

MASTER'S PROGRAMME IN WATER AND ENVIRONMENTAL ENGINEERING (WAT) COURSES 2019-2020

Courses:

WAT-E1011 Water & Environment, 10 cr
 WAT-E1030 Computational Methods in Water and Environmental Engineering, 5 cr
 WAT-E2010 Groundwater Hydrology, 5 cr
 WAT-E2020 Environmental Hydraulics, 5 cr
 WAT-E2030 Hydrological Modelling, 5 cr
 WAT-E2040 Surface Water Resources, 5 cr
 WAT-E2060 Sustainable Built Environment, 5 cr
 WAT-E2070 Sustainable Global Technologies (SGT) Studio, 10 cr
 WAT-E2080 Water and Governance, 5 cr
 WAT-E2090 Water and People in a Changing World, 5 cr
 WAT-E2100 Urban Water Systems, 5 cr
 WAT-E2110 Design and Management of Water and Wastewater Networks, 5 cr
 WAT-E2120 Physical and Chemical Treatment of Water and Waste, 5 cr
 WAT-E2130 Modelling and Control of Water and Wastewater Treatment Processes, 5 cr
 WAT-E2140 Sustainability in Environmental Engineering, 5 cr
 WAT-E2150 Environmental Risk Analysis L (5 cr) – course will not be organized anymore
 WAT-E2180 Biological Treatment of Water and Waste, 5 cr
 WAT-E3010 Special Course on Water & Environmental Engineering, 1 - 5 cr
 WAT-E3020 State of the World and Development, 2 cr

WAT-E1011 Water & Environment (10 cr)

Responsible teacher: Marko Keskinen

Status of the Course: Master's Programme in Water and Environmental Engineering, common studies (compulsory)

Level of the Course: Master's studies

Teaching Period: I (autumn term)

Learning Outcomes: After the completion of the course the student is able to...

- Recognise and describe the main characteristics of the water and environmental engineering field, including its link to sustainability [knowledge]
- Understand the principles of the hydrological cycle and water resources management, including the role of hydraulic structures [knowledge]
- Understand the key principles of good environmental and water quality [knowledge]
- Define the main aspects of water and environmental services and related infrastructures, particularly those related to water supply and sewerage systems [knowledge]
- Understand the basic principles of environmental engineering, including material and resource efficiency and environmental risk analysis [knowledge]
- Identify the broader societal context relevant to water and environmental engineering, including the key institutional, legal, and economic/entrepreneurial aspects [knowledge]
- Create his/her Personal Learning Portfolio, and in this way is able to recognise, assess and communicate his/her own key competences and strengths [identity]
- Work interactively as part of the group, with relevant communication and group working skills [identity]

Content:

The course introduces the key contents and principles of water and environmental engineering. The course covers the following themes: sustainability and global resources; environmental and water quality; hydrological cycle and water resources management; water and environmental services and related infrastructures; and environmental engineering, including material and resource efficiency and environmental risk analysis. The course also introduces the general setting for water and environmental engineering field, including governance, legislation and business/entrepreneurship contexts.

The course is structured according to weekly themes, with each week providing introduction to a selected theme and including individual and/or group assignments specific for that theme. The weekly themes are the same than those of WAT-E1030 course.

During the course, the WAT Master's Students also create their Personal Learning Portfolio, building on their existing skills and knowledge as well as their studies. The portfolio process runs through the entire duration of the Master's studies, and includes meetings with peer students and mentors. Non-WAT Master's Students compensate the portfolio work with additional assignment done at the end of the course.

Assessment Methods and Criteria:

MASTER'S PROGRAMME IN WATER AND ENVIRONMENTAL ENGINEERING (WAT) COURSES 2019-2020

Contact sessions, group work, individual assignments and Personal Learning Portfolio.

Assessment based on group work and individual assignments as well as on Peer and Self Assessment.

Study Material: Material given during the Contact Sessions and in MyCourses + Personal Learning Portfolio.

Substitutes for Courses: WAT-E1010 Introduction to Water and Environmental Engineering and WAT-E1020 Water and Environment (together)

Course Homepage: <https://mycourses.aalto.fi/course/search.php?search=WAT-E1011>

Grading Scale: 0-5

Registration for Courses:

Registration through WebOodi. Please see WebOodi for the registration dates.

A limited number of students will be accepted to the course, with preference given to our own Master's Programme students. Other students may be selected based on Motivation Letter and/or other criteria.

The course may not be organized if fewer than 5 students register to the course.

Language of instruction and studies: English, may be completed in Finnish or Swedish upon request

Further Information:

The course is implemented in collaboration with the other WAT common course running during Period I (WAT-E1030), and it is strongly recommended to take both of these courses simultaneously. Alternatively, students taking only this course must be ready to participate also in the relevant sessions of the other common course.

Kindly note that for this reason also the times announced in Oodi are tentative only, and also differ between the weeks: final times will be announced in MyCourses. By taking both courses (WAT-E1011, WAT-E1030), the student must prepare to be available for sessions, assignments and group work during Period I from Monday to Friday from 9am till 4 pm.

As the student groups are formed at the beginning of the course, participation in the course is confirmed by attending the first Contact Session. Due to the course format, participation in other sessions is required as well.

Please note that while the course starts during Period I, the work on Personal Learning Portfolio and group work continues for the entire Master's Programme and also includes a synthesis workshop during Period V in the first year. Course components are valid until the next time the course is given, or as arranged separately.

WAT-E1030 Computational Methods in Water and Environmental Engineering (5 cr)

Responsible teacher: Teemu Kokkonen

Status of the Course: Master Programme in Water and Environmental Engineering (common course).

Level of the Course: Master studies.

Teaching Period: I (autumn term).

Learning Outcomes: After completing the course the student

- knows the key computational methods (see below) related to water and environmental engineering [knowledge]
- can apply basic water and environmental measurement methods and related basic analyses in the laboratory and in the flume [skill]
- understands the basic concepts of storing and processing spatial data in GIS [knowledge]
- knows how linear regression and statistical testing can be applied in water and environmental engineering related problems [knowledge]
- is able to quantify errors associated with hydro-environmental measurements [skill]
- understands basic concepts of applying simulation models to problems related to water and environmental engineering [knowledge]
- knows how risk and life cycle assessment can be applied in the field of water and environmental engineering [knowledge]
- is aware of the potential of using computational methods in solving water and environmental problems [identity]

Content: Key computational methods related to water and environmental engineering. GIS in water and environment related problems. Application of statistical methods to analyze water and environment related problems. Risk and life cycle analysis. Calibration, validation, and application of environmental simulation models. Measurements in the laboratory and in the hydraulic flume. The course is structured according to weekly themes, with each week providing introduction to a selected theme and including tasks specific for that theme. The weekly themes are coordinated by Thematic Leaders (WAT staff), and they are the same for this course and WAT-E1011 course.

Assessment Methods and Criteria: Lectures and weekly exercises. Assessment of the course is based on the exercises.

Study Material: Study material is announced in the first lecture and in the course home page in MyCourses.

Substitutes for Courses: This course replaces the course Yhd-12.3015 Computational Methods in Water Resources Engineering.

MASTER'S PROGRAMME IN WATER AND ENVIRONMENTAL ENGINEERING (WAT) COURSES 2019-2020

Course Homepage: <https://mycourses.aalto.fi/course/search.php?search=WAT-e1030>

Grading Scale: 0-5

Registration for Courses:

Registration through WebOodi. Please see WebOodi for the registration dates.

A limited number of students will be accepted to the course, with preference given to students in the Master's Programme in Water and Environmental Engineering. Other students may be selected based on Motivation Letter and/or other criteria.

The course may not be organized if fewer than 5 students register to the course.

Language of instruction and studies: English, may be completed in Finnish or Swedish upon request.

Further Information: The course is implemented in collaboration with the other common courses running during Period I (WAT-E1011 Water and Environment), and it is strongly recommended to take both of these courses simultaneously. Alternatively, students taking only this course must be ready to participate also in the relevant sessions of the other common course. Course components are valid until the next time the course is given or as arranged separately.

WAT-E2010 Groundwater Hydrology L (5 cr)

Responsible teacher: Teemu Kokkonen; Harri Koivusalo

Status of the Course: Master Programme in Water and Environmental Engineering (advanced course).

Level of the Course: Master studies, doctoral studies.

Teaching Period: II (autumn term).

Learning Outcomes: After completing the course the student

- understands the theoretical background of groundwater flow [knowledge]
- understands the theoretical framework for the mathematical description of advection and dispersion in solute transport [knowledge]
- can construct and apply groundwater models to simple dimensioning problems [skill]
- can contribute as a team member of a group to a larger project work [skill]
- is aware of the assumptions and sources of error in the numerical groundwater flow and solute transport modeling [identity]

Content: Basic principles of flow in aquifers. One-dimensional and two-dimensional modelling of groundwater flow in confined and unconfined aquifers. Assessment of yield of an aquifer. Advection, diffusion, and dispersion in solute transport. Finite difference method in numerical solutions of groundwater and solute transport equations. Note that the course has a methodological emphasis with a focus on numerical groundwater and solute transport modelling.

Assessment Methods and Criteria: Lectures, weekly exercises, planning assignment (group work), exam. Assessment of the course is based on the exercises, the planning assignment and the exam. Relative weights between the different components are given in the beginning of the course.

Study Material: Study material is announced in the first lecture and in the course home page in MyCourses.

Substitutes for Courses: This course replaces the course Yhd-12.3105 Subsurface Hydrology.

Course Homepage: <https://mycourses.aalto.fi/course/search.php?search=WAT-E2010>

Prerequisites: WAT-E1030 Computational Methods in Water and Environmental Engineering, or equivalent knowledge.

Grading Scale: 0-5

Registration for Courses:

Registration through WebOodi. Please see WebOodi for the registration dates.

A limited number of students will be accepted to the course, with preference given to students in the Master's Programme in Water and Environmental Engineering. Other students may be selected based on Motivation Letter and/or other criteria.

The course may not be organized if fewer than 5 students register to the course.

Language of instruction and studies: English, may be completed in Finnish or Swedish upon request

Further Information: Course components are valid until the next time the course is given or as arranged separately.

WAT-E2020 Environmental Hydraulics L (5 cr)

Responsible teacher: Juha Järvelä

Status of the Course: Master Programme in Water and Environmental Engineering (elective course).

Level of the Course: Master studies, doctoral studies.

Teaching Period: IV (before V) (spring term)

Learning Outcomes: After completing the course the student

- Is able to describe and discuss environmental fluid mechanics fundamentals needed in analysing common

MASTER'S PROGRAMME IN WATER AND ENVIRONMENTAL ENGINEERING (WAT) COURSES 2019-2020

problems in environmental hydraulics [knowledge]

- Recognises the interdisciplinary framework of ecohydraulics, fluvial geomorphology, and ecology [knowledge]
- Can identify and analyse principles for environmentally sound hydraulic engineering practices [knowledge/skill]
- Analyses flow of water in open channels with the ability to solve common design problems [skill]
- Recognises and quantifies fluvial erosion, transport, and deposition processes [skill]
- Applies proven methods in collecting and analysing experimental hydraulic measurement data [skill]
- Is able to formulate a thesis or conclusion and justify it, and to anticipate criticisms of his/her arguments, while following common codes of research ethics [identity]

Content: Environmental fluid mechanics. Ecohydraulics, fluvial geomorphology, and ecology from an interdisciplinary point of view. Hydraulics of environmental channels with erosion and sediment transport considerations. Common hydraulic measurements based on experimental research in a laboratory flume. Basic principles related to hydro-environmental engineering solutions.

Assessment Methods and Criteria: Lectures, tutorials, individual exercises, laboratory flume investigations in a small group

Study Material: Material announced during the lectures and exercises.

Substitutes for Courses: Yhd-12.3136 Ekohydrauliikka

Course Homepage: <https://mycourses.aalto.fi/course/search.php?search=WAT-E2020>

Prerequisites: Links to and builds on the courses KJR-C2003 Basic course on fluid mechanics.

Grading Scale: 0-5

Registration for Courses:

Registration through WebOodi. Please see WebOodi for the registration dates.

For organising the tutorials and laboratory assignments, a limited number of students is accepted for the course: selection is based on Motivation Letter with preference given to WAT students.

Accepted students must confirm registration for the course by submitting the pre-survey, attending the first teaching event, and completing the first assignment on time.

Language of instruction and studies: English, may be completed in Finnish or Swedish upon request

Further Information: Partial fulfilments of the course are valid till the course starts again, however, a year at the most.

WAT-E2030 Hydrological Modelling L (5 cr)

Responsible teacher: Harri Koivusalo

Status of the Course: Master Programme in Water and Environmental Engineering (elective course).

Level of the Course: Master studies, doctoral studies.

Teaching Period: III (spring term)

Learning Outcomes: After the course the student ...

- Understands water balance and runoff generation mechanism in areas of different land use [Knowledge]
- Understands linkages from runoff processes to generation of nutrient and sediment loads [Knowledge]
- Is able to compile meteorological data for hydrological models [Skill]
- Is able to construct simple hydrological models and apply models in areas of different land use [Skill]
- Can make a plan of agricultural land drainage [Skill]
- Has improved systematic thinking based on modelling concepts [Identity]
- Has enhanced preparedness for hydrological impact assessments [Identity]

Content: History of hydrological modelling; Precipitation-runoff processes in forests, peatlands, agricultural areas, and urban areas; Construction and application of conceptual and process-based precipitation-runoff models; Stormwater modeling in urban areas; Estimation of sediment and nutrient loads in areas of different land use.

Assessment Methods and Criteria: Lectures, demonstrations, weekly exercises, exam. Assessment of the course is based on the exercises and the exam.

Study Material: Study material is announced in the first lecture and in the course home page in MyCourses.

Substitutes for Courses: Yhd-12.3210 Watershed Engineering

Course Homepage: <https://mycourses.aalto.fi/course/search.php?search=WAT-E2030>

Prerequisites: WAT-E1030 Computational Methods in Water and Environmental Engineering, or equivalent knowledge.

Grading Scale: 0-5

Registration for Courses:

Registration through WebOodi. Please see WebOodi for the registration dates.

A limited number of students will be accepted to the course, with preference given to students in the Master's Programme in Water and Environmental Engineering. Other students may be selected based on Motivation Letter

MASTER'S PROGRAMME IN WATER AND ENVIRONMENTAL ENGINEERING (WAT) COURSES 2019-2020

and/or other criteria.

The course may not be organized if fewer than 5 students register to the course.

Language of instruction and studies: English, may be completed in Finnish or Swedish upon request

Further Information: Course components are valid until the next time the course is given or as arranged separately.

WAT-E2040 Surface Water Resources L (5 cr)

Responsible teacher: Harri Koivusalo

Status of the Course: Master Programme in Water and Environmental Engineering (elective course).

Level of the Course: Master studies, doctoral studies.

Teaching Period: IV (spring term)

Learning Outcomes: After the course the student ...

- Understands factors leading to hydrological extremes in surface waters [knowledge].
- Is able to estimate flood and drought extremes using historical data [skill].
- Is able to quantify lake water balance components and assess regulation impacts on river flow [skills].
- Understands how predicted climate change impacts on water balance components [knowledge].
- Is able to apply multicriteria decision analysis in water resources planning [skills].
- Is able to identify different aspects of integrated water resources management [knowledge/identity].
- Is aware of the EU Water Framework Directive and its implementation [knowledge].
- Is aware of surface water resources and their distribution [knowledge/identity].

Content: Frequency analysis in hydrology; Lake water balance and estimation of its components; Regulation of lakes and rivers; Climate variability and hydrology; Decision support in water resources management; Integrated water resources management; Management of surface waters under the EU Water Framework Directive.

Assessment Methods and Criteria: Lectures, demonstrations, exercises, seminar work. Assessment of the course is based on the exercises and the seminar report.

Study Material: Study material is announced in the first lecture and in the course home page in MyCourses.

Course Homepage: <https://mycourses.aalto.fi/course/search.php?search=WAT-E2040>

Grading Scale: 0-5

Registration for Courses:

Registration through WebOodi. Please see WebOodi for the registration dates.

A limited number of students will be accepted to the course, with preference given to students in the Master's Programme in Water and Environmental Engineering. Other students may be selected based on Motivation Letter and/or other criteria.

The course may not be organized if fewer than 5 students register to the course.

Language of instruction and studies: English, may be completed in Finnish or Swedish upon request

Further Information: Course components are valid until the next time the course is given or as arranged separately.

WAT-E2060 Sustainable Built Environment L (5 cr)

Responsible teacher: Olli Varis

Status of the Course: Water and Environmental Engineering Master's Programme, Creative Sustainability Master's Programme

Level of the Course: Master's degree level

Teaching Period: II (autumn term)

Learning Outcomes: After the completion of the course the student is able to

- understand the fundamentals of main technologies and sustainable infrastructures in rapidly developing world
- explain connections and linkages between different sustainable technologies and infrastructure systems in built environments (water, waste, energy, transport, building design and construction, land tenure and land use)
- comprehend principles of resilient communities
- understand vulnerability of built environments
- work in multicultural teams and recognize his/her own expertise as part of the team or design problem

Content: The course covers fundamentals of basic infrastructures focusing on sustainable technologies, infrastructures and policies aiming for environmentally, culturally and economically more sustainable built environments globally. The key content covers water, energy, waste management, housing, land use, climate change, vulnerability and resilient communities.

Assessment Methods and Criteria: Active participation to lectures, workshops and group work. Course provides multidisciplinary and multicultural learning environment.

MASTER'S PROGRAMME IN WATER AND ENVIRONMENTAL ENGINEERING (WAT) COURSES 2019-2020

Study Material: Material given during the lecture and exercises.

Substitutes for Courses: Yhd-12.3086 Sustainable Global Technologies; changing course

Course Homepage: <https://mycourses.aalto.fi/course/search.php?search=WAT-E2060>

Prerequisites: Yhd-12.3081 State of the World and Development (2 cr) or similar knowledge.

Grading Scale: 0-5

Registration for Courses: Registration through WebOodi. Please see WebOodi for the registration dates.

A limited number of students will be accepted to the course, with preference given to our own Master's Programme students. Other students may be selected based on Motivation Letter and/or other criteria. The course may not be organized if fewer than 5 students register to the course.

Language of instruction and studies: English, may be completed in Finnish or Swedish upon request

Further Information: Course has close linkages with WAT-E2060, WAT-E2080 and WAT-E2090. Highly recommended prerequisite for WAT-E2070 Sustainable Global Technologies Studio.

WAT-E2070 Sustainable Global Technologies (SGT) Studio L (10 cr)

Responsible teacher: Olli Varis

Status of the Course: Water and Environmental Engineering Master's Programme Creative Sustainability Master's Programme

Level of the Course: Master's degree level

Teaching Period: III-V (spring term)

Learning Outcomes: After the completion of the course the student is able to

- understand the diverse linkages and relations from technology, innovations, design and entrepreneurship to socially, economically and environmentally sustainable development
- know different approaches and methods to analyze and implement projects involving such linkages, with in-depth knowledge of at least one such method in the specific setting of their project work
- review and use key literature related to sustainability and technology linkages
- write project proposals, plans and reports, and put into practice different phases of international project work through an array of organizational and business models (governmental, non-governmental, business and academic)
- work in an interactive manner as part of a team, and is familiar with the challenges and possibilities included in working in multidisciplinary and international teams
- recognize and analyze his/her own as well as others' roles and responsibilities in a team
- communicate and present the main outcomes of the project work in clear oral and written manner
- recognize main methods (project work, research, implementation) used in international development and innovation projects
- recognize different actors and stakeholders in the field of their own project, and communicate with them

Content: SGT Studio is a co-learning studio for Master's and PhD students working with various stakeholders. The course looks at the diverse, multi- and cross-disciplinary connections between sustainability and technology in developing contexts. The course includes expert lectures, interactive workshops and extensive project work done in teams. As part of the team work, students may travel abroad to carry out field research on their selected theme. The lecturers and workshops introduce students to the general context of the course as well as to the process of international project work and team work. In this course students will take part in real projects within research groups, civil society organizations or companies. The project work will be mentored by Aalto's research staff and practicing professionals.

Assessment Methods and Criteria: Project work, lectures, co-learning workshops and exercises, including possible 1-2 week field research and co-design trip to project site.

Study Material: Material given during the lecture and exercises. Students must also actively search for additional material for their group work.

Substitutes for Courses: Yhd-12.3092 Sustainable Technologies Studio

Course Homepage: <https://mycourses.aalto.fi/course/search.php?search=WAT-E2070>

Prerequisites: Strong recommendation: Yhd-12.3081 State of the World and Development (2 cr) and Yhd-12.3088 Sustainable Global Technologies; changing course (5 cr) or WAT-E2060 Sustainable Built Environment (5 cr)

Grading Scale: 0-5

Registration for Courses: Registration through WebOodi. Please see WebOodi for the registration dates.

A limited number of students will be accepted to the course, with preference given to our own Master's Programme students. Other students may be selected based on Motivation Letter and/or other criteria. The course may not be organized if fewer than 5 students register to the course.

Language of instruction and studies: English, may be completed in Finnish or Swedish upon request

Further Information:

MASTER'S PROGRAMME IN WATER AND ENVIRONMENTAL ENGINEERING (WAT) COURSES 2019-2020

The course is intended for both Master's and Doctoral students of all disciplines. Note that course field trips are at students' own cost unless otherwise stated in course project descriptions/call for applications.

Course has close linkages with WAT-E2060, and WAT-E2080.

The course is part of the Sustainable Global Technologies Programme (www.sgt.aalto.fi)

WAT-E2080 Water and Governance L (5 cr)

Responsible teacher: Marko Keskinen

Status of the Course: Master Programme in Water and Environmental Engineering (advanced course)

Level of the Course: Master studies, doctoral studies.

Teaching Period: III (spring term)

Learning Outcomes: After completion of the course the student...

- Understands the key characteristics of water governance [knowledge]
- Recognises the key institutions related to water governance in different settings [knowledge]
- Understands the role of legislation and permitting processes in relation to water [knowledge]
- Can apply selected approaches and methods for water governance analysis, and use this for a Case Study [skill]
- Is able to work in an interactive manner as part of a group, including analysing and discussing scientific literature [identity]

Content:

The main themes of the course include water governance and its key elements at different scales; policy-making and institutions in water resources management; and water-related laws and agreements as well as impact assessment and permitting processes.

Methodologically, the course introduces the student to basic approaches and methods related to governance analysis.

Assessment Methods and Criteria:

Contact Sessions, individual assignments and group work.

Assessment of the course is based on individual assignments and group work activities as well as Peer and Self Assessment.

Study Material: Material given during the lectures and in MyCourses. Students are also expected to search for additional material during the group work.

Substitutes for Courses:

Course Homepage: <https://mycourses.aalto.fi/course/search.php?search=WAT-E2080>

Prerequisites: WAT-E1011 Water and Environment, or equivalent knowledge.

Grading Scale: 0-5

Registration for Courses:

Registration through WebOodi: please see WebOodi for the registration dates.

Limited amount of students will be accepted to the course, with preference given to our own WAT Master's Students.

Other students may be selected based on Motivation Letter and/or other criteria.

The course may not be organized if fewer than 5 students register to the course.

Language of instruction and studies: English, may be completed in Finnish or Swedish upon request

Further Information:

Course components are valid until the next time the course is given or unless explicitly agreed otherwise with the teacher in charge.

As the student groups are formed at the beginning of the course, participation in the course is confirmed by attending the first Contact Session. Due to the course format, participation in other sessions is required as well.

WAT-E2090 Water and People in a Changing World L (5 cr)

Responsible teacher: Matti Kummu

Status of the Course: Advanced course at Master programme on Water and Environmental Engineering

Level of the Course: Master studies and doctoral studies.

Teaching Period: V (spring term)

Workload: Contact teaching (lecture-training sessions): 24h (6x4h)

Pre-assignment, orientation to lectures: 24h (6x4h)

Home assignments: 30h (6x5h)

Project work: 55h

TOTAL 133h

Learning Outcomes: After the course a student is able to...

MASTER'S PROGRAMME IN WATER AND ENVIRONMENTAL ENGINEERING (WAT) COURSES 2019-2020

- analyse and assess how global water resources are distributed in relation to human population and how this has changed over time
- recognise the connection between food production and use of water
- analyse the water stress and water scarcity in various scales by using spatial datasets and estimate their impact on human society
- apply GIS softwares (Matlab) on global water challenges
- use different kind of spatial datasets as a part of scientific research
- recognise the basics of visual scientific communication, and create informative maps and graphs

Content:

Food security and the overall wellbeing of human kind are threatened by the overexploitation of our water and land resources. Water scarcity is not only a threat to people, but also to many of the planet's key ecosystems. But how have we ended up in this situation, and how does the future look like?

In this course, the aim is to investigate how the world has changed over time, and how these changes have impacted on our water and land resources. Moreover, as the pressure on natural resources is expected to only grow in the future, an overview on future pathways is given.

Within the course, a student will explore and assess these changes using various spatial analyses methods of Matlab, over different global datasets. Moreover, advanced graph and map making is practised with Adobe Illustrator.

Assessment Methods and Criteria:

Course consist of lectures, hands-on trainings and workshops. Students do each week individual home assignment, which will be collected to a project work at the end of the course. In both, main emphasis is on illustrations and graphics.

Grading: active participation in lecture-training sessions (1/5), home assignments (2/5), individual project work (2/5)

Note: lecture-training sessions are compulsory and student need to attend to minimum five out of six of them, in order to pass the course.

Study Material: Will be given during the course

Substitutes for Courses: Yhd-12.3140 Water and People in a Changing World.

Course Homepage: <https://mycourses.aalto.fi/course/search.php?search=WAT-E2090>

Grading Scale: 0-5

Registration for Courses: Enrollment closes 2 weeks prior the course starts. Within the enrollment you are asked to write short motivation letter; this will be used to student selection if needed. Note: Max 20 students can attend to the course; priority is given to Water and Environmental Engineering MSc programme students.

Language of instruction and studies: English, may be completed in Finnish or Swedish upon request

WAT-E2100 Urban Water Systems L (5 cr)

Responsible teacher: Riina Liikanen

Status of the Course: Master Programme in Water and Environmental Engineering (elective course).

Level of the Course: Master studies, doctoral studies.

Teaching Period: II (autumn term)

Workload:

- Contact hours Lectures 25 h
- Exercise sessions 25 h
- Excursion 5 h
- Independent work Reading materials 40 h
- Project work 20 h
- Homework 20 h

Learning Outcomes: After completing the course the student

- Knows the water supply, wastewater and stormwater infrastructure and understands their role as a part of critical infrastructure
- Understands the elements and importance of the infrastructure's life cycle management
- Knows the organizational and financial management and legal framework of the water supply and wastewater services
- Knows how to conduct a project and present the results

Content: This course gives an introduction to the urban water systems and services. Physical elements, functions and information technologies of urban water infrastructure and their life-cycle management (planning, construction, operation, maintenance, asset management) are presented. Organizational and financial management as well as performance of the water services are discussed. Risk management and contingency planning of the services are also covered.

MASTER'S PROGRAMME IN WATER AND ENVIRONMENTAL ENGINEERING (WAT) COURSES 2019-2020

Assessment Methods and Criteria: Lectures, excursion, homework assignments (individual work), project work (group work). Assessment of the course is based on the assignments and the project work. Relative weights of the different components are given in the beginning of the course.

Study Material: Study material is announced in the first lecture and in the course home page in MyCourses.

Substitutes for Courses: Yhd-73.3005 Vesihuoltotekniikka

Course Homepage: <https://mycourses.aalto.fi/course/search.php?search=WAT-E2100>

Grading Scale: 0-5

Registration for Courses:

Registration through WebOodi. Please see WebOodi for the registration dates.

A limited number of students will be accepted to the course, with preference given to our own Master's Programme students. Other students may be selected based on Motivation Letter and/or other criteria.

The course may not be organized if fewer than 5 students register to the course.

Language of instruction and studies: English, may be completed in Finnish or Swedish upon request

Further Information: Course components are valid until the next time the course is given or unless explicitly agreed otherwise with the teacher in charge.

WAT-E2110 Design and Management of Water and Wastewater Networks L (5 cr)

Responsible teacher: Riku Vahala

Status of the Course: Master Programme in Water and Environmental Engineering (elective course).

Level of the Course: Master studies, doctoral studies.

Teaching Period: III (spring term)

Workload:

- Contact hours Lectures 22h
- Exercise sessions 22h
- Independent work Simulation exercises 80h
- Reading materials 7 h

Learning Outcomes: Upon completion, the student should be able to:

- Recognize the profound influence of water supply services and water quality on public health [identity]
- Understand and manage risks related to drinking water quality [knowledge, skill]
- Build and calibrate hydraulic simulation models of water distribution and wastewater collection systems [skill]
- Estimate, forecast and manage water demand [skill]
- Design and operate water distribution and wastewater collection systems [skill]
- Understand the multi-objective optimization problems related to system design and operation [knowledge, skill]

Content: This course gives an introduction to the design, operation and management of water distribution and wastewater collection systems. The course is useful for students interested in the operation, planning and design of these networks. Health and aesthetic aspects of water quality, water quality control in the networks (biofilm, deposits, internal corrosion, odour control), risk management (Water Safety Plan), water demand management (leakage and pressure control, innovative pricing, water policies, customer metering, etc.), inflow and infiltration assessment, hydraulic modeling, supervisory control and data acquisition (SCADA), system optimization, management of pressure transients, control of sewer overflows.

Assessment Methods and Criteria: Lectures, exercises and group work.

Study Material: Material given during the lectures and exercises.

Substitutes for Courses: Yhd-73.3115 Vesihuoltoverkkojen suunnittelu

Course Homepage: <https://mycourses.aalto.fi/course/search.php?search=WAT-E2110>

Prerequisites: WAT-E2100 Urban Water Systems, or equivalent knowledge

Grading Scale: 0-5

Registration for Courses:

Registration through WebOodi. Please see WebOodi for the registration dates.

A limited number of students will be accepted to the course, with preference given to our own Master's Programme students. Other students may be selected based on Motivation Letter and/or other criteria.

The course may not be organized if fewer than 5 students register to the course.

Language of instruction and studies: English, may be completed in Finnish or Swedish upon request

Further Information: Course components are valid until the next time the course is given or unless explicitly agreed otherwise with the teacher in charge.

WAT-E2120 Physical and Chemical Treatment of Water and Waste L (5 cr)

MASTER'S PROGRAMME IN WATER AND ENVIRONMENTAL ENGINEERING (WAT) COURSES 2019-2020

Responsible teacher: Anna Mikola

Status of the Course: Master Programme in Water and Environmental Engineering (elective course).

Level of the Course: Master studies, doctoral studies.

Teaching Period: IV (spring term)

Workload:

- Contact hours Lectures 30 h
- Exercise sessions & workshops 10 h
- Seminar 4 h
- Independent work Weekly exercises 25 h
- Reading materials 26 h
- Project assignment 16 h
- Preparing for the exams 20 h
- Exams 4 h

Learning Outcomes: Upon completion, the student should be able to:

- Describe the most important physical and chemical water, wastewater, sludge, solid waste and waste gas treatment processes [knowledge]
- Explain the theoretical background of relevant physical and chemical treatment units [knowledge]
- Choose favorable treatment methods for specific water, waste and gases [knowledge/skill]
- Design and dimension the most common physical and chemical unit processes [skill]
- Do simple chemical analyses in the analytical water laboratory and write a report [skill]
- Have a mind-set for understanding the inter-linkages between water, energy and other resources [identity]

Content: This course gives an introduction into the physical and chemical water, wastewater, sludge, solid waste and waste gas treatment processes. The course is useful for students interested in the operation and planning of municipal and industrial water, wastewater and waste treatment plants. Main content: Process principles (types of reactors, mass balances, process kinetics) and treatment processes (screening, sedimentation, flotation, coagulation, mixing, flocculation, filtration, adsorption, ion-exchange, membrane processes, gas transfer, disinfection, oxidation, precipitation).

Assessment Methods and Criteria: Lectures, weekly exercises, plant visit, laboratory project (group work), exams. Assessment of the course is based on the exercises, the laboratory assignment and the exams. Relative weights between the different components are given in the beginning of the course.

Study Material: Course book: Water quality engineering: physical/chemical treatment processes; Mark Benjamin, Desmond Lawler ISBN 978-1-118.16965-0 Other study material is announced in the first lecture and in the course home page in MyCourses.

Course Homepage: <https://mycourses.aalto.fi/course/search.php?search=WAT-E2120>

Grading Scale: 0-5

Registration for Courses: Registration through WebOodi. Please see WebOodi for the registration dates.

A limited number of students will be accepted to the course, with preference given to our own Master's Programme students. Other students may be selected based on Motivation Letter and/or other criteria. The course may not be organized if fewer than 5 students register to the course.

Language of instruction and studies: English, may be completed in Finnish or Swedish upon request

Further Information: This course is a parallel course to "WAT-E2180 Biological treatment of water and waste", which is highly recommended. Course components are valid until the next time the course is given or unless explicitly agreed otherwise with the teacher in charge.

WAT-E2130 Modelling and Control of Water and Wastewater Treatment Processes L (5 cr)

Responsible teacher: Anna Mikola

Status of the Course: Master Programme in Water and Environmental Engineering (elective course).

Level of the Course: Master studies, doctoral studies.

Teaching Period: V (spring term)

Workload:

- Contact hours Lectures 20 h
- Exercise sessions & workshops 20 h
- Project presentations 4 h
- Exams 2 h
- Independent work Weekly exercises 25 h
- Reading materials 34 h
- Project assignment 30 h

MASTER'S PROGRAMME IN WATER AND ENVIRONMENTAL ENGINEERING (WAT) COURSES 2019-2020

Learning Outcomes: Upon completion, the student should be able to:

- Understand the overall process train and the influence of the selected dimensioning on performance, including the characterization of the influent fractions as well as the identification of the process dynamics and of the main disturbances for the process operation [knowledge]
- Understand the modelling and control techniques: state-of-the-art models, basic controllers and their practical application to full scale processes [knowledge]
- Recognise the instrumentation available in the plants: actuators, on-line sensors/analyzers, structure of the automation system and their representation on the piping and instrumentation diagram [knowledge]
- Optimise plant operation in terms of resources consumption and effluent quality improvement [knowledge/skill]
- Analyse and understand the on-line and off-line data available at the treatment plants [skill]
- Design the automation system for the treatment plants by means of simulator software [skill]

Content: The course is useful for students interested in the operation, design and optimization of municipal and industrial water and wastewater treatment plants. Mathematical models of water and wastewater treatment: first principle models and data-derived models, calibration techniques; Basics of data analysis: data visualization, time series, outliers, missing data, time distribution; On-line sensors/analysers: characteristics, measurement principles; Off-line measurements: main parameters to be measured in the lab and related reference methods; Control algorithms: feedback, feedforward, cascade and predictive control; P&I symbols; Simulation software.

Assessment Methods and Criteria: Lectures, weekly exercises and individual simulation project. Assessment of the course is based on the exercises, exams and the simulation project. Relative weights between the different components are given in the beginning of the course.

Study Material: Study material is announced in the first lecture and in the course home page in MyCourses.

Course Homepage: <https://mycourses.aalto.fi/course/search.php?search=WAT-E2130>

Prerequisites: WAT-E2120 Physical & chemical treatment of water and waste and CHEM-E0190 Biological treatment of water and waste, or equivalent knowledge.

Grading Scale: 0-5

Registration for Courses:

Registration through WebOodi. Please see WebOodi for the registration dates.

A limited number of students will be accepted to the course, with preference given to our own Master's Programme students. Other students may be selected based on Motivation Letter and/or other criteria.

The course may not be organized if fewer than 5 students register to the course.

Language of instruction and studies: English, may be completed in Finnish or Swedish upon request

Further Information: Course components are valid until the next time the course is given or unless explicitly agreed otherwise with the teacher in charge.

WAT-E2140 Sustainability in Environmental Engineering L (5 cr)

Responsible teacher: Meeri Karvinen

Status of the Course: Master Programme in Water and Environmental Engineering (advanced course)

Level of the Course: Master's Degree level

Teaching Period: II (autumn term)

Workload: Contact sessions 20-40 h, including lectures, tutored group work, seminar and potentially excursion. Independent studying, which includes performance of group and individual assignments. Totally 135 h

Learning Outcomes: After the completion of the course the student

- is able to define the basic concept of sustainability and discuss on its linkage to other related concepts [knowledge]
- is able to discuss on the principles of different types of methods and measures that can be used to assess sustainability [knowledge]
- is able to apply selected method(s) used in sustainability assessment [skill]
- recognizes the differences and limitations of different methods used in sustainability appraisal in different industrial sectors [knowledge]
- is able to describe how environmental engineering may affect sustainability in the society [identity]
- recognizes his/her own strengths and weaknesses in group working [identity]

Content:

- Introduction to sustainability principles, components & dimensions (global-regional-local); sustainability strategies and regulations; sustainability measures, including indicators, footprints, indices, eco-labels, certificates etc.
- Sustainability and related concepts
- Sustainability assessment methods (e.g. LCA, MFA, MCA, social impact assessment, CBA etc.) with focus on LCA and MFA related techniques; data needs of sustainability appraisal and LCA (databases, process data

MASTER'S PROGRAMME IN WATER AND ENVIRONMENTAL ENGINEERING (WAT) COURSES 2019-2020

etc.)

- Cases from industry, related to for example waste management, energy technology, chemical safety

Assessment Methods and Criteria: Scoring of group work, individual assignment(s), seminar and activity (contact teaching).

Study Material: Course material will be announced in the beginning of the course.

Substitutes for Courses: Yhd-73.3510 Environmental Engineering

Course Homepage: <https://mycourses.aalto.fi/course/search.php?search=WAT-E2140>

Grading Scale: The course is assessed on scale 0/5 - 5/5 (0 = failed). The grade is comprised of the scores of the course assignments and final exam. The weighting of the separate tasks and the exam will be announced in the beginning of the course.

Registration for Courses:

Registration through WebOodi. Please see WebOodi for the registration dates.

A limited number of students will be accepted into the course, with preference given to our own WAT Master's degree students. Other students may be selected based on a Motivation Letter and/or other criteria.

The course may not be organized if fewer than 5 students enroll in the course.

Language of instruction and studies: English, may be completed in Finnish or Swedish upon request

Further Information: Responsible teacher: Jaana Sorvari, jaana.sorvari@aalto.fi. Course coordination: Meeri Karvinen, meeri.karvinen@aalto.fi.

WAT-E2150 Environmental Risk Analysis L (5 cr) – course will not be organized anymore

Responsible teacher:

Status of the Course: Master Programme in Water and Environmental Engineering (elective course).

Level of the Course: Master studies

Teaching Period: **NOTE: course will not be organised in Spring term 2020 – course will be removed**

Workload: Contact teaching 20-40 h, comprising lectures, tutored group or individual work, seminar and potentially excursion. Independent studying, which includes performance of assignments and studying for the exam (if included). Totally 135 h.

Learning Outcomes: After the completion of the course the student:

- knows the regulatory framework and specific terminology of environmental risk analysis (RA) particularly in the context of contaminated land management (CLM) [knowledge]
- recognizes the role of RA in different contexts (e.g. CLM, process safety management, chemicals' assessment, waste management) [knowledge]
- is able to explain the different levels and stages of site-specific RA (human health, ecological, groundwater pollution) procedure [skill]
- recognizes the and the key factors affecting the formation of risks at a specific site and basic methods used in the CLM context and their data needs, limitations and uncertainties [knowledge]
- recognizes the importance of risk communication [knowledge]
- is able to extract data and apply selected method(s) used in RA of contaminated land as well as interpret their results [skill]
- is able to act interactively as member of a project team and report and present its results [skill] and recognizes his/her own strengths and weaknesses in group working [identity]

Content: The course gives an insight to risk analysis (RA) used in environmental engineering. The focus is on RA of chemically contaminated land, other environmental applications will be dealt with only superficially. Following topics will be covered:

- policy instruments (strategies, regulations) related to RA
- principles and concepts of RA
- RA's data needs and data sources (databases, field studies, desk studies)
- different levels and work steps of RA
- RA methods, i.e. models and other methods (e.g. ecotoxicity tests and other laboratory studies, biomonitoring)
- principles and methods of uncertainty analysis
- RAs role in risk management
- RA in other contexts (process safety management, chemicals' assessment, waste management)
- risk communication issues

Assessment Methods and Criteria: Scoring of group work, individual assignment(s), activity (contact sessions and excursion) and exam (if organized).

Study Material: Material presented during the lectures and other contact sessions, other supporting reading material (to be specified and provided in MyCourses page).

Course Homepage: <https://mycourses.aalto.fi/course/search.php?search=WAT-E2150>

MASTER'S PROGRAMME IN WATER AND ENVIRONMENTAL ENGINEERING (WAT) COURSES 2019-2020

Grading Scale: The course is assessed on scale 0/5 - 5/5 (0 = failed). The grade is calculated from the scores of separate course assignments and exam (if included). All components of the course and their shares in the scoring as well as the scores equivalent to each grade will be announced in the beginning of the course.

Registration for Courses:

Registration through WebOodi. Please see WebOodi for the registration dates.

A limited number of students will be accepted into the course, with preference given to our WAT Master's Programme students. Other students may be selected based on a Motivation Letter and/or other criteria.

The course may not be organized if fewer than 5 students enroll on the course.

Language of instruction and studies: English, may be completed in Finnish or Swedish upon request

Further Information: Techer in charge: Jaana Sorvari, jaana.sorvari@aalto.fi.

WAT-E2180 Biological Treatment of Water and Waste L (5 cr)

Responsible teacher: Anna Mikola

Status of the Course: Master's Programme in Water and Environmental Engineering, advanced studies (optional)

Level of the Course: Master's level, doctoral level

Teaching Period: IV (spring term)

Workload: Contact hours. 20-60 h Independent work: 75-115 h

Learning Outcomes: Upon the completion, the student should be able to

- Describe the most important biological water, wastewater, sludge, waste and gas treatment methods [knowledge]
- Explain biochemical, microbiological and ecological phenomena in biological treatment processes [knowledge]
- Form the simple mass balances of biological unit processes [knowledge/skill]
- Identify the critical factors affecting the efficiency of biological treatment processes and describe their control systems [knowledge/skill]

Content: This course gives an introduction into the biological water, wastewater, sludge, solid waste and waste gas treatment processes. The main focus is on wastewater treatment. The course is useful for students interested in the design and operation of municipal and industrial water, wastewater and waste treatment bioprocesses. Introduction to aerobic, anoxic and anaerobic water and waste treatment processes and their biochemistry, microbiology and ecology (biosorption, metabolic processes, mass and energy balances, biomass composition and yield, optimal process environment, inhibitory effects, acclimatization, adaptation and succession); Types of processes and bioreactors; Process parameters and their optimization; Bioprocess control and bioreactor sizing

Assessment Methods and Criteria: Examination(s), exercises and reporting assessments, peer assessment

Study Material: Study material is announced in the first lecture and in the course home page in MyCourses.

Substitutes for Courses: CHEM-E0190 Biological Treatment of Water and Waste

Course Homepage: <https://mycourses.aalto.fi/course/search.php?search=WAT-2180>

Prerequisites: ENG-WAT-E1020 Water & environment or CHEM-E6125 Environmental Management in Industry or similar knowledge in environmental engineering as well as the basic knowledge in chemistry are recommended prerequisites.

Grading Scale: 0-5

Registration for Courses:

Registration through WebOodi. Please see WebOodi for the registration dates.

A limited number of students will be accepted to the course, with preference given to our own Master's Programme students. Other students may be selected based on Motivation Letter and/or other criteria.

The course may not be organized if fewer than 5 students register to the course.

Language of instruction and studies: English, may be completed in Finnish or Swedish upon request

Further Information: This course is a parallel course to "Physical and chemical treatment of water and waste", which is highly recommended. Course components are valid until the next time the course is given or unless explicitly agreed otherwise with the teacher in charge. Replaces the course CHEM-E0190 Biological treatment of water and waste.

WAT-E3010 Special Course on Water & Environmental Engineering L, V(V) (1-5 cr)

Responsible teacher: Matti Kummu

Status of the Course: Master's Programme in Water and Environmental Engineering, advanced studies (optional)

Level of the Course: Master's studies and doctoral studies

Teaching Period: I,II (autumn term) or III, IV, V (spring term). Organized upon notice.

Content: Changing content.

Substitutes for Courses: Yhd-73.3125 Vesitekniiikan erikoistyö OR Yhd-73.3272 Ympäristötekniikan erikoistyö OR

MASTER'S PROGRAMME IN WATER AND ENVIRONMENTAL ENGINEERING (WAT) COURSES 2019-2020

Yhd-12.3126 Vesitekniikan erikoiskurssi.

Course Homepage: <https://mycourses.aalto.fi/course/search.php?search=WAT-E3010>

Grading Scale: 0-5

Language of instruction and studies: English, may be completed in Finnish or Swedish upon request

WAT-E3020 State of the World and Development L (2 cr)

Responsible teacher: Olli Varis

Status of the Course: Master's Programme in Water and Environmental Engineering (advanced course, optional), Creative Sustainability Master's Programme

Level of the Course: Master's level, doctoral level

Teaching Period: I (autumn term)

Workload: Lectures 24h

Reading and independent study 30h

Learning Outcomes: After the course student is familiar with the main principles on global governance and environmental policies and can also recognize international actors and actions in the field of sustainable development.

Content: This course gives an introduction to the state of the world and development. The course highlights the environmental, social and economic aspects of sustainable development and explores the dilemma of development. The course has guest lecturers from different universities and organizations.

Assessment Methods and Criteria: Visiting lectures and reflections diary.

Substitutes for Courses: Yhd-12.3081 State of the World and Development

Course Homepage: <https://mycourses.aalto.fi/course/search.php?search=WAT-E3020>

Grading Scale: Pass/fail

Registration for Courses: Registration through WebOodi. Please see WebOodi for the registration dates. The course may not be organized if fewer than 5 students register to the course.

Language of instruction and studies: English, may be completed in Finnish or Swedish upon request

Further Information: Course is open for students from all study fields. Course is part of the Sustainable Global Technologies Programme (www.sgt.aalto.fi)