Book of modules

Water Technology (M.Eng.)

School of Engineering and Architecture

Heidelberg, 16th September 2021

SRH HOCHSCHULE HEIDELBERG

STAATLICH ANERKANNTE HOCHSCHULE

Module Overview Water Technology (M.Eng.) (90 CP)

Module	CP
---- Obligatory Classes ----	
M1 Water Quality	**8**
Water Chemistry Water Pollutants and Water Analytics Sustainability and Global Challenges Introduction Matlab	
M2 Water Treatment I	**8**
Hydrology and Soil Science Hydraulic Engineering Water Supply Project Management I	
M3 Water Treatment II	**8**
Municipal Wastewater Treatment Community Water Management Substantive Law (Water and Environment) Innovation Management	
M4 Water Treatment III	**8**
Industrial Wastewater Treatment Strategic Management and Leadership Risk Management	
M5 Waste Management	**8**
Solid Waste Treatment Sewage Sludge Treatment Air Pollution Control Project Management II	
M6 Water as Energy and Waste to Energy	**8**
Material Recovery and Water Re-Use Hydropower Procedural Law (Water and Environmental) Research Methods and Applied Research	
M7 Climate Change Mitigation	**10**
Water Project: “Climate Change Mitigation“ Research and Management	
M8 Electives	**6**
M9 Master Thesis	**26**

Module Overview Water Technology with precourse (M.Eng.) (120 CP)

Module Precourse	CP
---- Prep. Course Technical ----	
PT 1 - Technical Essentials I	**15**
Maths for Engineers I & II Material Sciences I Mechanics	
PT 2 - Technical Essentials II	**15**
Constructive Design Electrical Engineering Production Engineering Material Sciences II	

Module	CP
---- Obligatory Classes ----	
M1 Water Quality	**8**
Water Chemistry Water Pollutants and Water Analytics Sustainability and Global Challenges Introduction Matlab	
M2 Water Treatment I	**8**
Hydrology and Soil Science Hydraulic Engineering Water Supply Project Management I	
M3 Water Treatment II	**8**
Municipal Wastewater Treatment Community Water Management Substantive Law (Water and Environment) Innovation Management	
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Industrial Wastewater Treatment Strategic Management and Leadership Risk Management	
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Solid Waste Treatment Sewage Sludge Treatment Air Pollution Control Project Management II	
M6 Water as Energy and Waste to Energy	**8**
Material Recovery and Water Re-Use Hydropower Procedural Law (Water and Environmental) Research Methods and Applied Research	
M7 Climate Change Mitigation	**10**
Water Project: “Climate Change Mitigation“ Research and Management	
M8 Electives	**6**
M9 Master Thesis	**26**

Module Overview Water Technology with internship (M.Eng.) (120CP)

Module	CP
---- Obligatory Classes ----	
M1 Water Quality	**8**
Water Chemistry Water Pollutants and Water Analytics Sustainability and Global Challenges Introduction Matlab	
M2 Water Treatment I	**8**
Hydrology and Soil Science Hydraulic Engineering Water Supply Project Management I	
M3 Water Treatment II	**8**
Municipal Wastewater Treatment Community Water Management Substantive Law (Water and Environment) Innovation Management	
M4 Water Treatment III	**8**
Industrial Wastewater Treatment Strategic Management and Leadership Risk Management	
M5 Waste Management	**8**
Solid Waste Treatment Sewage Sludge Treatment Air Pollution Control Project Management II	
M6 Water as Energy and Waste to Energy	**8**
Material Recovery and Water Re-Use Hydropower Procedural Law (Water and Environmental) Research Methods and Applied Research	
M7 Climate Change Mitigation	**10**
Water Project: “Climate Change Mitigation“ Research and Management	
M8 Electives	**6**
M9 Master Thesis	**26**
M10 Internship	**30**

Study Schedule

	Technical Essentials I	Technical Essentials II	Credits
Preliminary course technical sciences	Mathematics for Engineers I & II Material Sciences I Mechanics	Constructive Design Electrical Engineering Production Engineering Material Sciences II Language	
	15	15	30 ECTS

	Block 1	Block 2	Block 3	Block 4	Credits
1. Semester	Water Quality	Water Treatment I	Water Treatment II	Water Treatment III	
	8	8	8	8	32 ECTS
2. Semester	Waste Management	Water as Energy and Waste to Energy	Water Project- Climate Change Mitigation	Electives	
	8	8	10	6	32 ECTS
3. Semester	Masterthesis				
	26				26 ECTS
					90 ECTS

	Block 1	Block 2	Block 3	Block 4	Credits
1. Semester	Water Quality	Water Treatment I	Water Treatment II	Water Treatment III	
	8	8	8	8	32 ECTS
2. Semester	Waste Management	Water as Energy and Waste to Energy	Water Project- Climate Change Mitigation	Electives	
	8	8	10	6	32 ECTS
3. Semester	Internship				
	30				30 ECTS
4. Semester	Masterthesis				
	26				26 ECTS
					120 ECTS

MODULES
TECHNICAL PRECOURSE

MASTER
WATER TECHNOLOGY

SRH Hochschule Heidelberg, Degree Program: Water Technology (M.Eng.)					
Module description and module number: Prep Course Technics - 01 Technical Essentials I					
5-week block	**Frequency**	**Duration of the module**	**Type (* details or exceptions in the "Use" field**	**ECTS points**	**Student's workload Note: the basis for calculation is generally 1 ECTS = 25 hrs. Deviations are covered exclusively by Appendix 2 (Bachelor) and 2a (Master) of the SPO**
1+2	1 x per year	10 weeks		15	Total workload 375 hrs. (100%) In class 200 hrs Private studies 175 hrs

Requirements for enrolment	Use / Restrictions	Type / Duration of exam	Teaching and learning methods	In charge of module
		Written Exam Student Research Project	Interactive lecture Problem based learning Group Work	Prof. Dr.-Ing. Denise Reichel

Learning objectives

After completion of this 10-week module, the students on the Master's program are able to apply basic technical principles in the fields of material sciences, technical mechanics and mathematics to a current technical problem in the context of product development (e.g., design of an e-bike), and to come to an appropriate solution.

The students learn how to use particular tools to solve problems. Thus, they compile or extend their engineering methodology toolbox which they will continue to use in the course of their engineering master's program and which is essential for the successful completion of the course. Hence, they also train their engineering thought processes towards finding solutions. The technical prep course is developed in line with a relevant design project (e.g., construction of an e-bike).

Students also get to improve their competence in a foreign language.

Learning outcomes: Professional expertise and methodical skills

After completion of the Mathematics module, students can describe forces, torques and other mechanical parameters for the product in question using scalars and vectors. They can calculate with vectors and scalars (triple product, cross product). They can solve systems of mathematical equations. Students can carry out curve sketching, explain the terms (limit, derivation, integral, Riemann integral), and calculate these. They are able to determine the area under a curve and calculate the volume of a solid figure by rotating a plane curve around a straight axis. They can derive and integrate functions with several variables. Furthermore, students can rank and solve differential equations (ordinary differential equations). They can apply the fundamentals of numerical methods.

On the basis of technical mechanics, students acquire the ability to solve problems concerning the statics of rigid bodies for planar and three-dimensional cases in the central and the general force system. They specifically apply the mathematical methods they have learnt, such as vector calculations, to solve the problem. Students are able to define the statics of certain systems and train this ability by performing calculations for a given project (e.g. frame of e-bike). In addition, students can calculate the deformation of elastic bodies and develop and solve material structure equations for torsion, bending and normal forces. They are familiar with the fundamentals of kinetics and fluid mechanics, and can apply the law of energy conservation to a current topic (e.g., e-bike). Students are able to handle terms such as the "finite element method" and to apply them appropriately.

In Material Sciences students acquire the ability to make decisions on which material groups are relevant to the given problem. It enables them to classify and describe materials e.g. in relation to their properties or their applications. The students can describe the properties of metal materials and are able to select suitable materials for industrial products (e.g., frame of e-bike), and to determine the required material finishes. Students are able to describe the essential failure mechanisms of metal materials and to assess damaged or destroyed components e.g. on the basis of the fracture surface. Students can describe the essential material testing procedures, in particular static and vibration testing, and use the material parameters thus derived as a basis for argument.

Learning outcomes: Social skills

The students are able to discuss topical issues in the group, reach a consensus agreement and take responsibility for the solution.

Learning outcomes: Personal skills

The students can target their work approach and time management in a specific and complex research project, thus ensuring

full independence and responsibility for successful completion.

Constructive alignment

The module length of 10 weeks is chosen deliberately to enable students on the one hand to master the mathematical principles and to complete the course with a consistent examination (test), and on the other to handle a technical problem in the context of a research project.

Course contents

Subject area: Mathematics
• forces, torques
• units
• scalars, vectors
• triple product, cross product
• equation systems, curve sketching (limit, derivation, integral, Riemann integral)
• ordinary differential equations
• introduction to numerical methods

Subject area: Material Sciences
• classification of materials
• atomic structure, bonds, crystalline structures and faults, diffusion
• alloys
• elasticity/plasticity of materials, strengthening mechanisms
• failure mechanisms
• material testing
• non-metal materials

Subject area: Technical Mechanics
• statics of rigid bodies
• deformation of elastic bodies
• material structure equations for torsion, bending, normal forces
• fundamentals of kinematics
• fundamentals of fluid mechanics
• law of energy conservation
• basic terms and applications of the finite element method (FEM)

Recommended literature for preparation and follow-up

• Engineering Mechanics Statics , by Hibbeler, R.C., Pearson-Prentice Hall. (Latest ed.)

• Mechanics of Materials, Sixth Edition in SI Units by BEER, Ferdinand P., JOHNSTON, E. Russell Jr, DeWOLF, John T., MAZUREK, David F., McGrawHill

• “Engineering Mechanics, Dynamics”, Meriam, J. L., and Kraige, L. G. (Latest ed)

• A Complete Course Calculus. Robert A. Adams, Christopher, Essex, Eight Edition. ISBN 978 0-321-78107-9 QA303.2.A33 2013

• Materials Science and Engineering: An Introduction 9th Edition by William D. Callister Jr., David G. Rethwisch

• Nelson-Best: Schaum’s Outlines - Engineering Mechanics: Statics, McGraw Hill, New York etc. (2010)

• J.H. Allen III: Statics for Dummies, For Dummies Publ., (2010)

• A. Jayendran: Mechanical Engineering – Grundlagen des Maschinebaus in englischer Sprache, B.G. Teubner, Wiesbaden 2006 (oder neuer)

• F. Safier: Schaum’s Outlines - Precalculus, McGraw Hill, New York etc. (2012)

• Ryan: Calculus for Dummies, For Dummies Publ., (2012)

Optional information: Courses and lecturers:

Courses		
Lecturer	**Title of the course in the module**	**Weekly hours**
Prof. Dr. D. Reichel	Mathematic for Engineers I and II	80
Prof. Dr. A. Gerber	Material Sciences I	40
Prof. Dr. E. Lübcke	Mechanics	40
Various	Language	40

SRH Hochschule Heidelberg, Degree Program: Water Technology (M.Eng.)

Module description and module number: Prep Course Technics - 02 Technical Essentials II

5-week block	Frequency	Duration of the module	Type (* details or exceptions in the "Use" field	ECTS points	Student's workload Note: the basis for calculation is generally 1 ECTS = 25 hrs. Deviations are covered exclusively by Appendix 2 (Bachelor) and 2a (Master) of the SPO
1+2	1 x per year	10 weeks		15	Total workload 375 hrs. (100%) In class 200 hrs Private studies 175hrs

Requirements for enrolment	Use / Restrictions	Type / Duration of exam	Teaching and learning methods	In charge of module
Technical Essentials II		Written Exam Project Work Presentation	Interactive lecture Problem based learning Group Work	Prof. Dr.-Ing. Denise Reichel

Learning objectives

After completion of this 10-week module, students can design essential components of a topical technical product (e.g., an e-bike) and create a CAD model thereof. Building on the previous module, the students can apply the results gained (material used, strengths, force calculations) and implement them in the design (e.g. construction of the e-bike frame).

The students extend their language competence in the same foreign language as that taught in Technical Essentials I.

Learning outcomes: Professional expertise and methodical skills

After the Electrical Engineering course, the students are able on the one hand to apply the basic electrical engineering principles required for engineering professions to everyday problems, and on the other to generally apply the principle of energy storage technology to the current project (e.g., e-bike).

Material Sciences II enables students to utilize fundamental knowledge of innovative materials (e.g., ceramics, polymers, fiber reinforced composites) in selecting alternative materials for a given product.

After completion of the Manufacturing course, students are able to identify the principal production methods of metal materials and innovative materials, and to take the strengths and risks of the production technologies into account. The Design course enables them to create graphical representations of geometrical bodies and simple components both as multiview projections and as three-dimensional views. Apart from solid bodies, the students can also produce sections through such bodies in technical drawings complying with the standards. Furthermore, they can depict dimensions, tolerances, joints, surface finishes and typical properties of cast components in accordance with the standards. The students are able to apply what they have learnt to the creation of various types of drawings (e.g., production and assembly drawings). After introduction to the structure and methodology of a CAD system (e.g., Autocad, CATIA V5, Inventor) students are able to use their knowledge of technical drawing and design systems in the context of simple construction tasks using this software.

The Electrical Engineering course enables students to describe the basic principles of electrical charges and fields. The rules of electrical resistance are explained, and coils, capacitors and memristors demonstrated. Forces exerted on charges are calculated. Students are able to calculate and design simple, passive circuits, they are introduced to the concepts of the electrical and the magnetic field. Time varying electrical and magnetic fields, as well as selected principles of energy storage are introduced.

In Material Sciences II, students can enhance and apply their knowledge of aluminum alloys, steel materials, ceramics and fiber reinforced composites in the context of a topical product (e.g., e-bike). Thus, they hone and strengthen their problem-oriented thinking abilities.

In Manufacturing, the students are enabled to determine suitable production methods for the manufacture of the product in question (e.g., e-bike), select the appropriate production techniques, and plan the actual production of the product using these techniques.

Learning outcomes: Social skills

The students are able to discuss topical issues in the group, reach a consensus agreement and take responsibility for the solution.

Learning outcomes: Personal skills

The students can target their work approach and time management in a specific and complex research project, thus ensuring full independence and responsibility for successful completion.

Constructive alignment

The module length of 10 weeks is chosen deliberately to enable students to tackle a technical problem in-depth and using interdisciplinary methods in the context of a research project.

Course contents

Subject area: Design
• depiction of geometrical bodies with multiview projection and 3-dimensional views
• sections through geometrical bodies
• dimensions
• tolerances
• surface qualities
• representation of joint connections
• introduction to CAD systems (e.g. Inventor or Catia)

Subject area: Material Sciences II (selection of material groups varies according to the given topic)
• steel materials (in-depth)
• aluminum alloys
• ceramics
• fiber reinforced composites

Subject area: Manufacturing
• classification and systematization of manufacturing processes
• primary forming (overview of the various casting processes and molds)
• transforming (milling processes)
• separating techniques (geometrically defined and undefined processes)
• joining processes (overview)
• coatings (overview)I
• changing material properties (overview, sintering)

Subject area: Electrical Engineering
• basic principles of electrical charges and fields
• basic principles of electrical resistance
• coils and capacitors
• memristors in conjunction with voltage sources
• power sources in linear and nonlinear circuits
• magnetic fields and electromagnetic induction
• alternating and direct current circuit

Recommended literature for preparation and follow-up

- Materials Science and Engineering: An Introduction 9th Edition by William D. Callister Jr., David G. Rethwisch
- MANUFACTURING Engineering and Technology Serope Kalpakjian, Stephen R. Schmid SI Edition, 7/E

Optional information: Courses and lecturers:

Courses		
Lecturer	**Title of the course in the module**	**Weekly hours**
Prof. Dr. E. Özdemir	Constructive Design	40
Prof. Dr. E. Theophile	Electrical Engineering	40
Prof. Dr. A. Gerber	Material Sciences II	40

Prof. Dr. E. Theophile	Production Engineering	40
Various	Language	40

MODULES MAIN COURSE

MASTER
WATER TECHNOLOGY

SRH Hochschule Heidelberg, Degree Program: Water Technology (M.Eng.)

Module description and module number: M1 Water Quality

5-week block	Frequency	Duration of the module	Type (* details or exceptions in the "Use" field	ECTS points	Student's workload Note: the basis for calculation is generally 1 ECTS = 25 hrs. Deviations are covered exclusively by Appendix 2 (Bachelor) and 2a (Master) of the SPO
1	2 x per year	5 weeks	compulsory	8	Total workload 200 hrs. (100%) In class 90 hrs Private studies 110 hrs

Requirements for enrolment	Use / Restrictions	Type / Duration of exam	Teaching and learning methods	In charge of module
None	Water Technology	Station Test	1. Interactive lecture 2. Project Work 3. Group Work 4. Laboratory Experiments 5. Field trip 6. Data research and analysis 7. Learning Diary	Dr. Kenneth Bedu-Addo

Learning objectives

Learning outcomes professional skills

The students will aquire a solid foundation of the influences of environmental impacts on water, soil and air, of water chemistry and the water cycle. After the module the students are able to judge the water quality, to name the contained substances and their impact on the environment. They can summarize the most important measuring methods and water analytics and can explain their principles. Furthermore they are able to carry out simulations (MATLAB) and know the importance of process simulation. They are also able to compare the importances of water in ancient cultures and today.

Learning outcomes methodology

The students are able to describe the solubility of gases, carbonic acid system and calcium carbonate and redox processes. They know methods and can apply them to analyze the water quality and to determine water pollutants. They can do correct water sampling. Upon successful completion of this course, students are able to describe general concepts of computer science and the general concepts of programming and are able to create first models in MATLAB.

Learning outcomes social skills

Out of the need to prepare laboratory transcripts on the experiments the students can communicate in a technical way and debate their own results in detail in a group. The students are able to work effectively in an interdisciplinary context with other people in different situations and international environment.

Students will have the competence to take active part in discussions on global challenges. They can work together as a team, participate in subject-specific and interdisciplinary discussions and develop cooperated solutions.

Learning outcomes personal skills

Students are able to engage in independent learning and recognize the need for continual professional development. Students can accumulate knowledge of the subject area and practice it in the laboratory.

Constructive alignment

The contents of the course are delivered in interactive lectures that involve group exercises, case studies, presentations and laboratory experiments. Excursions and laboratory experiments will give practical examples for the study material and enable the student to test and apply their own newly gained expertise. This kind of practical experience supports the theoretical input by lectures.

The examination form will be a station test to test the students' procedures and behaviour when completing theoretical and

practical tasks. So the student will run through a course of testings stations (laboratory exoeriments, water analytics, calculations/exercises and simulations tasks)..

Course contents

Water Chemistry

This course introduces the water cycle and chemical aspects related to water. Major topics as solubility of gases, carbonic acid system and calcium carbonate, redox processes, calculation of pH or calcium carbonate dissolution potential.

Laboratory experiments will be carried out as e.g. acid and base capacity, flocculation and precipitation, determination of water hardness

Water Pollutants and Water Analytics

This course introduces the main water pollutants and different analysing and measuring methods as well as their principles. Modern materials, used for detecting, measuring and treating problems in the field of environmental engineering are explained and the working principles are discussed. There are simple but typical methods for analysing water, sewage, soil and waste taught, which serve the students as the basis for their later work in this area.

The following topics will be discussed:

- Inorganic parameters measured by probes/electrodes (Dissolved oxygen, pH, Alcalinity, electric conductivity, nutrients
- Nutrients (N, P) analysis by colorimetric methods and photometric methods)
- Analysis of particles
- Organics sum parameters (COD, BOD, TOC) and their analysing methods
- Handling with micropollutants (e.g. sources, entry paths, emission analysis)

Laboratory experiments will be carried out and also the sampling methods and important factors of water sampling will be discussed in detail.

Sustainability and Global Challeneges

This course introduces participants to the goals, principles, and practical applications of sustainability from science/engineering, policy, and business perspectives. In this course, we will examine the major environmental issues and trends happening in modern society from a scientific and practical perspective, including energy and resource use, pollution, climate change, water, and population. An overview of sustainability and sustainability plans from organizations and institutions will be discussed and critiqued. Also the topic of life cycle assessment will be covered in this course.

Introduction Matlab

This course teaches computer programming to people with little or no previous experience. It uses the programming system and language MATLAB (MATrix LABoratory) because it is easy to learn, versatile and very useful for engineers and other professionals. MATLAB is a special language that is an excellent choice for writing medium-size programs that solve problems in manipulating numbers. The design of the language makes it possible to write a powerful program in a few lines. The problems can be relatively complex, while the MATLAB programs they solve are relatively simple: relative, i.e. to the equivalent program written in a general-purpose language such as C++ or Java. As a result, MATLAB is used in a variety of fields, from the natural sciences to all disciplines of engineering to finance and beyond, and is widely used in industry. Therefore, a solid background in MATLAB is an indispensable skill in today's labour market. This course is not a MATLAB tutorial. It is an introductory programming course that uses MATLAB to illustrate general concepts of computer science and programming.

Recommended literature for preparation and follow-up

Quaschning, Volker (2010): Renewable Energy and Climate Change;John Wiley & Sons

Nathanson, Schneider (2014): Basic Environmental Technology: Water Supply, Waste Management and Pollution Control, 6th

Edition, Paperback

Gray (2010): Water Technology: An Introduction for Environmental Scientists and Engineers, 3rd Edition, Butterworth-Heinemann

Förtstner, Ulrich (2012): Umweltschutztechnik, 8th Edition, Springer-Verlag

Essington, Michael E (2015): Soil and Water Chemistry: An Integrative Approach (2015), 2nd Edition, CRC Press

Optional information: Courses and lecturers:

Courses		
Lecturer	**Title of the course in the module**	**Hours / Module**
A. Banard	Introduction Matlab	20
Dr. T. Sterr / Dr. F. Tettenborn	Sustainability and Global Challenges	20
Dr. K. Bedu-Addo	Water Chemistry	20
Dr. F. Tettenborn / Dr. K. Bedu-Addo	Water Pollutants and Water Analytics	30

SRH Hochschule Heidelberg, Degree Program: Water Technology (M.Eng.)

Module description and module number: M2 Water Treatment I

5-week block	Frequency	Duration of the module	Type (* details or exceptions in the "Use" field	ECTS points	Student's workload Note: the basis for calculation is generally 1 ECTS = 25 hrs. Deviations are covered exclusively by Appendix 2 (Bachelor) and 2a (Master) of the SPO
2	2 x per year	5 weeks	compulsory	8	Total workload 200 hrs. (100%) In class 90 hrs Private studies 110 hrs

Requirements for enrolment	Use / Restrictions	Type / Duration of exam	Teaching and learning methods	In charge of module
None	Water Technology	Student Research Project	1. Interactive lecture 2. Case study 3. Group Work 4. Role play 5. Simulation 6. Experiments 7. Field trip 8. Data research and analysis 9. Learning Diary	Prof. Dr. U. Gayh

Learning objectives

Learning outcomes professional skills

Main topic of this module is the provision of drinking water. The students are able to qualifiy water sources for their use as drinking water and to select appropriate methods of treatment in detail. With the completion of this module students acquire profound knowledge of biogeochemical and hydrological processes, of migrating compounds in soil and groundwater. They are able to describe the behaviour of chemicals in the environment, to analyse the contamination in soils and groundwater and they can explain and report the approach to remediate contaminated sites.

Students are able to define the basic terms of hydraulic engineering and hydraulics. They are able to explain the application of basic hydrodynamic formulations as conservation laws to practical hydraulic engineering problems. Students will be able to design simple water distribution systems. Besides this, the students can illustrate important tasks of hydraulic engineering and give an overview over river engineering, flood protection, hydraulic power engineering and waterways engineering.

Learning outcomes methodology

The students are able to analyze contaminations in soils and groundwater using special engineering methods. They can do transport modelling in the unsaturated zone, estimations of groundwater pollution and analyze the impacts of remediation measures. They can forecast die distribution, mobility and remediation of non-aqueous phase liquids in soil and groundwater. With the completion of this module students can apply the acquired theoretical knowledge to model sites and assess the situation technically and conceptually. They are able to draw comparisons on different investigation strategies and techniques. Model projects can be devised and treated. They are able to transpose selected processes in drinking water treatment into a mathematical model with respect to equilibrium, kinetics and mass balances. They are able to set up and apply models and assess their possibilities and limitations. The students are able to apply hydraulic engineering methods and approaches to basic practical problems and design respective hydraulic engineering systems. Furthermore they are able to use project managing tools as e.g. MS Project.

Learning outcomes social skills

The students are able to prepare complex contamination issues in teamwork and are able to find remediation measures. Students can discuss technical and scientific tasks within a project subject specific and interdisciplinary.

Learning outcomes personal skills

Students can independently exploit sources, acquire the particular knowledge of the subject and apply it to new problems. They can apply the skills of project management on their working method and reflect their impact.

Constructive alignment

The contents of the course are delivered in interactive lectures that involve group exercises, case studies, presentations and laboratory experiments and excursions. The excursions and laboratory experiments will give practical examples for the study material and enable the student to test and apply their own newly gained expertise. This kind of practical experience supports the theoretical input by lectures.

The examination form will be a student research project (SRP) to test students' ability to independently write an analytical academic text. This examination type fits well for testing multiple, complex learning outcomes on an advanced scientific level.

Course contents

Hydrology and Soil Science

- Concept of capillarity, multiphase distribution in porous media, residual saturation, permeability, infiltration into the subsurface
- Factors and processes of soil formation, mineral and organic components, surface types and properties, retention of nutrients and pollutants,
- Hazards from faulty land use, erosion, salinization, and contamination
- Complexity of soil and groundwater contamination
- Remediation and modifications of redox conditions, pH, and electrolyte concentration

Hydraulic Engineering

- Flow of incompressible fluids in pipes and open channels
- Regulative constructions in open channel flows and
- Flood protection and dimensioning of protective construction
- Construction of wells and sewers
- Nature-oriented hydraulic engineering and renaturation
- Inland waterways engineering
- Ancient Water Technology: construction techniques, location of reservoirs, dams, ponds as wells as for transport of water (aqueducts, pipes, canals, tunnels)

Water Supply

- Urban Water Infrastructure and water supply system
- Water catchment (Groundwater, bank filtrate, …)
- Water treatment and the processes (sedimentation, filtration, coagulation, membrane treatment, adsorption, water softening, gas exchange, ion exchange and disinfection)
- Differentiation parameters depending of different water sources, contaminations and socio-political conditions
- Water storage and the distribution system that carries water to the consumer
- Regional and local water needs and determination of water demand
- Current situation of global water resources
- Rain water management
- User and Stakeholder conflicts
- Functions of reservoirs, their design and arrangement in the water supply
- Protection of water reservoirs
- Interaction of water resource management and drinking water supply
- Modeling of processes involved in drinking water supply
- Legal aspects, organization forms of drinking water suppliers

Project Management

- Project Objectives

- Smart Criteria
- Functions and Tools of Project Management
- Project Organization Structure
- Project Planning
- Main Features of Risk Management
- MS Project
- Teambuilding

Recommended literature for preparation and follow-up

Kerzner H. (2017): Project Management: A Systems Approach to Planning, Scheduling, and Controlling, Wiley; Auflage: 12

Johnson G., Whittington R., Scholes K.,(2011) Exploring strategy: Harlow ; Munich [u.a.] : Financial Times Prentice Hall

Low Sui Pheng (2018): Project Management for the Built Environment : Study Notes, Singapore, Springer

Nathanson, Schneider (2014): Basic Environmental Technology: Water Supply, Waste Management and Pollution Control, 6th Edition, Paperback

Gray (2010): Water Technology: An Introduction for Environmental Scientists and Engineers, 3rd Edition, Butterworth Heinemann

Förtstner, Ulrich (2012): Umweltschutztechnik, 8th Edition, Springer-Verlag

White F. (2016): Fluid Mechanics, 8th ed., in SI Units, Mc Graw Hill Education

Gerhard M., Gerhart, L., Hochstein, L. (2017): Munson's Fluid Mechanics, 8th ed., Wiley

Optional information: Courses and lecturers:

Courses		
Lecturer	**Title of the course in the module**	**Hours / Module**
Dr. T. Sterr	Hydrology and Soil Science	10
Prof. Dr. Özdemir	Hydraulic Engineering	30
Prof. Dr. Cuppens / Dr. Rothe	Water Supply	40
Dr. Cudaj	Project Management I	10

SRH Hochschule Heidelberg, Degree Program Water Technology (M.Eng.)

Module description and module number: M3 Water Treatment II

5-week block	Frequency	Duration of the module	Type (* details or exceptions in the "Use" field	ECTS points	Student's workload Note: the basis for calculation is generally 1 ECTS = 25 hrs. Deviations are covered exclusively by Appendix 2 (Bachelor) and 2a (Master) of the SPO
3	2 x per year	5 weeks	compulsory	8	Total workload 200 hrs. (100%) In class 90 hrs Private studies 110 hrs

Requirements for enrolment	Use / Restrictions	Type / Duration of exam	Teaching and learning methods	In charge of module
None	Water Technology	Report/Presentation	1. Interactive lecture 2. Case study 3. Group Work 4. Role play 5. Simulation 6. Experiments 7. Excursions 8.Learning diary	Prof. Dr.-Ing. Andreas Gerber

Learning objectives

Learning outcomes professional skills

After successful completion of the module students are able to explain the processes of a wastewater treatment in detail and know different discharge limits. The students can examplify their expert knowledge on urban water infrastructures. They can present the derivation and detailed explanation of important standards for the design of drinking water supply and wastewater disposal systems. Students aquire the ability to steer the innovation process from idea generation to market entry as an overall approach. Students aquire the ability to steer the innovation process from idea generation to market entry as an overall approach integrating all relevant disciplines..

Learning outcomes methodology

The students are able to understand and to practically apply methodologies for wastewater analysis as well as descriptions of experiments and experimental setups in wastewater technology. Students can describe urban wastewater systems by means of software-based modeling and are able to design a communal wastewater treatment plant. The students are able to apply the relevant standards and guidelines for the design and operation of urban water infrastructures independently. Besides the acquirement of technical skills, they are able to address and solve biochemical problems in the wastewater treatment. Furthermore, they are also able to develop their own ideas to improve the existing water related infrastructures, systems and concepts. Students are able to select suitable processes for the treatment with respect to the national or cultural and developmental context. They'll be able to select and apply various methodologies of Innovation Management depending on the industry sector and the enterprise size.

Learning outcomes social skills

The students are able to work effectively in an interdisciplinary context with other people in different situations and international environment. They are able to articulate logically and persuasively in both oral and written form on the content and problems of each discipline.

Students will have the competence to take active part in discussions on municipal wastewater and water management topics. Students will function effectively both as a leader and as members of project teams and demonstrate an appreciation for diversity.

Learning outcomes personal skills

The students will be able to independently extend their knowledge and apply it to new problems. They are able to conduct experiments following written procedures without external assistance. Students are able to engage in independent learning and recognize the need for continual professional development. They can summarize the impact of engineering solutions in a global, economic, environmental, and social context. Additionally students will aquire soft skills which are necessary to steer innovation projects in a manifold environment as typically found in globally acting companies

Constructive alignment

The module teaches and refreshes some fundamental knowledge and specific scientific methods. Within project work the students can demonstrate that they are able to transfer this knowledge in realistic scenarios. Real-life practical work prepares them to conduct analysis, to develop specifications and to use modeling tools.

The examination form “Report and Presentation” tests the ability to research and present a scientific topic; the focus lies on a clear, memorable presentation and on the ability to situate the topic within the broader subject field (material, methodology, social and personal skills). Actual topics which are getting more and more important and which are today a challenge for water treatment systems should be covered in the project.

While defining an own research question for a topic for the “Climate Change Mitigation Project” (M7) as academic performance they show the application of innovation management. The coursework is an exposé.

Course contents

Municipal Wastewater Treatment

In this course the stages of a wastewater treatment plant will be discussed. The focus is on mechanical and biological treatment methods. The course contains exercises with calculations and design, laboratory experiments and excursions

- Charaterization of wastewater
- Mechanical treatment (Screens, Grit chamber, Preliminary Sedimentation, Secondary Settlement Tanks, Membrane Filtration)
- Biological Treatment (aerobic, anaerobic, anoxic), metobolism of microorganisms and kinetic of mirobiotic processes, denitritfication, nitrification, Activated Sludge Model
- Mathematical modelling of nitrogen removal
- Wastewater treatment plant design and modelling
- Parameters routinely measured in municipal wastewater effluents
- Costing of wastewater and water analyses
- Ancient Water Technology: Wastewater (how and where and what)

Water Management

Water management has as focus on the understanding of the global situation with water and wastewater. Following topics are included:

- Urban water infrastructure (supply networks/sewer systems)
- Dimensioning and operation of water management plants
- Static and structural requirements of the sewer system
- Regional planning and decentralised systems
- Drainage systems
- Protection of the local water balance and water pollution control

Substantive Law

- Legal regulations in the area of groundwater and surface water
- Water discharge limit values
- Legal regulations in the area of emissions and air quality
- Legal regulations in the area soil protection
- EU environmental law and international environmental laws
- Ancient Water Technology: Laws and administration, water as weapon

Innovation Management

Focus topics of the course are:

- Innovation in the industrial context
- Overall Innovation process
- Organizational view
- KPIs for Innovation processes
- Creativity techniques
- Systematic idea development
- Product development
- Meaning of patents for innovative companies
- Market entry strategies

Recommended literature for preparation and follow-up

M. A. Schilling: Strategic Management of technical Innovation, 5th Edition, Mc GRaw Hill Education, 2016

M. Dodgson, D.M. Gann et al.: The Oxford Handbook of Innovation Management, Oxford Univerity Press, 2014

C.M. Christensen: The Innovator's Dilemma, Harvard Business School Press, 1997

W. Chan Kim, R. Mauborgne: Blue Ocean Strategy, Harvard Business Review Press, 201

Nathanson, Schneider (2014): Basic Environmental Technology: Water Supply, Waste Management and Pollution Control, 6th Edition, Paperback

Gray (2010): Water Technology: An Introduction for Environmental Scientists and Engineers, 3rd Edition, Butterworth-Heinemann

Förtstner, Ulrich (2012): Umweltschutztechnik, 8th Edition, Springer-Verlag

Peter Fritzson: Principles of Object-Oriented Modeling and Simulation with Modelica 2.1,Wiley-IEEE Press,.

Henze, M. (2002): Activated sludge models ASM1, ASM2, ASM2d and ASM3, London : IWA Publ.,

Optional information: Courses and lecturers:

Courses		
Lecturer	**Title of the course in the module**	**Hours / Module**
Dr. L. Schuh	Municipal Wastewater Treatment	40
Prof. Dr. A. Gerber	Innovation Management	10
Prof. A. Cuppens / C. Dittrich	Water Management	20
K. Winkler	Substantive Law (Water and Environment)	20

SRH Hochschule Heidelberg, Degree Program: Water Technology (M.Eng.)

Module description and module number: M4 Water Treatment III

5-week block	Frequency	Duration of the module	Type (* details or exceptions in the "Use" field	ECTS points	Student's workload Note: the basis for calculation is generally 1 ECTS = 25 hrs. Deviations are covered exclusively by Appendix 2 (Bachelor) and 2a (Master) of the SPO
4	2 x per year	5 weeks	compulsory	8	Total workload 200 hrs. (100%) In class 90 hrs Private studies 110 hrs

Requirements for enrolment	Use / Restrictions	Type / Duration of exam	Teaching and learning methods	In charge of module
None	Water Technology	Case Study	1. Interactive lecture 2. Case study 3. Group Work 4. Role play 5. Simulation 6. Learning Diary	Prof. Dr.-Ing. Nils Albrecht

Learning objectives

Learning outcomes professional skills

The students know for the wastewater from different industrial sectors the necessary process steps of the wastewater treatment. They can apply and combine techniques of mechanical, biological and physical-chemical processes in a useful and efficient way. Additionally, the students are able to identify the essential tasks in the disciplines "Strategic Management" and "Risk Management" and "Management & Leadership". They can describe and explain the functions of these three management forms. They can employ the necessary terminology appropriately in discussions. Based on specific case studies, the students can apply the knowledge gained to new cases and extend it independently.

Learning outcomes methodology

The students are able to employ the essential methods in the disciplines. They are able to calculate physical and chemical wastewater treatments techniques and can evaluate their efficiencies. Furthermore they can adapt the following methods to do analysis in the field of strategic and risk management:

BGC Matrix / SWOT-Analysis / Competitor Analysis / Porter's Five Forces Model / Blue Ocean Strategy / Ansoff Matrix / PESTLE / Fault Tree Analysis / Event Tree Analysis / FMEA / Delphi Method / Bow-Tie

Learning outcomes social skills

The students are able to discuss several fundamental strategic approaches in the group, reach a consensus agreement and take responsibility for the solution. In individual work, they are able to flesh out the results of group work, create a design and carry out the necessary calculations.

Learning outcomes personal skills

The students can target their work approach and time management in a specific and complex case study, thus ensuring full independence and responsibility for successful completion.

Constructive alignment

This module teaches the students professional expertise, methodical skills, social skills and self-competence. Special emphasis is placed on the development of decision-making competence, which is based on the aforementioned competencies. For this reason, the case study (CS) has been chosen as the examination format for testing these competencies. In the case study, the students in this module should prove that they have a common understanding of the complex relationships with which decision makers in international corporations are confronted. The starting point of the case study is the continued strategic alignment of a reality-oriented company.

As academic performance the students have to submit their learning diary.The learning diary is a proven instrument for students to document their own learning practices, systematically reflect upon them and change them if necessary. It also

serves to make the learning process more binding and sustainable.

Course contents

Industrial Wastewater Treatment

Treatment technologies for different industrial sectors (e.g. Pharmaceutical and hospitals, automotive industry, food industry, chemical industry, textile industry, leachate)
Physical treatment technologies UV-irradiation and membrane filtration / Chemical treatment technologies / Activated Carbon / SBR-Technology / Anaerobic biological treatment / Precipitation / Flocculation

Strategic Management and Leadership

Strategy - Definition and Features / Vision and Mission Statements / Strategy Formulation / Implementation / Evaluation / Strategic Decisions / Business Policy / Business Ethics / Corporate Governance / Strategic Management for the Millenials / Human resources management / business start-up / management techniques / Organizational structure / Quality Management

Risk Management

Risk Definition and Interpretation / Risk Management Standard ISO 31000 / Risk Assessment Tools: FTA, ETA, Bow-Tie / Sources - Classification: Legal, Operational, Technical, Political, Social, Market / Macro and Micro Risk / Internal and External Risk / Management of Risk / Risk Treatment / Mitigation Strategies / Measurement of Risk / Comparing Risks / Risk Maturity Models / Risk Management Framework

Recommended literature for preparation and follow-up

Industrial Wastewater Treatment

N.F. Gray: Water Technology, Elsevier, Third Edition, 2010

Drinnan/Spellman: Water and Wastewater Treatment, CRC Press, Second Edition, 2013

G. Dietrich: Hartinger Handbuch Abwasser- und Recyclingtechnik, Hanser, Third Edition, 2017

Binnie/Kimber: Basic Water Treatment, ICE Publishing, Fifth Edition, 2013

Strategic Management and Leadership

R. Lynch: Strategic Management, Pearson Education Limited; Auflage: 8th New edition (2. Februar 2018)

Risk Management

ISO 31000:2009, Risk management

ISO/TR 31004:2013, Risk management — Guidance for the implementation of ISO 31000

ISO: ISO 31000 : Risk management – a practical guide for SMEs, 2015

ONR 49000 Risk management for organisations and systems

Optional information: Courses and lecturers:

Courses		
Lecturer	**Title of the course in the module**	**Hours / module**
Prof. Dr. N. Albrecht	Risk Management	20
Dr. Lowak	Strategic Management and Leadership	20
Dr. Bedu-Addo, Dr. M. Weißroth,	Industrial Wastewater Treatment	50

Module description and module number: M5 Waste Management					
5-week block	**Frequency**	**Duration of the module**	**Type (* details or exceptions in the "Use" field**	**ECTS points**	**Student's workload Note: the basis for calculation is generally 1 ECTS = 25 hrs. Deviations are covered exclusively by Appendix 2 (Bachelor) and 2a (Master) of the SPO**
5	2 x per year	5 weeks	compulsory	8	Total workload 200 hrs. (100%) In class 90 hrs Private studies 110 hrs

Requirements for enrolment	Use / Restrictions	Type / Duration of exam	Teaching and learning methods	In charge of module
Successful finalization of M3	Water Technology	Student Research Project	1. Interactive lecture 2. Case study 3. Group Work 4. Excursion 5. Simulation 6. Learning Diary	Dr. Sterr

Learning objectives

Learning outcomes professional skills

After successful completion of the module students are able to characterize waste types, sewage sludge and to discuss legal regulations in the area of emissions and air quality. The students are able to describe waste as a resource as well as advanced technologies for recycling and recovery of resources from waste in detail. This covers collection, transport, treatment and disposal in national and international contexts. The students are able to explain the design and layout of anaerobic and aerobic waste treatment plants, as well as waste incineration plants in detail and can describe different techniques in addition to explaining different methods for waste analytics.

Students are able to combine processes for cleaning of off-gases depending on the pollutants contained in the gases. The y are able to select suitable processes for the treatment of wastes or raw material with respect to their characteristics and the process aims. They can evaluate the efforts and costs for processes and select economically feasible treatment concepts.

The student are able to discuss advantages and disadvantages of different methods od the extended project management. They know the influence of project management on the organisational structure and culture of a company.

Learning outcomes methodology

After successful completion of the module students are able to select and plan waste treatment plants and waste gas treatment plants for different purposes.

The students are able to apply new approaches of project management (Six Sigma / TQM / Methodology of Change Management (e.g. Kottter, Lewin).

Learning outcomes social skills

Students can work together as a team and discuss technical tasks. They are able to participate in subject-specific and interdisciplinary discussions. Collaborating with other students in a team enables them to make connections necessary to develop working partnerships necessary for successful projects.

Learning outcomes personal skills

The students can target their work approach and time management in a specific and complex project, thus ensuring full independence and responsibility for successful completion.

Constructive alignment

The module teaches and refreshes some fundamental knowledge in the field of waste management and air pollution control. Within the project the students can demonstrate that they are able to transfer this knowledge to realistic scenarios.

The student research project is a continuation of the project of M3. The objective is to integrate appropriate waste and sewage sludge treatment and air pollution control equipment. In this project the basic terms of project management learned in the lecture should be considered.

Course contents

Solid Waste Treatment

- Waste composition and process specific material characterization
- Waste avoidance and recycling
- Waste logistics (Collection, transport, export, fees and taxes)
- Waste Incineration (Incineration techniques: grate firing, ash transfer, boiler, reaction principles, legal background, introduction flue gas cleaning and ash treatment)
- Mechanical-biological waste treatment (aerobic and anaerobic degradation, technical layout and process design)
- Landfills

Sewage Sludge Treatment

- Compositions and classification of sewage sludge
- Processes of sewage sludge treatment
- Posibilities to optimize sewage sludge treatment e.g. ultrasonic treatment
- Ancient Water Technology: Water in Agriculture, Water as Symbol, Water as Weapon

Air Pollution Control

- Different forms of air pollutants
- Classification of off gas treatment processes and definition of their area of application
- Flue gas cleaning: Volume, composition, legal framework and emission limits, dry treatment, scrubber, de-NOx techniques, dioxin elimination, mercury and sulphur elimination
- Air pollution control in water and wastewater plants

Project management II

Basic terms of quality management:

- Six Sigma
- TQM

Basic terms of Change Managements

- movements and obstacles
- methodology of Lewin
- methodology of Kotter
- 5-phase-model of Krüger
- learning organization
- evaluation

Extension of project management

- multi-project management
- project map
- agile project management

Recommended literature for preparation and follow-up

G. Dietrich: Hartinger Handbuch Abwasser- und Recyclingtechnik, Hanser, Third Edition, 2017

H. Kerzner: Project Management: A Systems Approach to Planning, Scheduling, and Controlling, Wiley; Auflage: 12 (1. September 2017)

Exploring strategy: Gerry Johnson ; Richard Whittington ; Kevan Scholes, Harlow ; Munich [u.a.] : Financial Times Prentice Hall, 2011

Project Management for the Built Environment : Study Notes / by Low Sui Pheng, Singapore : Springer, 2018

Optional information: Courses and lecturers:

Courses		
Lecturer	**Title of the course in the module**	**Hours / module**
Dr. T. Sterr / D. Fear	Solid Waste Treatment	20
D. Baris	Sewage Sludge Treatment	30
Prof. Dr. B. Leisenheimer	Air pollution control and emission abatement	20
Dr. Cudaj	Project Management II	20

SRH Hochschule Heidelberg, Degree Program: Water Technology (M.Eng.)

Module description and module number: M6 Water as Energy and Waste to Energy

5-week block	Frequency	Duration of the module	Type (* details or exceptions in the "Use" field	ECTS points	Student's workload Note: the basis for calculation is generally 1 ECTS = 25 hrs. Deviations are covered exclusively by Appendix 2 (Bachelor) and 2a (Master) of the SPO
6	2 x per year	5 weeks	compulsory	8	Total workload 200 hrs. (100%) In class 90 hrs Private studies 110 hrs

Requirements for enrolment	Use / Restrictions	Type / Duration of exam	Teaching and learning methods	In charge of module
none	Water Technology	Project Work (50%) + Written Exam (120 min) (50%)	1. Interactive lecture 2. Project Work 3. Group Work 4. Project development 5. Data research and analysis 6. Excursions 7. Learning Diary	Prof. Dr.-Ing. Ulrike Gayh

Learning objectives

Learning outcomes professional skills

By the end of this module the students can explain in detail knowledge the importance of the recovery of valuable substances as e.g. nutrient recovery. They can evaluate the ecological impact and the technical effort of different technologies and management systems

The students are able to describe waste as a resource as well as advanced technologies for recycling and the recovery of resources from waste in detail.

Furthermore, they are able to describe fundamentally the use of water power to generate electricity.

Learning outcomes methodology

Students are able to apply the acquired theoretical foundations on exemplary water power systems and evaluate and assess technically the resulting relationships in the context of dimensioning and operation of these energy systems.

With respect to research methods, the students learn how to apply various methods of data collection and data processing. They are able to name the advantages and disadvantages of each approach. Students will be able to use both statistical and qualitative methods for doing research. The participants will be able to align research problems with research questions and pick the suitable methods of data collection and evaluation and thus be enabled to do a scientifically correct research work.

Learning outcomes social skills

Through active discussions of various topics within the seminar of the module, students improve their understanding and the application of the theoretical background and are thus able to transfer what they have learned in practice. As projects are generally group efforts, they also develop communication and cooperation skills.

Learning outcomes personal skills

Students are able to engage in independent learning and recognize the need for continual professional development. They can demonstrate and practice individual time management skills while carrying out the project work.

Constructive alignment

The contents of the course are delivered in interactive lectures that involve group exercises, case studies, presentations and laboratory experiments. The excursions and laboratory experiments will give practical examples for the study material and enable the student to test and apply their own newly gained expertise. This kind of practical experience supports the theoretical input by lectures.

The examination form will be a project work and a written exam. The core of the project is the analysis and critical discussion of either a problem in the field of water re-use and resource recovery or hydropower. As projects are generally group efforts, they also develop communication and cooperation skills. Besides the project work which controls also the application of the course "Research Methods & Applied Research", the knowledge of all courses will be tested in a written exam.

Course contents

Water Re-Use and Resource Recovery

- Water Re-Use
  - need for water reuse
  - reduction of pollution and conservation of energy
  - legal conditions of wastewater reuse
  - zero discharge
- Nutrient recovery, mainly P-recovery
  - processes for phosphorus recovery
  - economic and ecological aspects of P-recovery processes
  - Potential in wastewater treatment plants
  - strategical approaches for nutrient recovery in different countries
  - potential for the reduction of the phosphorous demand for fertilizers
- Introduction to resource oriented sanitation systems
  - composition of sanitary wastewater (greywater, black water, brown water, yellow water)
  - needs and requirements
  - possibilities of separation of wastewater
  - treatment techniques of black water, grey water, brown water, yellow water
  - concept of water reuse and nutrient usage
  - retention and handling of harmful substances

Hydropower

- Hydrologic cycle
- Water power in the global context
- Principles of hydro-energy
- Turbomachinery (pumps and turbines)
- Classification of Hydropower: Flow and Storage hydropower, low and high pressure systems
- Costs, potentials and use of hydro-energy
- Construction of hydroelectric power plants: description of the individual components and their technical system interaction
- Other options (wave energy, current energy, tidal plants etc.)
- Hydropower and the environment
- Ancient Water Technology: Water energy – types of exploitation: watermills, pumps, machinery etc. and water as means of transport (ships, seas, rivers, lakes)

Research Methods & Applied Research

- Literal and patent background research, laboratory and technological research
- Criteria of good research, research design, creating a hypothesis and research questions

- Elements thesis writing and writing research proposals
- Creating, handling and evaluating qualitative data
- Open and closed questioning techniques, structured, semi-structured and open interviews
- How to conduct an interview.
- Reliability and Validity of data is being discussed.
- Key concepts of statistics and application of statistical procedures
- Population and sampling, research problem and hypothesis, dependent and independent variables, the normal curve and its properties, probability, and correlation
- Design of experiments
- Scale up processes
- Product lifecycle management (PLM)

Procedural Law

- Environmental Impact Assessment
- International rules and right to water
- EU environmental law and international environmental laws
- Other relevant topics relevant for water and environmental engineering topics

Recommended literature for preparation and follow-up

Nathanson, Schneider (2014): Basic Environmental Technology: Water Supply, Waste Management and Pollution Control, 6th Edition, Paperback

Gray (2010): Water Technology: An Introduction for Environmental Scientists and Engineers, 3rd Edition, Butterworth-Heinemann

Förtstner, Ulrich (2012): Umweltschutztechnik, 8th Edition, Springer-Verlag

White F. (2016): Fluid Mechanics, 8th ed., in SI Units, Mc Graw Hill Education

Gerhard M., Gerhart, L., Hochstein, L. (2017): Munson‘s Fluid Mechanics, 8th ed., Wiley

Optional information: Courses and lecturers:

Courses		
Lecturer	**Title of the course in the module**	**Hours / Module**
Dr. T. Seidel / Prof. Dr. U. Gayh	Research Methods and Applied Research	30
H. Lohr	Procedural Law (Water Environment)	20
Prof. Dr. E. D. Özdemir	Hydropower	20
Dr. F. Tettenborn	Water Re-Use and Resource Recovery	20

SRH Hochschule Heidelberg, Degree Program: Water Technology (M.Eng.)

Module description and module number: M7 Water Project Climate Change Mitigation

5-week block	Frequency	Duration of the module	Type (* details or exceptions in the "Use" field	ECTS points	Student's workload Note: the basis for calculation is generally 1 ECTS = 25 hrs. Deviations are covered exclusively by Appendix 2 (Bachelor) and 2a (Master) of the SPO
7+8	2 x per year	8 weeks	compulsory	10	Total workload 250 hrs. (100%) In class 30 hrs Private studies 220 hrs

Requirements for enrolment	Use / Restrictions	Type / Duration of exam	Teaching and learning methods	In charge of module
none	Water Technology	Scientific Poster Presentation	1. Interactive lecture 2. Case study 3. Group Work 4. Role play 5. Simulation 6. Learning Diary	Prof. Dr.-Ing. Ulrike Gayh

Learning objectives

Based on the competences aquired in modules 1-6 the students are able to identify and to develop an innovative water treatment technique or process respectiveley improvement. They can prove the feasibility of their idea and can demonstrate the implementation and their detailed knowledge in the field of water technology.

Learning outcomes professional skills

The students can develop solving strategies and approaches for fundamental and practical problems in the field of water technology. Scientific work techniques that are used can be described and critically reviewed. They can exemplify the state of technology and application and discuss critically in the context of actual problems and general conditions of science and society.

Learning outcomes methodology

The students are able to independently select methods or planning approaches for their project work and to justify their choice.

Furthermore they are able to create a scientific poster presentation.

Learning outcomes social skills

Students are able to administrate a complex project work by an appropriate split of work and a reliable scheduling in order to achieve the expected project results in time and good quality. They are able to plan ahead the project proceeding and to account for decision making at project conditions. They deal confidently with constructive critics and they can consider external advice in their own work. Due to the possibility to do the project in partner universities, companies or with other institutes or organisation their social skill be further encouraged.

Learning outcomes personal skills

The water project demands highest transfer of competencies aquired in other lectures to the own project work. Collaboration within an interdisciplinary team developing an industrial product demonstrates the students real industrial conditions with all aspects of human factors. The students are capable of independently planning and documenting the work steps and procedures while considering the given deadlines. This includes the ability to accurately procure the newest scientific information. Furthermore, they can obtain feedback from experts with regards to their work progress, and to accomplish results on the state of the art in science and technology.

Constructive alignment

Students acquire the ability to steer the innovation process from idea generation to market entry as an overall approach integrating all relevant disciplines. They'll be able to select and apply various methodologies of innovation management, project management or also process simulation to implement the project. Depending on the situation of the country, the relevance of water, the industry sector or the enterprise size. Additionally students will aquire soft skills which are necessary to steer innovation projects in a manifold environment as typically found in globally acting companies. The examination form is a scientific poster presentation. The students have to show if they can present the essence of their work briefly and comprehensible and can reflect on the value of the work and its findings

Furthermore the learning diary which has been written in parallel to the module 1 – 6 should be submitted. This learning diary is a critical reflection and organization of learning experiences (material and personal skills) during the study course. It is an ongoing logbook of the student's own learning process.

The learning diary is a proven instrument for students to document their own learning practices, systematically reflect upon them and change them if necessary. It also serves to make the learning process more binding and sustainable.

Course contents

Research and Management

Change management / academic writing / design of experiments / patent background research, laboratory and technological research / process development / market potential / technical feasibilty / poster presentation

Water Project: Climate Change Mitigation

The student develop and implement an own water project which is based to the topic of climate change mitigation. But also subjects such as water re-use strategies, reduction of the chemical footprint of water treatment systems etc. could be considered.They work with solving strategies and approaches for fundamental and practical problems in the field of water techhnology. Topics are besides theory based procedures the integration of safety-related, ecological, ethical, and economic view points of science and society. Further topics to be discussed are the proof of technical feasibility and market potential, the technical design and development of a prototype/pilot plant, the detailed design of an industrial product/process.

Recommended literature for preparation and follow-up

Compare literature M1 – M7

Optional information: Courses and lecturers:

Courses		
Lecturer	**Title of the course in the module**	**Hours / Module**
Prof. Dr. U. Gayh	Research and Management	15
Prof. Dr. U. Gayh	Water Project: Climate Change Mitigation	15

SRH Hochschule Heidelberg, Degree Program: Water Technology (M.Eng.)					
Module description and module number: M8 Electives					
5-week block	**Frequency**	**Duration of the module**	**Type (* details or exceptions in the "Use" field**	**ECTS points**	**Student's workload Note: the basis for calculation is generally 1 ECTS = 25 hrs. Deviations are covered exclusively by Appendix 2 (Bachelor) and 2a (Master) of the SPO**
8	2 x per year	5 weeks	compulsory	6	Total workload 150 hrs. (100%) In class 60 hrs Private studies 90 hrs

Requirements for enrolment	Use / Restrictions	Type / Duration of exam	Teaching and learning methods	In charge of module
none	Water Technology International Business and Engineering	various	1. Interactive Lecture 2. Practical Work 3. Problem-Oriented Learning	Prof. Dr.-Ing. Ulrike Gayh

Learning objectives

The elective module gives the chance to specialize in certain aspects of Water Technology, Engineering or Business. Content and competence varies.

Constructive alignment

Interactive lecture, practical work, group work, problem-oriented learning, problem analysis and correlation. The examination depends on the content of the course.

Course contents

The elective gives the students the possibility of choosing and sharpening their own profile within the degree program. Students can choose electives from a large array of courses offered by SRH School of Engineering and can and can either focus on engineering aspects or on business economics and management. The course offers elective classes that allow students to immerse themselves in specialized topics with lecturers who are experts in their respective fields of innovation and practitioners who bring real-world, real-time experience to the classroom. The topics are defined by current technical or economic state of the art themes. Therefore, the content varies over time.

Detailed information about current elective offers will be given to the students by the faculty. The electives can be selected between electives with focus on water topics or general topics. Previously, for general elective classes have been offered as for example:

- Entrepreneurship
- LCA Life Cycle Assessment
- Business Strategies
- Industry 4.0

The electives will be realized together with students from the Master program International Business and Engineering.

Recommended literature for preparation and follow-up
To be announced by the lecturer

Optional information: Courses and lecturers:

Courses		
Lecturer	**Title of the course in the module**	**Hours / Module**
Various	Elective	60

SRH Hochschule Heidelberg, Degree Program: Water Technology (M.Eng.)

Module description and module number: M9 Master Thesis

5-week block	Frequency	Duration of the module	Type (* details or exceptions in the "Use" field	ECTS points	Student's workload Note: the basis for calculation is generally 1 ECTS = 25 hrs. Deviations are covered exclusively by Appendix 2 (Bachelor) and 2a (Master) of the SPO
1-4 (3. Sem.) 5-8 (4. Sem.) if internship in 3. Sem.	2 x per year	18 weeks	compulsory	26	Total workload 780 hrs. (100%)

Requirements for enrolment	Use / Restrictions	Type / Duration of exam	Teaching and learning methods	In charge of module
Modules 1-8	Water Technology	Thesis (80%) Colloquium (20%)	1. Interactive Lecture 2. Practical Work 3. Problem-Oriented Learning	Prof. Dr.-Ing. Ulrike Gayh

Learning objectives

Learning outcomes professional skills

In the master thesis the students show deeper knowledge, understanding, capabilities and attitudes in the context of the program of study. The thesis should be written at the end of the program and offers the opportunity to delve more deeply into and synthesize knowledge acquired in previous studies.

Students should considerably demonstrate more in-depth knowledge of the major subject/field of study, including deeper insight into current research and development work. They use a holistic view to critically, independently and creatively identify, formulate and deal with complex issues.

The students present and discuss the knowledge in the respective field and argue these findings in written and spoken English. Students are prepared and have the foundations to conduct independent empirical research, present and evaluate their results responsibly, critically and objectively.

Learning outcomes methodology

The student integrates their knowledge and abilities which they accumulated during the Master course into the thesis. Additionally, they do independent research under the guidance of a supervisor, so that the thesis extends existing knowledge by new professional insights. They demonstrate the ability to investigate, discuss, evaluate and verify information on scientific level.

The student demonstrates the ability to apply research methods to their own project, select an appropriate research question and give a suitable, logical structure to the thesis project.

Learning outcomes social and personal skills

The aim of the thesis is for the student to display the knowledge and transfer it to the topics of the thesis. Students are able to formulate issues, plan and carry out advanced tasks within specified time limits. They can show a successful time-management and motivate themselves to finish their thesis successfully, even through difficult periods.

Constructive alignment

The main focus of the thesis project is the scientific content of the work, which will be submitted in written form. This way the student is also able to prove its ability of applying scientific methods, which is not restricted to a written text only. Initially a research question and the structure of the thesis has to be done and to be confirmed by the supervisor. The master thesis can also carried out in a company. The candidate demonstrates the capability to apply logic thinking onto gathered information and draw valid results from it, so to earn the title Master of Engineering. Elements such as experiments or modelling can be included. Finally, the student is required to present its findings to the supervisors. In the presentation, the candidate proves its ability to summarize the most important content of his/her thesis coherently and comprehensively. During this examination, the student

needs to justify his/her choices and conclusions.

Master Thesis Guidelines

The master's thesis is a carefully argued scholarly paper of approximately 20,000 words (roughly 80 pages). It should present an original argument that is carefully documented from primary and/or secondary sources. The thesis must have a substantial research component and a focus that falls within arts and science, and it must be written under the guidance of an advisor. As the final element in the master's degree, the master thesis gives students an opportunity to demonstrate expertise in the chosen research area.

After doing the initial research on their topic, students prepare a 1-2 paragraph abstract, a preliminary bibliography (approximately ten to fifteen books or journal articles), and a brief outline before approaching a possible advisor. These will help students to convince their future advisor of the value and interest of their project. Once a faculty member has agreed to be the advisor, students need to discuss the anticipated graduation date and agree on a timetable for meetings and submission of drafts. It is each student's responsibility to keep his/her advisor apprised of the work's progress.

After a student has refined his/her topic and his/her advisor has approved it, the student needs to complete the Application for Approval of Master's Thesis Topic, have the advisor sign it, and submit it to the office.

In most cases, students and advisors need to meet three or four times: initially, to finalize a topic, and to review the first or second draft. Keep in mind that the advisor must have enough time to read and evaluate the work before returning it to the student with comments, and that the student must have time to incorporate those comments. Don't expect the advisor to return the thesis in a day or two, whether it is an early draft or the final copy. Students should also be prepared for the possibility that their advisor will request substantial changes in the thesis. Do not expect that the draft thesis will require only minor corrections, or that the proposed final version will necessarily be approved without further changes. It is each student's responsibility to see that the final copy is free from spelling and grammatical errors; the advisor is not responsible for line-by-line editing.

Recommended literature for preparation and follow-up
To be announced

SRH Hochschule Heidelberg, Degree Program: Water Technology (M.Eng.)

Module description and module number: M10 Internship

5-week block	Frequency	Duration of the module	Type (* details or exceptions in the "Use" field	ECTS points	Student's workload Note: the basis for calculation is generally 1 ECTS = 25 hrs. Deviations are covered exclusively by Appendix 2 (Bachelor) and 2a (Master) of the SPO
1-4 (3. Sem.)	2 x per year	18 weeks	optional	30	Total workload 780 hrs. (100%)

Requirements for enrolment	Use / Restrictions	Type / Duration of exam	Teaching and learning methods	In charge of module
Min. 40 ECTS	WT	Internship Report	1. Internship	Prof. Dr. Ulrike Gayh

Learning objectives

Learning outcomes professional skills

In the internship the students show deeper knowledge, understanding, capabilities and attitudes in the context of the practical work in the water sector. The aim of the module is to display the knowledge and transfer it to the topics of the internship

They should considerably demonstrate more in-depth knowledge of the major subject/field of the internship.

Learning outcomes methodology

The students integrate their knowledge and abilities which they accumulated during the study course into practical work.

Learning outcomes social skills

Students improve their understanding and the application of the theoretical background and are thus able to transfer what they have learned into practice. They develop communication and cooperation skills.

Learning outcomes personal skills

Students are able to engage in independent learning and recognize the need for continual professional development. They can compare the requirements of the company with the gained skills during their study course. They can evaluate their own interest and possibilities on the job market

Constructive alignment

The main focus of the internship is to apply the gained knowledge and skill in the study course in practical work.

The students will be informed about intention, content and possibilities for an internship (compare internship regulations). They search and apply for the internship by themselves and develop also their social skills in interviews. The lecturers have a consulting role.

The students can apply their earned knowledge and skills in practice and gain further expertise.

Interim meetings with the superviser and optionally the mentoring professor ensure that the internship an optimum outcome.

The content of the internship will be submitted in written form. In this practical report the students should do a reflectice analysis of the internship. The practical report is a written report on it. Its aim is to allow students to document and reflect upon their personal learning process and skill acquisition during the internship. In addition, they should present examples of how the material and methodology skills they acquired over the course of their studies were applied in the field.

As coursework a presentation has to be given to present the content of the internship to the lecturers and other students.