-	5. Moduldauer:	1 Semester
3. Leistungspunkte:	6.0 LP	6. Turnus:	jedes 2. Semester, SoSe
4. SWS:	4.0	7. Sprache:	Englisch

8. Modulverantwortlicher:	Dr.-Ing. Richard Junesch
9. Dozenten:	• Stefan Fina • Nina Gribat
10. Zuordnung zum Curriculum in diesem Studiengang:	DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Outgoing → Wahlmodule DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Outgoing → Wahlmodule M.Sc. Water Resources Engineering and Management, PO 2012 → Spezialisierungsmodule
11. Empfohlene Voraussetzungen:	prerequisite modules: Regional and Urban Planning I
12. Lernziele:	The students are acquainted with basic methods of analysis and assessment in spatial planning. The students are able to cope with function, prerequisites and methodical problems of the methods presented.The lectures demonstrate the usage of planning instruments and methods based on planning cases from Germanyand other countries.
13. Inhalt:	The course Regional Planning II deals with the following planning methods: • Indicator-based monitoring and evaluation methods • Multi-criteria decision analysis (e.g. cost-benefit analysis, utility value analyis, analytic hierarchy process) • Methods of impact assessment • Techniques of demand forecast and land suitability analysis • Hazard and vulnerability analysis (climate change adaptation) The course Urban Planning II gives an overview on: • Levels of spatial planning in urban areas • Urban development planning • Urban analysis • Urban renewal • Urban planning instruments • Land use planning and implementation planning • Legal framework
14. Literatur:	Skript "Regional and Urban Planning II"
15. Lehrveranstaltungen und -formen:	• 344201 Vorlesung Regional Planning II • 344202 Vorlesung Urban Planning II
16. Abschätzung Arbeitsaufwand:	Time of attendance: approx.45hours Private Study: approx. 120 hours

17. Prüfungsnummer/n und -name:	• 34421 Regional Planning II (PL), schriftliche Prüfung, 60 Min., Gewichtung: 1.0 • 34422 Urban Planning II (PL), schriftliche Prüfung, 60 Min., Gewichtung: 1.0
18. Grundlage für ... :	
19. Medienform:	Optional
20. Angeboten von:	

Modul: 15160 Water and Power Supply

2. Modulkürzel:	021410105	5. Moduldauer:	1 Semester
3. Leistungspunkte:	6.0 LP	6. Turnus:	jedes 2. Semester, WiSe
4. SWS:	0.0	7. Sprache:	Englisch

8. Modulverantwortlicher:	Markus Noack
9. Dozenten:	• Ralf Minke • Markus Noack
10. Zuordnung zum Curriculum in diesem Studiengang:	DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Outgoing → Wahlmodule DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Outgoing → Wahlmodule M.Sc. Water Resources Engineering and Management, PO 2012 → Spezialisierungsmodule M.Sc. Water Resources Engineering and Management, PO 2012 → Vertiefungsmodule → Vertiefungsmodule Wahlpflicht
11. Empfohlene Voraussetzungen:	None
12. Lernziele:	**Power Demand, Supply and Distribution:** The students… • know the German, European and worldwide energy markets related to demand, supply and its distribution capabilities • are aware of that non-renewable energy sources are strictly limited and time-scales for conversion of energy markets long • have an idea about the relations between energy, politics, social changes and influences on environment • have a basic knowledge about present energy conversion systems, theoretical limits of efficiencies, and the potential to enhance applied technology • have a basic understanding about where and how energy is provided and distributed • comprehend the balance between load and supply in electrical grids and the resulting necessity for control energy. **Water Demand, Supply and Distribution:** The students… • know the German and worldwide water systems related to demand, supply and its distribution capabilities • have an overview on the water supply situation all over the world. • recognize the different possibilities and levels of water supply • have an idea of the relations between water, politics, social changes and influences on environment.
13. Inhalt:	**Power Demand, Supply and Distribution:**

- Energy demand, energy supply
- Energy generation
  - overview of different types of power plants
  - renewable energy
  - thermal power plants (conventional and nuclear)
- Areas of application of different power plants
- Emission control techniques
- Cooling of thermal power plants
  - methods
  - water resources aspects
- Energy transport and energy storage
- Net techniques
- Energy market
  - trade
  - politics
  - law
- social changes due to energy supply

Water Demand, Supply and Distribution:

- Water supply and water distribution: necessity, basic requirements, elements, hydrological cycle
- Water demand calculation: water consumption, water demand, consumer groups, losses, forecasting, design periods
- Water collection: Selection of source, groundwater withdrawal, springwater tapping, surface water intakes, rainwater harvesting, seawater desalination, recycling of treated sewage, drinking water protection areas
- Water transmission and distribution: necessity, hydraulic basics, dimensioning and calculation of branched and closed loop systems.
- Pumps and pumping stations: necessity, types, hydraulics for pumping design, pumping stations and pressure boosters
- Water storage: necessity, types and functions of tanks and reservoirs
- Case study: planning and design of a water supply system for a small town

14. Literatur:	Lecture notes can be downloaded from the internet. Hints are given for additional literature from the internet as well as libraries.
15. Lehrveranstaltungen und -formen:	• 151601 Vorlesung Energy Demand, Supply and Distribution • 151602 Vorlesung Water Demand, Supply and Distribution
16. Abschätzung Arbeitsaufwand:	Time of attendance: 45 h Private Study: 135 h
17. Prüfungsnummer/n und -name:	15161 Water and Power Supply (PL), schriftliche Prüfung, 120 Min., Gewichtung: 1.0
18. Grundlage für ... :	
19. Medienform:	
20. Angeboten von:	

200 Chalmers

Zugeordnete Module:
210 Incoming
220 Outgoing

210 Incoming

Zugeordnete Module:
211 Semi-Compulsory Modules
80990 Master's Thesis WAREM

Modul: 80990 Master's Thesis WAREM

2. Modulkürzel:	-	5. Moduldauer:	1 Semester
3. Leistungspunkte:	30.0 LP	6. Turnus:	jedes Semester
4. SWS:	20.0	7. Sprache:	Englisch

8. Modulverantwortlicher:	Univ.-Prof.Dr. Silke Wieprecht
9. Dozenten:	
10. Zuordnung zum Curriculum in diesem Studiengang:	DoubleM.D. Water Resources Engineering and Management, PO 2012 ➞ Chalmers ➞ Incoming DoubleM.D. Water Resources Engineering and Management, PO 2012 ➞ Mara ➞ Incoming
11. Empfohlene Voraussetzungen:	The topic of the Master Thesis can be handed out only the moment at least 78 credit points have been acquired already by the candidate. One month after 90 credit points have been acquired the candidate is supposed to start the work on his master thesis or to ask for the assignment of the topic at the latest.
12. Lernziele:	Capability to implement an independently composed project schedule for the treatment of a recent scientific problem in an international research environment. Effective scientific work in a team, enforcement of strategies internally and particularly externally. Acquire the necessary stamina to not be discouraged by unexpected problems and throwbacks in scientific projects and to finally be successful by the formulation of alternative methods of resolution. Multidisciplinarity through contacts with representatives of other fields like Chemistry, Mathematics, Informatics, etc. Obtaining the capability to discuss the own results of research in the environment of the recent international research comprehensively and to represent them in written (Master's Thesis) and oral (talk) form.
13. Inhalt:	Treatment of a recent scientific problem in an international research environment. The successful treatment of the scientific problem requires the specialisation in the related field of research and the acquisition of the necessary knowledge.
14. Literatur:	Recent literature on the topic of the scientific problem
15. Lehrveranstaltungen und -formen:	
16. Abschätzung Arbeitsaufwand:	900 h (Contact time: 900 h)
17. Prüfungsnummer/n und -name:	3999 Masterarbeit (PL), schriftliche Prüfung, Gewichtung: 1.0
18. Grundlage für ... :	
19. Medienform:	
20. Angeboten von:	

211 Semi-Compulsory Modules

Zugeordnete Module:

15150	Fuzzy Logic and Operation Research
19100	Chemistry and Biology for Environmental Engineers
19330	Industrial Waste Water
50090	Environmental Fluid Mechanics I
50120	Environmental Informatics
50220	Groundwater and Resources Management
50620	Hydraulic Structures

Modul: 19100 Chemistry and Biology for Environmental Engineers

2. Modulkürzel:	021230502	5. Moduldauer:	1 Semester
3. Leistungspunkte:	6.0 LP	6. Turnus:	unregelmäßig
4. SWS:	6.0	7. Sprache:	-

8. Modulverantwortlicher:	Univ.-Prof.Dr. Jörg Metzger
9. Dozenten:	• Jörg Metzger • Karl Heinrich Engesser • Brigitte Schwederski • Bertram Kuch • Daniel Dobslaw
10. Zuordnung zum Curriculum in diesem Studiengang:	DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Incoming → Semi-Compulsory Modules DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Outgoing → Pflichtmodule DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Incoming → Elective Moduls DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Outgoing → Pflichtmodule M.Sc. Water Resources Engineering and Management, PO 2012 → Spezialisierungsmodule M.Sc. Water Resources Engineering and Management, PO 2012 → Vertiefungsmodule → Vertiefungsmodule Wahlpflicht
11. Empfohlene Voraussetzungen:	
12. Lernziele:	**Lecture: Inorganic chem istry** The students • know the fundamental concepts of chemistry (atomic structure, periodic system, chemical formulae, stoichiometry, molecular structures) and are able to use them, • know the principle types of chemical substances and chemical reactions and can apply their knowledge to synthetic problems, • know about the most important industrial compounds, their preparation and environmental aspects in their application. **Lecture: Organic chemistry** The students

- can identify important functional groups in organic molecules

- know the main compound classes in organic chemistry and the common rules for their nomenclature

- know the most important representatives thereof and

  are able to draw their structural formulae

- know the structure and properties of important bio-molecules such as fats, carbohydrates, proteins, nucleic acids, ATP, lignin and humic acids

- know the most important reactions involved in chemical and microbial degradation of organic matter

- know summary parameters used to characterize water quality

- know the properties of bio-molecules and can explain their general function with respect to cell structures, enzymatic and immune reactions

- knows selected environmental organic contaminants (PAH, dioxins, pesticides etc.) and their properties

Lecture: Biology and ecology of water, soil and air systems

The students

- know about the relation between water, soil and air compartments and many diseases, happening especially in developing countries

- know about the reasons for break out of diseases, the structure and function of prokaryotic and eucaryotic cells as well as the methods for identification and determination of growth conditions and possible growth limitations

- comprehend microbial metabolism, energy production, release and conservation, enzyme syntheses and their regulation.

- know important events and scientists in the history of biology

- know basics in ecology of natural and artificial ('technical') ecosystems as well as selected methods to detect distorted equilibria in technical ecosystems influenced by mankind

Lecture: Technical and medical microbiology for engineers

The students

- know the most important microorganisms being active in plants treating waste water, air and contaminated soil

- know the kind of participation in purification and thus the procedures used to make them feel happy as well as the problems associated with excess biomass

- are aware of a detailed overview of the kind of medically important microorganisms and of the most relevant agents of illness met in these plants; this holds also for the compartments 'drinking water' and 'sewage sludge'.

13. Inhalt:

Lecture: Inorganic chemistry

- atomic structure: stable nuclear particles, atomic nuclei, isotopes and radioactivity, atomic spectra and the hydrogen atom, heavier atoms
- the periodic system of the elements: the sequence of elements, the electronic configuration of some elements, the periodicity of some properties
- chemical bonding: the ionic bond, the metallic bond, the covalent bond, hydrogen bonding, van der Waals forces
- quantitative Relationships and Stoichiometric Equations
- characterizing chemical reactions: the chemical equilibrium, water: the solvent, acid/base reactions, redox reactions
- descriptive part: selected chemical compounds and their preparation and properties

Lecture: Organic chemistry

- functional groups and compound classes
- classification of chemical reactions in organic chemistry
- organic bio-molecules (e.g. proteins, carbohydrates, nucleic acids, fats, humic acids, lignin): structure and function
- chemical and microbial degradation of organic matter in the environment
- summary parameters
- organic environmental contaminants

Lecture: Biology and ecology of water, soil and air systems

The following topics are presented within the lecture:

- Introduction in history of microbiology
- Important waterbased/water related diseases
- Function of microscopy of staining techniques
- Structure and function of prokaryotic cells
- Structure and function of eucaryotic cells
- Necessity and effects of microbial nutrition
- Microbial growth relations and possible limitations
- Microbial metabolism: Energy production, conservation and release
- Microbial metabolism: Enzymes syntheses and regulation.

Lecture: Technical and medical microbiology for engineers

- Important (sewage) water based /water related diseases/detection and possible countermeasures

- Important soil and air connected diseases
- (micro)biological principles in application of engineering techniques
- Implication of engineer work on ecosystems /environment protection problems

Some test systems for estimation of (bio)degradability of chemicals will be evaluated

14. Literatur:	Lecture notes pdf download of powerpoint slides for lectures Exercises as hand-out or download (pdf)
15. Lehrveranstaltungen und -formen:	• 191001 Lecture Inorganic chemistry • 191002 Lecture Organic chemistry • 191003 Lecture Biology and ecology of water, soil and air systems • 191004 Lecture Technical and medical microbiology for engineers
16. Abschätzung Arbeitsaufwand:	Time of attendance: Inorganic chemistry (Schwederski): Lecture, 1 SWS = 14 hours Organic chemistry (Metzger/Kuch): Lecture, 1 SWS = 14 hours Biology and ecology of water, soil and air systems (Engesser): Lecture, 1 SWS = 14 hours Technical and medical microbiology for engineers (Engesser): Lecture, 1 SWS = 14 hours Exercises for Chemistry and Biology for environmental engineers, 2 SWS = 28 hours Exam: 2 hours Sum of attendance: 86 hours Exercises (group work with presentations): 28 hours Self -study: 94 hours:
17. Prüfungsnummer/n und -name:	19101 Chemistry and Biology for Environmental Engineers (PL), schriftlich oder mündlich, 120 Min., Gewichtung: 1.0
18. Grundlage für ... :	
19. Medienform:	Video projector (powerpoint) presentation explanations on blackboard, group work with presentations
20. Angeboten von:	Hydrochemie und Hydrobiologie in der Siedlungswasserwirtschaft

Modul: 50090 Environmental Fluid Mechanics I

2. Modulkürzel:	021420012	5. Moduldauer:	1 Semester
3. Leistungspunkte:	6.0 LP	6. Turnus:	jedes 2. Semester, WiSe
4. SWS:	5.0	7. Sprache:	Englisch

8. Modulverantwortlicher:	Prof.Dr.-Ing. Rainer Helmig
9. Dozenten:	• Jürgen Braun • Holger Class • Wolfgang Nowak
10. Zuordnung zum Curriculum in diesem Studiengang:	DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Incoming → Semi-Compulsory Modules DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Outgoing → Pflichtmodule DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Incoming → Compulsory Modules DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Outgoing → Pflichtmodule M.Sc. Water Resources Engineering and Management, PO 2012 → Vertiefungsmodule → Vertiefungsmodule Pflicht
11. Empfohlene Voraussetzungen:	Technical Mechanics • Introduction to the statics of rigid bodies • Introduction to elastostatics • Introduction to the mechanics of incompressible fluids Higher Mathematics • Partial differential equations • Vector analysis • Numerical integration Fundamentals of Flow Mechanics • Conservation equations for mass, momentum, energy • Navier-Stokes, Euler, Reynolds, Bernoulli equation
12. Lernziele:	Students have fundamental knowledge of flow in various natural hydrosystems and its application in civil and environmental engineering.
13. Inhalt:	The lecture deals with flow in natural hydrosystems with particular emphasis on groundwater / seepage flow and on flow in surface water / open channels. Groundwater hydraulics includes flow in confined, semi-confined and unconfined groundwater aquifers, wells, pumping tests and other hydraulic investigation methods for exploring groundwater aquifers. In addition, questions concerning regional groundwater

	management (z.B. recharge, unsaturated zone, saltwater intrusion) are discussed. Using the example of groundwater flow, fundamentals of CFD (Computational Fluid Dynamics) are explained, particularly the numerical discretisation techniques finite volume und finite difference. The hydraulics of surface water deals with shallow water equations / Saint Venant equations, unstationary channel flow, turbulence und layered systems. Calculation methods such as the methods of characteisitcs are explained. The contents are: • Potential flow and groundwater flow • Computational Fluid Dynamics • Shallow water equations for surface water • Charakteristikenmethode • Examples from civil and environmental engineering
14. Literatur:	Lecture notes: Hydromechanics, Helmig and Class Lecture notes: Ausbreitungs- und Transportvorgänge in Strömungen, Cirpka White, F.M.: Fluid Mechanics, WCB/McGraw-Hill, New York, 1999 Freeze, R.A. and Cherry J.A.: Groundwater, Prentice Hall, 1979
15. Lehrveranstaltungen und -formen:	• 500901 Lecture Environmental Fluid Mechanics I • 500902 Excersice Environmental Fluid Mechanics I
16. Abschätzung Arbeitsaufwand:	Sum 180 h
17. Prüfungsnummer/n und -name:	• 50091 Environmental Fluid Mechanics I (PL), schriftliche Prüfung, 120 Min., Gewichtung: 1.0 • V Vorleistung (USL-V), schriftliche Prüfung
18. Grundlage für ... :	
19. Medienform:	
20. Angeboten von:	

Modul: 50120 Environmental Informatics

2. Modulkürzel:	021430002	5. Moduldauer:	1 Semester
3. Leistungspunkte:	6.0 LP	6. Turnus:	jedes 2. Semester, WiSe
4. SWS:	4.0	7. Sprache:	Englisch

8. Modulverantwortlicher:	Prof.Dr.-Ing. Andras Bardossy
9. Dozenten:	Johannes Riegger
10. Zuordnung zum Curriculum in diesem Studiengang:	DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Incoming → Semi-Compulsory Modules DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Outgoing → Wahlmodule DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Incoming → Compulsory Modules DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Outgoing → Wahlmodule M.Sc. Water Resources Engineering and Management, PO 2012 → Spezialisierungsmodule M.Sc. Water Resources Engineering and Management, PO 2012 → Vertiefungsmodule → Vertiefungsmodule Wahlpflicht
11. Empfohlene Voraussetzungen:	
12. Lernziele:	Skills in Spreadsheet Calculations for Data Processing,Design, Creation, Handling and Application of Relational Database Management Systems for Environmental Issues, Creation and display of Environmental GIS data sets .Use of GIS functionalities to investigate spatial and attribute relationships
13. Inhalt:	**Information Processing & Environmental Data Management** (Excel & Access): Environmental Database Design, Relational Database Management, Data Normalization, Data Security **GIS Tools in Environmental Engineering (ArcGIS):** Basics of GIS, Data implementation, Spatial Structures and Attributes, Display of Environmental Information, Charts & Diagrams, Digitization, Spatial and Logical Queries, Data Links, Geo-Referencing, Field Calculations
14. Literatur:	Script: J. Riegger ‘Environmental Informatics’ User Handbooks for Excel, Access, ArcGIS **Getting to know ArcGIS Desktop ISBN: 9781589482609**
15. Lehrveranstaltungen und -formen:	• 501201 Lecture Environmental Data Management • 501202 Lecture GIS Tools in Environmental Engineering
16. Abschätzung Arbeitsaufwand:	Time of attendance: approx. 56 hours

	Private Study: approx. 124 hours during semester Sum: 180h
17. Prüfungsnummer/n und -name:	50121 Environmental Informatics (PL), schriftliche Prüfung, 120 Min., Gewichtung: 1.0
18. Grundlage für ... :	
19. Medienform:	
20. Angeboten von:	

Modul: 15150 Fuzzy Logic and Operation Research

2. Modulkürzel:	021430004	5. Moduldauer:	1 Semester
3. Leistungspunkte:	6.0 LP	6. Turnus:	jedes 2. Semester, SoSe
4. SWS:	4.0	7. Sprache:	Deutsch

8. Modulverantwortlicher:	Prof.Dr.-Ing. Andras Bardossy
9. Dozenten:	Andras Bardossy
10. Zuordnung zum Curriculum in diesem Studiengang:	DoubleM.D. Water Resources Engineering and Management, PO 2012 ➞ Chalmers ➞ Incoming ➞ Semi-Compulsory Modules M.Sc. Water Resources Engineering and Management, PO 2012 ➞ Spezialisierungsmodule
11. Empfohlene Voraussetzungen:	Modul Statistik und Informatik
12. Lernziele:	Die Studierenden sind mit den Grundlagen der Fuzzy-Modellierung wie Fuzzy Zahlen, Fuzzy Regeln, Fuzzy Sets, Membership Funktionen vertraut und können einfache auf Fuzzy-Logik basierende Modelle erstellen. Zudem kennen sie die Anwendungsmöglichkeiten von Fuzzy-Modellen ebenso wie deren Limitierungen. Die Studierenden erkennen die Problematik der Steuerung und Optimierung von komplexen Systemen für verschiedene Zielvorgaben. Sie beherrschen die grundlegenden Methoden der Systemsteuerung und können diese anwenden.
13. Inhalt:	**Fuzzy-Logic:** Um komplexe Prozesse und Zusammenhänge unserer Umwelt zu beschreiben und mögliche Folgen von Eingriffen abschätzen zu können, ist es notwendig, diese in mathematischen Modellen abzubilden. Fuzzy-Logik (oder Unscharfe-Logik) bietet einfache Werkzeuge, um derartige Modelle zu erstellen: Fuzzy-Sets, Membership Funktionen, Fuzzy Zahlen, Fuzzy Regeln **Operation Research:** Die Steuerung von Systemen mit komplexer Mehrfachzielsetzung ist eine Problemstellung wie sie beispielsweise auftritt bei der Steuerung von Wasserreservoirs, die für die Trinkwasserversorgung als auch den Hochwasserschutz eingesetzt werden. Die Optimierung der kombinierten Nutzung eines Wasserspeichers für verschiedene Wasserbereitstellungen mit unterschiedlicher Versorgungssicherheit ist ein weiteres Beispiel. Die Vorlesung gibt eine Einführung in die prinzipiellen Methoden der Systemsteuerung am Beispiel der Wasserwirtschaft.
14. Literatur:	Fuzzy rule based modeling with applications to geophysical, biological and engineering systems / András Bárdossy; Lucien Duckstein. - Boca Raton [u.a.] : CRC Press, 1995
15. Lehrveranstaltungen und -formen:	• 151501 Vorlesung Fuzzy Logic • 151502 Vorlesung Operation Research

16. Abschätzung Arbeitsaufwand:	Präsenzzeit:	40 h
	Selbststudium:	140 h
	Gesamt:	180 h
17. Prüfungsnummer/n und -name:	15151	Fuzzy Logic and Operation Research (PL), schriftliche Prüfung, 90 Min., Gewichtung: 1.0
18. Grundlage für ... :		
19. Medienform:		
20. Angeboten von:		

Modul: 50220 Groundwater and Resources Management

2. Modulkürzel:	021420016	5. Moduldauer:	2 Semester
3. Leistungspunkte:	6.0 LP	6. Turnus:	jedes 2. Semester, SoSe
4. SWS:	4.0	7. Sprache:	Englisch

8. Modulverantwortlicher:	Anne Weiß
9. Dozenten:	Frieder Haakh
10. Zuordnung zum Curriculum in diesem Studiengang:	DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Incoming → Semi-Compulsory Modules DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Incoming → Elective Moduls M.Sc. Water Resources Engineering and Management, PO 2012 → Spezialisierungsmodule
11. Empfohlene Voraussetzungen:	Recommended background knowledge: Technical Mechanics Introduction to the mechanics of incompressible fluids Higher Mathematics Partial differential equations Fluid Mechanics Groundwater flow, alllication of type-curves (Theis,..)
12. Lernziele:	Students know how groundwater resources are monitored and made accessible and how they should be protected to ensure sustainability with regard ot other stakeholders within the catchment area Qualification to start working in a water supply company or in the administration (dep. Water resources management) or consulting engineers
13. Inhalt:	Methods commonly used in practice for monitoring and exploring groundwater as well as making it accessible are presented. The contents are: Function and operation of monitoring wells Examples of bore hole geophysics Monitoring networks, operation and optimisation Building and operation of extraction wells (or well systems) Vertical wells Syphoning systems for water abstraction Pumping tests (design, interpretation) Conservation of ecvidence of impacts in environment (case study) Practical application of numerical models for solving water management questions (case studies) Environmental impact assessment for a groundwater extraction (case study) Groundwater protection Protection goals Threats to groundwater Water protection zones (purpose and demarcation) Water pollution control and agriculture in water-supply areas System analysis concerning groundwater management

	Extraction optimisation taking the interests of the various stakeholders into account“
14. Literatur:	Lecture notes by F. Haakh Script (compendium) “Grundwassererschließung und Grundwasserschutz” (about 375 pages) “Practical aspects of groundwater resources management” (about 275 pages) Excercises (via Mail)
15. Lehrveranstaltungen und -formen:	• 502201 Lecture Grundwassererschließung und Grundwasserschutz • 502202 Seminar practical aspects of groundwater resources management for drinking water supply
16. Abschätzung Arbeitsaufwand:	Sum: 180h
17. Prüfungsnummer/n und -name:	• 50221 Grundwassererschließung und Grundwasserschutz (BSL), schriftliche Prüfung, 120 Min., Gewichtung: 1.0 • 50222 Practical Aspects of Groundwater Resources Management (BSL), schriftliche Prüfung, 120 Min., Gewichtung: 1.0
18. Grundlage für ... :	
19. Medienform:	
20. Angeboten von:	

Modul: 50620 Hydraulic Structures

2. Modulkürzel:	021410106	5. Moduldauer:	2 Semester
3. Leistungspunkte:	6.0 LP	6. Turnus:	jedes 2. Semester, WiSe
4. SWS:	4.0	7. Sprache:	Englisch

8. Modulverantwortlicher:	Univ.-Prof.Dr. Silke Wieprecht
9. Dozenten:	Silke Wieprecht
10. Zuordnung zum Curriculum in diesem Studiengang:	DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Incoming → Semi-Compulsory Modules M.Sc. Water Resources Engineering and Management, PO 2012 → Vertiefungsmodule → Vertiefungsmodule Pflicht
11. Empfohlene Voraussetzungen:	
12. Lernziele:	**Advanced Studies in Hydraulic Structures:** The students… • Know about the basic features of hydraulic structures • have an overview what are the main components and know how to arrange them in order to ensure a satisfying operation • are able to dimension all parts of different hydraulic structures • are aware of implicating river works into an overall context of a fluvial system and know how to act and to evaluate in spatial and temporal interrelation • are able to realize the economic and ecologic significance of hydraulic structures as dams, reservoirs and hydro power plants **Case Study in Hydraulic Structures** : The students… • are able to use of the gained theoretical knowledge with the help of a practical example • are aware of the technical relations and their effects on non-technical areas of interest • can give a well-founded argumentation of chosen estimations and are able to present their own results • can give a convincing presentation • are able to assess objectively different planning alternatives
13. Inhalt:	**Advanced Studies in Hydraulic Structures** : The course deals with main structural components of hydraulic engineering schemes such as weirs, dams, hydro power plants, pipelines and ancillary works. The main features as hydraulic and structural dimensioning are treated. The application of structural power plants, reservoirs and river development works is discussed. Conventional engineering methods as well as approaches with improved environmental compatibility are taken into consideration. **Case Study in Hydraulic Structures** : The case study uses the content of the lecture „Advanced Studies in Hydraulic Structures“. In working groups of 3 to five students a real hydraulic structures will be planned and completely dimensioned. There are hydraulic calculations to be carried out as hydraulic capacity of spillway, dimensioning of stilling basin, hydrological and sedimentological calculations. As well the stabilities of

	the structures itself has to be checked. Additionally an analysis of the demand of potentially provided electricity, drinking water or irrigation water, resp. is required. The intermediate results will be presented by the groups. Every student has to deliver at least one presentation. Finally a poster for the final presentation and assessment has to be designed. This is the basis for the development of the assessment criteria for the different alternatives.
14. Literatur:	Lecture notes can be downloaded from the internet. Additional detailed information for the case study will be provided during the lectures.
15. Lehrveranstaltungen und -formen:	• 506201 Lecture and Practice Advanced Studies in Hydraulic Structures • 506202 Lecture and Presentation Case Study in Hydraulic Structures,
16. Abschätzung Arbeitsaufwand:	Sum 180h
17. Prüfungsnummer/n und -name:	50621 Hydraulic Structures (LBP), schriftliche Prüfung, Gewichtung: 1.0
18. Grundlage für ... :	
19. Medienform:	
20. Angeboten von:	

Modul: 19330 Industrial Waste Water

2. Modulkürzel:	021210151	5. Moduldauer:	1 Semester
3. Leistungspunkte:	6.0 LP	6. Turnus:	jedes 2. Semester, WiSe
4. SWS:	4.0	7. Sprache:	Englisch

8. Modulverantwortlicher:	Prof./Uni.Reg.deBlumenau Uwe Menzel
9. Dozenten:	• Uwe Menzel • Michael Koch
10. Zuordnung zum Curriculum in diesem Studiengang:	DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Incoming → Semi-Compulsory Modules DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Incoming → Compulsory Modules M.Sc. Water Resources Engineering and Management, PO 2012 → Spezialisierungsmodule
11. Empfohlene Voraussetzungen:	
12. Lernziele:	Students have: • a basic understanding for the problems and requirements of industrial waste water treatment • an overview of measures for production integrated environmental protection, relevant treatment methods for process water and its characterization • an overview of water analysis including sampling, the main principles of different analytical techniques and the ways to assure the quality of chemical analysis
13. Inhalt:	Fundamentals of industrial waste water treatment Determiniation of current situation possible process integrated measures measures for reuse and recirculation of water mass and concentration balance Basic elements and examples for applications to the advanced purification processes: biological waste water treatment Sampling and analytical techniques using: onsite measurements oxidation - reduction acids and bases sum parameters photometry spectrometry chromatography Analytical quality assurance
14. Literatur:	-lecture notes (approx. 400 pages) -exercisis -Lehr- und Handbuch der Abwassertechnik, 4. revised edition, volume I. GFA-Verlag St. Augustin 1994. -ATV V: Lehr- und Handbuch der Abwassertechnik, volume v: Organisch verschmutzte Abwässer der Lebensmittelindustrie, Wilhelm Ernst & Sohn Verlag, Berlin. -ATV VII: Lehr- und Handbuch der Abwassertechnik, volume VII: Industrieabwässer mit anorganischen Inhaltsstoffen, Wilhelm Ernst & Sohn Verlag, Berlin. (in each case the current edition) -Deutsche Einheitsverfahren zur Wasser-, Abwasser und Schlammuntersuchung -Standard Methods for the Examination of Water and Wastewater -Wenclawiak, Koch, Hajicostas: Quality Assurance in Analytical Chemistry. Springerverlag 2003
15. Lehrveranstaltungen und -formen:	• 193301 Lecture Treatment of Industrial Waste Water • 193302 Lecture Water Analysis and Analytical Quality Control

16. Abschätzung Arbeitsaufwand:	Time of attendance: I Treatment of Industrial Waste Water: 2 SWS = 24 hours II Water Analysis and Analytical Quality Control: 2 SWS = 24 hours Exam: 2 hours sum of attendance: 50 hours self-study: 130 hours **total: 180 hours**
17. Prüfungsnummer/n und -name:	19331 Industrial Waste Water (PL), schriftliche Prüfung, 120 Min., Gewichtung: 1.0
18. Grundlage für ... :	
19. Medienform:	power-point-presentation, blackboard and over-head projector
20. Angeboten von:	Institut für Siedlungswasserbau, Wassergüte- und Abfallwirtschaft

220 Outgoing

Zugeordnete Module:
221 Pflichtmodule
222 Wahlmodule

221 Pflichtmodule

Zugeordnete Module:

19100	Chemistry and Biology for Environmental Engineers
19120	Sanitary Engineering
19150	German as a Foreign Language
19310	Urban Drainage and Design of Wastewater Treatment Plants
50090	Environmental Fluid Mechanics I
50110	Requirements of Professional Life and Engineering in Practise
56000	Requirements of Professional Life and Engineering in Practise 2

Modul: 19100 Chemistry and Biology for Environmental Engineers

2. Modulkürzel:	021230502	5. Moduldauer:	1 Semester
3. Leistungspunkte:	6.0 LP	6. Turnus:	unregelmäßig
4. SWS:	6.0	7. Sprache:	-

8. Modulverantwortlicher:	Univ.-Prof.Dr. Jörg Metzger
9. Dozenten:	• Jörg Metzger • Karl Heinrich Engesser • Brigitte Schwederski • Bertram Kuch • Daniel Dobslaw
10. Zuordnung zum Curriculum in diesem Studiengang:	DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Incoming → Semi-Compulsory Modules DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Outgoing → Pflichtmodule DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Incoming → Elective Moduls DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Outgoing → Pflichtmodule M.Sc. Water Resources Engineering and Management, PO 2012 → Spezialisierungsmodule M.Sc. Water Resources Engineering and Management, PO 2012 → Vertiefungsmodule → Vertiefungsmodule Wahlpflicht
11. Empfohlene Voraussetzungen:	
12. Lernziele:	**Lecture: Inorganic chem istry** The students • know the fundamental concepts of chemistry (atomic structure, periodic system, chemical formulae, stoichiometry, molecular structures) and are able to use them, • know the principle types of chemical substances and chemical reactions and can apply their knowledge to synthetic problems, • know about the most important industrial compounds, their preparation and environmental aspects in their application. **Lecture: Organic chemistry** The students

- can identify important functional groups in organic molecules

- know the main compound classes in organic chemistry and the common rules for their nomenclature

- know the most important representatives thereof and

  are able to draw their structural formulae

- know the structure and properties of important bio-molecules such as fats, carbohydrates, proteins, nucleic acids, ATP, lignin and humic acids

- know the most important reactions involved in chemical and microbial degradation of organic matter

- know summary parameters used to characterize water quality

- know the properties of bio-molecules and can explain their general function with respect to cell structures, enzymatic and immune reactions

- knows selected environmental organic contaminants (PAH, dioxins, pesticides etc.) and their properties

Lecture: Biology and ecology of water, soil and air systems

The students

- know about the relation between water, soil and air compartments and many diseases, happening especially in developing countries

- know about the reasons for break out of diseases, the structure and function of prokaryotic and eucaryotic cells as well as the methods for identification and determination of growth conditions and possible growth limitations

- comprehend microbial metabolism, energy production, release and conservation, enzyme syntheses and their regulation.

- know important events and scientists in the history of biology

- know basics in ecology of natural and artificial ('technical') ecosystems as well as selected methods to detect distorted equilibria in technical ecosystems influenced by mankind

Lecture: Technical and medical microbiology for engineers

The students

- know the most important microorganisms being active in plants treating waste water, air and contaminated soil

- know the kind of participation in purification and thus the procedures used to make them feel happy as well as the problems associated with excess biomass

- are aware of a detailed overview of the kind of medically important microorganisms and of the most relevant agents of illness met in these plants; this holds also for the compartments 'drinking water' and 'sewage sludge'.

13. Inhalt:

Lecture: Inorganic chemistry

- atomic structure: stable nuclear particles, atomic nuclei, isotopes and radioactivity, atomic spectra and the hydrogen atom, heavier atoms
- the periodic system of the elements: the sequence of elements, the electronic configuration of some elements, the periodicity of some properties
- chemical bonding: the ionic bond, the metallic bond, the covalent bond, hydrogen bonding, van der Waals forces
- quantitative Relationships and Stoichiometric Equations
- characterizing chemical reactions: the chemical equilibrium, water: the solvent, acid/base reactions, redox reactions
- descriptive part: selected chemical compounds and their preparation and properties

Lecture: Organic chemistry

- functional groups and compound classes
- classification of chemical reactions in organic chemistry
- organic bio-molecules (e.g. proteins, carbohydrates, nucleic acids, fats, humic acids, lignin): structure and function
- chemical and microbial degradation of organic matter in the environment
- summary parameters
- organic environmental contaminants

Lecture: Biology and ecology of water, soil and air systems

The following topics are presented within the lecture:

- Introduction in history of microbiology
- Important waterbased/water related diseases
- Function of microscopy of staining techniques
- Structure and function of prokaryotic cells
- Structure and function of eucaryotic cells
- Necessity and effects of microbial nutrition
- Microbial growth relations and possible limitations
- Microbial metabolism: Energy production, conservation and release
- Microbial metabolism: Enzymes syntheses and regulation.

Lecture: Technical and medical microbiology for engineers

- Important (sewage) water based /water related diseases/detection and possible countermeasures

- Important soil and air connected diseases
- (micro)biological principles in application of engineering techniques
- Implication of engineer work on ecosystems /environment protection problems

Some test systems for estimation of (bio)degradability of chemicals will be evaluated

14. Literatur:	Lecture notes pdf download of powerpoint slides for lectures Exercises as hand-out or download (pdf)
15. Lehrveranstaltungen und -formen:	• 191001 Lecture Inorganic chemistry • 191002 Lecture Organic chemistry • 191003 Lecture Biology and ecology of water, soil and air systems • 191004 Lecture Technical and medical microbiology for engineers
16. Abschätzung Arbeitsaufwand:	Time of attendance: Inorganic chemistry (Schwederski): Lecture, 1 SWS = 14 hours Organic chemistry (Metzger/Kuch): Lecture, 1 SWS = 14 hours Biology and ecology of water, soil and air systems (Engesser): Lecture, 1 SWS = 14 hours Technical and medical microbiology for engineers (Engesser): Lecture, 1 SWS = 14 hours Exercises for Chemistry and Biology for environmental engineers, 2 SWS = 28 hours Exam: 2 hours Sum of attendance: 86 hours Exercises (group work with presentations): 28 hours Self -study: 94 hours:
17. Prüfungsnummer/n und -name:	19101 Chemistry and Biology for Environmental Engineers (PL), schriftlich oder mündlich, 120 Min., Gewichtung: 1.0
18. Grundlage für ... :	
19. Medienform:	Video projector (powerpoint) presentation explanations on blackboard, group work with presentations
20. Angeboten von:	Hydrochemie und Hydrobiologie in der Siedlungswasserwirtschaft

Modul: 50090 Environmental Fluid Mechanics I

2. Modulkürzel:	021420012	5. Moduldauer:	1 Semester
3. Leistungspunkte:	6.0 LP	6. Turnus:	jedes 2. Semester, WiSe
4. SWS:	5.0	7. Sprache:	Englisch

8. Modulverantwortlicher:	Prof.Dr.-Ing. Rainer Helmig
9. Dozenten:	• Jürgen Braun • Holger Class • Wolfgang Nowak
10. Zuordnung zum Curriculum in diesem Studiengang:	DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Incoming → Semi-Compulsory Modules DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Outgoing → Pflichtmodule DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Incoming → Compulsory Modules DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Outgoing → Pflichtmodule M.Sc. Water Resources Engineering and Management, PO 2012 → Vertiefungsmodule → Vertiefungsmodule Pflicht
11. Empfohlene Voraussetzungen:	Technical Mechanics • Introduction to the statics of rigid bodies • Introduction to elastostatics • Introduction to the mechanics of incompressible fluids Higher Mathematics • Partial differential equations • Vector analysis • Numerical integration Fundamentals of Flow Mechanics • Conservation equations for mass, momentum, energy • Navier-Stokes, Euler, Reynolds, Bernoulli equation
12. Lernziele:	Students have fundamental knowledge of flow in various natural hydrosystems and its application in civil and environmental engineering.
13. Inhalt:	The lecture deals with flow in natural hydrosystems with particular emphasis on groundwater / seepage flow and on flow in surface water / open channels. Groundwater hydraulics includes flow in confined, semi-confined and unconfined groundwater aquifers, wells, pumping tests and other hydraulic investigation methods for exploring groundwater aquifers. In addition, questions concerning regional groundwater

	management (z.B. recharge, unsaturated zone, saltwater intrusion) are discussed. Using the example of groundwater flow, fundamentals of CFD (Computational Fluid Dynamics) are explained, particularly the numerical discretisation techniques finite volume und finite difference. The hydraulics of surface water deals with shallow water equations / Saint Venant equations, unstationary channel flow, turbulence und layered systems. Calculation methods such as the methods of characteisitcs are explained. The contents are: • Potential flow and groundwater flow • Computational Fluid Dynamics • Shallow water equations for surface water • Charakteristikenmethode • Examples from civil and environmental engineering
14. Literatur:	Lecture notes: Hydromechanics, Helmig and Class Lecture notes: Ausbreitungs- und Transportvorgänge in Strömungen, Cirpka White, F.M.: Fluid Mechanics, WCB/McGraw-Hill, New York, 1999 Freeze, R.A. and Cherry J.A.: Groundwater, Prentice Hall, 1979
15. Lehrveranstaltungen und -formen:	• 500901 Lecture Environmental Fluid Mechanics I • 500902 Excersice Environmental Fluid Mechanics I
16. Abschätzung Arbeitsaufwand:	Sum 180 h
17. Prüfungsnummer/n und -name:	• 50091 Environmental Fluid Mechanics I (PL), schriftliche Prüfung, 120 Min., Gewichtung: 1.0 • V Vorleistung (USL-V), schriftliche Prüfung
18. Grundlage für ... :	
19. Medienform:	
20. Angeboten von:	

Modul: 19150 German as a Foreign Language

2. Modulkürzel:	SZ	5. Moduldauer:	1 Semester
3. Leistungspunkte:	6.0 LP	6. Turnus:	unregelmäßig
4. SWS:	8.0	7. Sprache:	-

8. Modulverantwortlicher:	John Nixon
9. Dozenten:	
10. Zuordnung zum Curriculum in diesem Studiengang:	DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Outgoing → Pflichtmodule DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Outgoing → Pflichtmodule M.Sc. Water Resources Engineering and Management, PO 2012 → Deutschkurse
11. Empfohlene Voraussetzungen:	
12. Lernziele:	
13. Inhalt:	
14. Literatur:	
15. Lehrveranstaltungen und -formen:	• 191501 Seminar German as a Foreign Language I • 191502 Seminar German as a Foreign Language II
16. Abschätzung Arbeitsaufwand:	
17. Prüfungsnummer/n und -name:	• 19151 German as a Foreign Language I (PL), schriftlich oder mündlich, Gewichtung: 1.0 • 19152 German as a Foreign Language II (PL), schriftlich oder mündlich, Gewichtung: 1.0
18. Grundlage für ... :	
19. Medienform:	
20. Angeboten von:	

Modul: 50110 Requirements of Professional Life and Engineering in Practise

2. Modulkürzel:	021410901	5. Moduldauer:	3 Semester
3. Leistungspunkte:	3.0 LP	6. Turnus:	jedes Semester
4. SWS:	2.0	7. Sprache:	Englisch

8. Modulverantwortlicher:	Anne Weiß
9. Dozenten:	
10. Zuordnung zum Curriculum in diesem Studiengang:	DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Outgoing → Pflichtmodule DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Outgoing → Pflichtmodule M.Sc. Water Resources Engineering and Management, PO 2012 → Vertiefungsmodule → Vertiefungsmodule Pflicht
11. Empfohlene Voraussetzungen:	
12. Lernziele:	• Capability to summarize a water-related topic or the investigations of a scientific, water related problem in terms of two 20 min presentations, discussion on the topic after presenting. • Ability to participate in a scientific discussion, asking questions to presenters. • Writing a summary of a visit at a technical site, condense information to a short report.
13. Inhalt:	• Treatment of a water related topic or a recent scientific problem in an international research environment. • The successful treatment of the scientific problem requires the specialisation in the related field of research and the acquisition of the necessary knowledge.
14. Literatur:	Recent literature on the water related topic/ scientific problem,.
15. Lehrveranstaltungen und -formen:	• 501101 Seminar Requirements of Professional Life and Engineering in Practise • 501102 Excursion Requirements of Professional Life and Engineering in Practise
16. Abschätzung Arbeitsaufwand:	90 h (Contact time: 70 h)
17. Prüfungsnummer/n und -name:	50111 Requirements of Professional Life and Engineering in Practise (USL), schriftliche Prüfung, Gewichtung: 1.0
18. Grundlage für ... :	
19. Medienform:	
20. Angeboten von:	

Modul: 56000 Requirements of Professional Life and Engineering in Practise 2

2. Modulkürzel:	Warem	5. Moduldauer:	1 Semester
3. Leistungspunkte:	3.0 LP	6. Turnus:	unregelmäßig
4. SWS:	0.0	7. Sprache:	-

8. Modulverantwortlicher:	Anne Weiß
9. Dozenten:	
10. Zuordnung zum Curriculum in diesem Studiengang:	DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Outgoing → Pflichtmodule DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Outgoing → Pflichtmodule
11. Empfohlene Voraussetzungen:	
12. Lernziele:	
13. Inhalt:	
14. Literatur:	
15. Lehrveranstaltungen und -formen:	
16. Abschätzung Arbeitsaufwand:	
17. Prüfungsnummer/n und -name:	56001 Requirements of Professional Life and Engineering in Practise 2 (USL), schriftliche Prüfung, Gewichtung: 1.0
18. Grundlage für ... :	
19. Medienform:	
20. Angeboten von:	

Modul: 19120 Sanitary Engineering

2. Modulkürzel:	021220012	5. Moduldauer:	1 Semester
3. Leistungspunkte:	6.0 LP	6. Turnus:	jedes 2. Semester, WiSe
4. SWS:	4.0	7. Sprache:	Englisch

8. Modulverantwortlicher:	Dr.-Ing. Klaus Fischer
9. Dozenten:	• Klaus Fischer • Heidrun Steinmetz
10. Zuordnung zum Curriculum in diesem Studiengang:	DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Outgoing → Pflichtmodule DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Outgoing → Pflichtmodule M.Sc. Water Resources Engineering and Management, PO 2012 → Vertiefungsmodule → Vertiefungsmodule Pflicht
11. Empfohlene Voraussetzungen:	
12. Lernziele:	The students have detailed knowledge about waste avoidance procedures in household and industry. Waste avoidance includes the ecology - oriented daily shopping, the substitution of contaminated materials in the industrial production as well as the Zero Emission Society. In the case of unavoidable waste fractions, the students acquire the competence to establish collection and transportation systems for these wastes, within the logistic, economic and legal frame. Main emphasis is given to the collection of recyclables. The students know the relevant factors which influence the waste amount and waste composition in general and in particular within the separate collection of recyclables. The students are acquainted with the state of the art of recycling technologies for separate collected paper, glass, metal and plastic including the pretreatment process. They have knowledge of the aerobic and anaerobic treatment and utilization of separate collected biowaste. Not avoided and recycled waste has to be treated before disposing off e.g. in a landfill site. The students possess a general knowledge of the mechanical and biological treatment technology as well as of the thermal waste treatment. They are able to evaluate the different treatment and recycling processes from an ecological and economic point of view. The students have knowledge about the most important components of the urban drainage and the basic treatment processes of wastewater. Thus they are able to compare different systems in dependence of changing boundary conditions and assess the effectiveness and pros and cons of the systems, e.g. concerning impacts on the environment, economical and operational aspects. They obtain an understanding for system connections between the urban drainage system and the wastewater treatment system as well as between the urban water system and the environment.
13. Inhalt:	Solid Waste Management: • Waste generation and waste composition • National and international regulations for waste • Waste avoidance

	• Collection and transport of waste • Separate collection of recyclables • Sorting of recyclables • Recycling technologies for paper, glass, metal, plastic • Biological treatment of waste • Waste Disposal • Ecological indicator systems Waste Water Technology: • Basics of urban drainage and municipal wastewater treatment • Quantity and Composition of Wastewater • Urban drainage systems • stormwater treatment • mechanical wastewater treatment • biological wastewater treatment • sludge treatment • natural close and ECOSAN systems
14. Literatur:	Lecture Manuscripts Solid Waste Management G. Tchobanoglous et. Al.: Handbook of solid waste management; Bililteski, B. et.al.: Waste Management, Springer 1994 ISBN: 3-540-59210-5 Butler, D., Davies, J.W: .Urban drainage, Spon press London, Henze, M., Harremoes, J., la Coour Jansen, J., Arvin, E: Wastewater treatment. Springer Verlag Berlin
15. Lehrveranstaltungen und -formen:	• 191201 Vorlesung Solid Waste Management • 191202 Vorlesung Waste Water • 191203 Exkursion Sanitary Engineering
16. Abschätzung Arbeitsaufwand:	Time of attendance: I Solid Waste Management, lecture: 2.0 SWS = 28 hours II Waste Water: 2 SWS = 28 hours excursion: 12 hours exam: 2 hours sum of attendance: 70 hours self-study: 110 hours total: 180 hours
17. Prüfungsnummer/n und -name:	• 19121 Solid Waste Management and Waste Water Technology (PL), schriftliche Prüfung, 120 Min., Gewichtung: 1.0 • V Vorleistung (USL-V), schriftlich, eventuell mündlich
18. Grundlage für ... :	• 19310 Urban Drainage and Design of Wastewater Treatment Plants • 19330 Industrial Waste Water
19. Medienform:	
20. Angeboten von:	

Modul: 19310 Urban Drainage and Design of Wastewater Treatment Plants

2. Modulkürzel:	021210251	5. Moduldauer:	-
3. Leistungspunkte:	6.0 LP	6. Turnus:	unregelmäßig
4. SWS:	5.0	7. Sprache:	-

8. Modulverantwortlicher:	Univ.-Prof.Dr.-Ing. Heidrun Steinmetz
9. Dozenten:	
10. Zuordnung zum Curriculum in diesem Studiengang:	DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Outgoing → Pflichtmodule DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Outgoing → Pflichtmodule M.Sc. Water Resources Engineering and Management, PO 2012 → Spezialisierungsmodule M.Sc. Water Resources Engineering and Management, PO 2012 → Vertiefungsmodule → Vertiefungsmodule Wahlpflicht
11. Empfohlene Voraussetzungen:	
12. Lernziele:	
13. Inhalt:	
14. Literatur:	
15. Lehrveranstaltungen und -formen:	• 193101 Vorlesung und Übung Design of Sewer System and Stormwater Treatment • 193102 Vorlesung und Übung Design of Wastewater Treatment Plants • 193103 Seminar Case Study • 193104 Exkursion
16. Abschätzung Arbeitsaufwand:	
17. Prüfungsnummer/n und -name:	19311 Urban Drainage and Design of Wastewater Treatment Plants (PL), schriftliche Prüfung, 120 Min., Gewichtung: 1.0
18. Grundlage für ... :	
19. Medienform:	
20. Angeboten von:	

222 Wahlmodule

Zugeordnete Module:
15160 Water and Power Supply
34420 Regional and Urban Planning II
50120 Environmental Informatics
50130 Integrated Watershed Modeling
50190 Geohydrological Modelling I and II
50330 Regional and Urban Planning I

Modul: 50120 Environmental Informatics

2. Modulkürzel:	021430002	5. Moduldauer:	1 Semester
3. Leistungspunkte:	6.0 LP	6. Turnus:	jedes 2. Semester, WiSe
4. SWS:	4.0	7. Sprache:	Englisch

8. Modulverantwortlicher:	Prof.Dr.-Ing. Andras Bardossy
9. Dozenten:	Johannes Riegger
10. Zuordnung zum Curriculum in diesem Studiengang:	DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Incoming → Semi-Compulsory Modules DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Outgoing → Wahlmodule DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Incoming → Compulsory Modules DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Outgoing → Wahlmodule M.Sc. Water Resources Engineering and Management, PO 2012 → Spezialisierungsmodule M.Sc. Water Resources Engineering and Management, PO 2012 → Vertiefungsmodule → Vertiefungsmodule Wahlpflicht
11. Empfohlene Voraussetzungen:	
12. Lernziele:	Skills in Spreadsheet Calculations for Data Processing,Design, Creation, Handling and Application of Relational Database Management Systems for Environmental Issues, Creation and display of Environmental GIS data sets .Use of GIS functionalities to investigate spatial and attribute relationships
13. Inhalt:	**Information Processing & Environmental Data Management** (Excel & Access): Environmental Database Design, Relational Database Management, Data Normalization, Data Security **GIS Tools in Environmental Engineering (ArcGIS):** Basics of GIS, Data implementation, Spatial Structures and Attributes, Display of Environmental Information, Charts & Diagrams, Digitization, Spatial and Logical Queries, Data Links, Geo-Referencing, Field Calculations
14. Literatur:	Script: J. Riegger ‘Environmental Informatics’ User Handbooks for Excel, Access, ArcGIS **Getting to know ArcGIS Desktop ISBN: 9781589482609**
15. Lehrveranstaltungen und -formen:	• 501201 Lecture Environmental Data Management • 501202 Lecture GIS Tools in Environmental Engineering
16. Abschätzung Arbeitsaufwand:	Time of attendance: approx. 56 hours

	Private Study: approx. 124 hours during semester Sum: 180h
17. Prüfungsnummer/n und -name:	50121 Environmental Informatics (PL), schriftliche Prüfung, 120 Min., Gewichtung: 1.0
18. Grundlage für ... :	
19. Medienform:	
20. Angeboten von:	

Modul: 50190 Geohydrological Modelling I and II

2. Modulkürzel:	021430007	5. Moduldauer:	1 Semester
3. Leistungspunkte:	6.0 LP	6. Turnus:	jedes 2. Semester, WiSe
4. SWS:	4.0	7. Sprache:	Englisch

8. Modulverantwortlicher:	Prof.Dr.-Ing. Andras Bardossy
9. Dozenten:	Johannes Riegger
10. Zuordnung zum Curriculum in diesem Studiengang:	DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Outgoing → Wahlmodule DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Outgoing → Wahlmodule M.Sc. Water Resources Engineering and Management, PO 2012 → Spezialisierungsmodule
11. Empfohlene Voraussetzungen:	Contents of Geohydrology and Geoengineering
12. Lernziele:	• Setup of a Geohydrological Model • Spatial and temporal Discretization (Stability Criteria) • Adequate Transfer of Nature into a Model • Simplification of complex Geohydrological Systems • Choice of adequate Numerical Scheme • Unique Calibration of Flow and Transport • Assessment of Geohydrological Model Approaches and Model Realizations
13. Inhalt:	Geohydrological Modelling 1: Groundwater Flow, Conceptual Model, Numerical Model, Modelling of Natural Systems, Calibration Process, Sensitivity Analysis, Model Verification and Validation. Geohydrological Modelling 2: Complex & Transient Systems, 3D-Flow, Fractured Systems, Double Porosity, Advective and Dispersive Transport, Numerical Methods for Transport, Stability Criteria, Chemical Reactions, Measurement of Transport Parameters, Transport Calibration
14. Literatur:	Script: J. Riegger ‘Geohydrological Modelling’ Anderson & Woessner ‘Applied Groundwater Modelling’ Spitz & Moreno : ‘A Practical Guide to Groundwater and Solute Transport Modeling’ Freeze & Cherry: ‘Groundwater’
15. Lehrveranstaltungen und -formen:	• 501901 Lecture Geohydrological Modelling 1 • 501902 Lecture Geohydrological Modelling 2
16. Abschätzung Arbeitsaufwand:	Sum: 180h
17. Prüfungsnummer/n und -name:	• 50191 Geohydrological Modelling I and II (PL), schriftliche Prüfung, 120 Min., Gewichtung: 1.0 • 50192 Geohydrological Modelling I and II (USL), schriftliche Prüfung, Gewichtung: 1.0
18. Grundlage für ... :	

19. Medienform:

20. Angeboten von:

Modul: 50130 Integrated Watershed Modeling

2. Modulkürzel:	021430009	5. Moduldauer:	1 Semester
3. Leistungspunkte:	6.0 LP	6. Turnus:	jedes 2. Semester, SoSe
4. SWS:	4.0	7. Sprache:	Deutsch

8. Modulverantwortlicher:	Prof.Dr.-Ing. Andras Bardossy
9. Dozenten:	• Johannes Riegger • Andras Bardossy
10. Zuordnung zum Curriculum in diesem Studiengang:	DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Outgoing → Wahlmodule DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Outgoing → Wahlmodule M.Sc. Water Resources Engineering and Management, PO 2012 → Spezialisierungsmodule M.Sc. Water Resources Engineering and Management, PO 2012 → Vertiefungsmodule → Vertiefungsmodule Wahlpflicht
11. Empfohlene Voraussetzungen:	Recommended background knowledge: Basic knowledge of hydrology and geohydrology Prerequisite module: none
12. Lernziele:	**Hydrological Modeling:** Construction of models for each part in the runoff process and how these models are used and integrated in different environment management systems. **Integrated model systems for the groundwater management:** Design of hydrogeological databases, visualization of data, GIS-Operations for the groundwater and hydrological modeling, Geostatistic, stochastic modeling, Monte Carlo Methods.
13. Inhalt:	**Hydrological Modeling:** What happens to the rain? This is the basic question that needs to be addressed in order to predict the amount of discharge at a certain location in a river system at a given time. Which parts of the fate of rainfall can be determined on a physical basis, and which are still left to empirical searching? Beside the qualitative determination of e.g. the processes of evapotranspiration, infiltration, interflow etc. we also need to describe the quantities of these processes to be able to forecast e.g. flood events. Hydrological watershed modelling is fundamental to integrated water management. There are complex interactions between the elements of the environmental continuum. In order to predict future behaviour and to quantify effects of management changes, quantitative mathematical descriptions are needed. A number of advanced hydrological watershed models have been developed in the last 30 years. A few of them will be reviewed in terms of their data needs and there predictive power. The participants are encouraged to form groups and to use their selected models for the same catchment so that the different approaches are compared.

	Integrated model systems for the groundwater management: Modern integrated model systems require techniques for the efficient construction of ground water models and their integration in “Decision Support Systems” as well as strategies for the handling of uncertainties. The course will discuss the specific “GIS-Methods” that are important for the integrations of databases, the visualization of data and the calculation of spatial data like ground water recharge. Special focus is laid on GIS supported hydrological modeling of the ground water recharge and the runoff parameters as well as adequate choice of the hydrological model concepts for the calculation of the local water balance in different data situations. To handle the model uncertainties, geostatistic methods and associated stochastic modeling attempts like the “Monte Carlo Simulation” will be mentioned.
14. Literatur:	Hydrological Modeling: Beven, K.J., 2000. Rainfall-Runoff Modelling: The Primer. Wiley, 360pp. Singh, V.P. (Ed.), 1995. Computer Models of Watershed Hydrology. Water Resource Publications, Littleton, Colorado, USA.
15. Lehrveranstaltungen und -formen:	• 501301 Lecture and excercise Hydrological Modeling • 501302 Lecture and excercise Integrated model systems for the groundwater management
16. Abschätzung Arbeitsaufwand:	Sum: 180h
17. Prüfungsnummer/n und -name:	50131 Integrated Watershed Modeling (PL), schriftliche Prüfung, 150 Min., Gewichtung: 1.0
18. Grundlage für ... :	
19. Medienform:	
20. Angeboten von:	

Modul: 50330 Regional and Urban Planning I

2. Modulkürzel:	021100010	5. Moduldauer:	1 Semester
3. Leistungspunkte:	6.0 LP	6. Turnus:	jedes 2. Semester, WiSe
4. SWS:	4.0	7. Sprache:	Englisch

8. Modulverantwortlicher:	Dr.-Ing. Richard Junesch
9. Dozenten:	• Richard Junesch • Nina Gribat
10. Zuordnung zum Curriculum in diesem Studiengang:	DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Outgoing → Wahlmodule DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Outgoing → Wahlmodule M.Sc. Water Resources Engineering and Management, PO 2012 → Spezialisierungsmodule
11. Empfohlene Voraussetzungen:	
12. Lernziele:	The students understand the major challenges, objectives, strategies and instruments in spatial planning and urban development in Europe as well as in developing countries. The students are acquainted with the legal framework of comprehensive and sector planning and know the capabilities and limits of public planning as “positive” and “negative” planning.
13. Inhalt:	The course Regional Planning I covers the following topics: • Overview on current planning issues • Basic Terms of Spatial Planning • Strategies in Spatial Planning • Instruments of Spatial Planning • Performance of Plans, Assessing Plans The course Urban Planning I provides an overview on the origin of planned urban development, starting in Greece and the Roman Empire, passing through all important periods up to the 21st century. The second part introduces urbanisation processes in third world countries, planned and unplanned urban conglomerations, including Mega Cities and Global Cities.
14. Literatur:	Berke, P.R. et al. (2006): Urban Land Use Planning. Urbana/Chicago: University of Illinois Press Hall, P. (2002): Urban and Regional Planning. New York: Routledge
15. Lehrveranstaltungen und -formen:	• 503301 Lecture Regional Planning I • 503302 Lecture Urban Planning I
16. Abschätzung Arbeitsaufwand:	Time of attendance: approx. 45 hours Private Study: approx.135 hours
17. Prüfungsnummer/n und -name:	50331 Regional and Urban Planning I (PL), schriftliche Prüfung, Gewichtung: 1.0
18. Grundlage für ... :	

19. Medienform:

20. Angeboten von:

Modul: 34420 Regional and Urban Planning II

2. Modulkürzel:	-	5. Moduldauer:	1 Semester
3. Leistungspunkte:	6.0 LP	6. Turnus:	jedes 2. Semester, SoSe
4. SWS:	4.0	7. Sprache:	Englisch

8. Modulverantwortlicher:	Dr.-Ing. Richard Junesch
9. Dozenten:	• Stefan Fina • Nina Gribat
10. Zuordnung zum Curriculum in diesem Studiengang:	DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Outgoing → Wahlmodule DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Outgoing → Wahlmodule M.Sc. Water Resources Engineering and Management, PO 2012 → Spezialisierungsmodule
11. Empfohlene Voraussetzungen:	prerequisite modules: Regional and Urban Planning I
12. Lernziele:	The students are acquainted with basic methods of analysis and assessment in spatial planning. The students are able to cope with function, prerequisites and methodical problems of the methods presented.The lectures demonstrate the usage of planning instruments and methods based on planning cases from Germanyand other countries.
13. Inhalt:	The course Regional Planning II deals with the following planning methods: • Indicator-based monitoring and evaluation methods • Multi-criteria decision analysis (e.g. cost-benefit analysis, utility value analyis, analytic hierarchy process) • Methods of impact assessment • Techniques of demand forecast and land suitability analysis • Hazard and vulnerability analysis (climate change adaptation) The course Urban Planning II gives an overview on: • Levels of spatial planning in urban areas • Urban development planning • Urban analysis • Urban renewal • Urban planning instruments • Land use planning and implementation planning • Legal framework
14. Literatur:	Skript "Regional and Urban Planning II"
15. Lehrveranstaltungen und -formen:	• 344201 Vorlesung Regional Planning II • 344202 Vorlesung Urban Planning II
16. Abschätzung Arbeitsaufwand:	Time of attendance: approx.45hours Private Study: approx. 120 hours

17. Prüfungsnummer/n und -name:	• 34421 Regional Planning II (PL), schriftliche Prüfung, 60 Min., Gewichtung: 1.0 • 34422 Urban Planning II (PL), schriftliche Prüfung, 60 Min., Gewichtung: 1.0
18. Grundlage für ... :	
19. Medienform:	Optional
20. Angeboten von:	

Modul: 15160 Water and Power Supply

2. Modulkürzel:	021410105	5. Moduldauer:	1 Semester
3. Leistungspunkte:	6.0 LP	6. Turnus:	jedes 2. Semester, WiSe
4. SWS:	0.0	7. Sprache:	Englisch

8. Modulverantwortlicher:	Markus Noack
9. Dozenten:	• Ralf Minke • Markus Noack
10. Zuordnung zum Curriculum in diesem Studiengang:	DoubleM.D. Water Resources Engineering and Management, PO 2012 → Chalmers → Outgoing → Wahlmodule DoubleM.D. Water Resources Engineering and Management, PO 2012 → Mara → Outgoing → Wahlmodule M.Sc. Water Resources Engineering and Management, PO 2012 → Spezialisierungsmodule M.Sc. Water Resources Engineering and Management, PO 2012 → Vertiefungsmodule → Vertiefungsmodule Wahlpflicht
11. Empfohlene Voraussetzungen:	None
12. Lernziele:	**Power Demand, Supply and Distribution:** The students… • know the German, European and worldwide energy markets related to demand, supply and its distribution capabilities • are aware of that non-renewable energy sources are strictly limited and time-scales for conversion of energy markets long • have an idea about the relations between energy, politics, social changes and influences on environment • have a basic knowledge about present energy conversion systems, theoretical limits of efficiencies, and the potential to enhance applied technology • have a basic understanding about where and how energy is provided and distributed • comprehend the balance between load and supply in electrical grids and the resulting necessity for control energy. **Water Demand, Supply and Distribution:** The students… • know the German and worldwide water systems related to demand, supply and its distribution capabilities • have an overview on the water supply situation all over the world. • recognize the different possibilities and levels of water supply • have an idea of the relations between water, politics, social changes and influences on environment.
13. Inhalt:	**Power Demand, Supply and Distribution:**

- Energy demand, energy supply
- Energy generation
  - overview of different types of power plants
  - renewable energy
  - thermal power plants (conventional and nuclear)
- Areas of application of different power plants
- Emission control techniques
- Cooling of thermal power plants
  - methods
  - water resources aspects
- Energy transport and energy storage
- Net techniques
- Energy market
  - trade
  - politics
  - law
- social changes due to energy supply

Water Demand, Supply and Distribution:

- Water supply and water distribution: necessity, basic requirements, elements, hydrological cycle
- Water demand calculation: water consumption, water demand, consumer groups, losses, forecasting, design periods
- Water collection: Selection of source, groundwater withdrawal, springwater tapping, surface water intakes, rainwater harvesting, seawater desalination, recycling of treated sewage, drinking water protection areas
- Water transmission and distribution: necessity, hydraulic basics, dimensioning and calculation of branched and closed loop systems.
- Pumps and pumping stations: necessity, types, hydraulics for pumping design, pumping stations and pressure boosters
- Water storage: necessity, types and functions of tanks and reservoirs
- Case study: planning and design of a water supply system for a small town

14. Literatur:	Lecture notes can be downloaded from the internet. Hints are given for additional literature from the internet as well as libraries.
15. Lehrveranstaltungen und -formen:	• 151601 Vorlesung Energy Demand, Supply and Distribution • 151602 Vorlesung Water Demand, Supply and Distribution
16. Abschätzung Arbeitsaufwand:	Time of attendance: 45 h Private Study: 135 h
17. Prüfungsnummer/n und -name:	15161 Water and Power Supply (PL), schriftliche Prüfung, 120 Min., Gewichtung: 1.0
18. Grundlage für ... :	
19. Medienform:	
20. Angeboten von:	