MASTER'S PROGRAMME IN WATER AND ENVIRONMENTAL ENGINEERING CURRICULA 2020-2021, 2021-2022 / COURSE DESCRIPTIONS

Note that due to the effects of the COVID-19 virus, course descriptions may change. Check the latest information on courses on the MyCourses website.

WAT-E1100 - Water and Environmental Engineering

Departments: Department of Built Environment
Scope: 15 cr
Status: Master's Programme in Water and Environmental Engineering, common studies (compulsory)
Level: Master
Also qualifies to postgraduate studies: No
Course with varying content: No
Course can be repeated: No
Teaching language: English
Languages of attainment: English
Grading scale: 0-5
Teaching Periods: 2020-2021 Autumn I / 2021-2022 Autumn I
Teacher-in-Charge: Meeri Karvinen
SDG goals: Clean water and sanitation, Sustainable cities and communities, Climate action, Life below water, Life on land, Peace, justice and strong institutions
Substitute: WAT-E1010 Introduction to Water and Environmental Engineering and WAT-E1020 Water and Environment (together) WAT-E1011 Water and Environment and WAT-E1030 Computational methods in Water and Environmental Engineering (together)
Prerequisite: -
Outcome: The intended learning outcomes of the 15 ECTS course are divided in two parts: first part describes the knowledge and context of the field, while the other part the skills required in the field
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]
- Identify the broader societal context relevant to water and environmental engineering, including the key covernance and 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]

In addition, the student:

- knows the key computational methods 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]
- is aware of the potential of using computational methods in solving water and environmental problems [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 management. The course also introduces the general setting for water and environmental engineering field, including key governance contexts.
The course also introduces the 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; 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 individual and/or group assignments specific for that theme. The weekly themes are coordinated by Thematic Leaders (WAT staff).
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.

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

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

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

Registration: Registration via Sisu. 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.

Further information: Kindly note that the times announced are tentative only, and also differ between the weeks: final times will be announced in MyCourses. 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.

WAT-E2010 - Groundwater Hydrology D

Departments: Department of Built Environment

Scope: 5 cr

Status: Master's Programme in Water and Environmental Engineering (advanced course).

Level: Master, Doctoral

Also qualifies to postgraduate studies: Yes

Course can be repeated: No

Teaching language: English

Languages of attainment: English

Grading scale: 0-5

Teaching Periods: 2020-2021 Autumn II / 2021-2022 Autumn II

Teacher-in-Charge: Teemu Kokkonen

SDG goals: Clean water and sanitation

Substitute: -

Prerequisite: WAT-E1100 Water and Environmental Engineering, or equivalent knowledge.

Outcome: 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.

Workload: See MyCourses page

Assessment: 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.

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

Registration: Registration via Sisu. 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.

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

WAT-E2020 - Environmental Hydraulics D

Departments: Department of Built Environment

Scope: 5 cr

Status: Master Programme in Water and Environmental Engineering (advanded course).

Level: Master, Doctoral

Also qualifies to postgraduate studies: Yes

Course can be repeated: No

Teaching language: English

Languages of attainment: English

Grading scale: 0-5

Teaching Periods: 2020-2021 Spring IV / 2021-2022 Spring IV

Teacher-in-Charge: Juha Järvelä

SDG goals: Clean water and sanitation, Affordable and clean energy, Sustainable cities and communities, Climate action, Life below water, Life on land

Substitute: -

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

Outcome: After completing the course the student

- Is able to describe and discuss environmental fluid mechanics fundamentals needed in analysing common 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.
- Basic principles related to hydro-environmental engineering solutions.

Workload: Contact teaching: Lectures 12 h Exercises 28 h Independent studying: Weekly tasks 60 h Experimental assignment 35 h

Assessment: Lectures, tutorials, individual exercises, laboratory experimentation

Material: Material announced during the lectures and exercises.

Registration: Registration via Sisu. 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 in time.

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

WAT-E2030 - Hydrological Modelling D

Departments: Department of Built Environment

Scope: 5 cr

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

Level: Master, Doctoral

Also qualifies to postgraduate studies: Yes

Course can be repeated: No

Teaching language: English

Languages of attainment: English

Grading scale: 0-5

Teaching Periods: 2020-2021 Spring III / 2021-2022 Spring III

Teacher-in-Charge: Harri Koivusalo

SDG goals: Zero hunger, Clean water and sanitation, Sustainable cities and communities, Climate action, Life on land

Substitute: -

Prerequisite: WAT-E1100 Water and Environmental Engineering, or equivalent knowledge.

Outcome: 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.

Workload: See MyCourses page

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

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

Registration: Registration via Sisu. 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.
Further information: Course components are valid until the next time the course is given or as arranged separately.

WAT-E2040 - Surface Water Resources D

Departments: Department of Built Environment
Scope: 5 cr
Status: Master Programme in Water and Environmental Engineering (advanced course).
Level: Master, Doctoral
Also qualifies to postgraduate studies: Yes
Course can be repeated: No
Teaching language: English
Languages of attainment: English
Grading scale: 0-5
Teaching Periods: 2020-2021 Spring V / 2021-2022 Spring V
Teacher-in-Charge: Harri Koivusalo (2020-2021), Eliisa Lotsari (2021-2022)
SDG goals: Clean water and sanitation, Sustainable cities and communities, Climate action, Life below water
Substitute: -
Prerequisite: -
Outcome: 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.

Workload: See MyCourses page
Assessment: Lectures, demonstrations, exercises, case study work and reviews. Assessment of the course is based on the exercises and the case study report.
Material: Study material is announced in the first lecture and in the course home page in MyCourses.
Registration: Registration via Sisu. 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.
Further information: Course components are valid until the next time the course is given or as arranged separately.

WAT-E2060 - Sustainable Built Environment D

Departments: Department of Built Environment

Scope: 5 cr

Status: Water and Environmental Engineering Master's Programme (advanced courses), Creative Sustainability Master's Programme

Level: Master, Doctoral

Also qualifies to postgraduate studies: Yes

Course can be repeated: No

Teaching language: English

Languages of attainment: English

Grading scale: 0-5

Teaching Periods: 2020-2021 Autumn II / 2021-2022 Autumn II

Teacher-in-Charge: Olli Varis

SDG goals: No poverty, Clean water and sanitation, Affordable and clean energy, Industry, innovation and infrastructure, Reduced inequalities, Sustainable cities and communities, Responsible consumption and production, Climate action, Life on land, Partnerships for the goals

Substitute: -

Prerequisite: WAT-E3020 State of the World and Development (2 cr) or similar knowledge (e.g. WAT-E1100)

Outcome: After the completion of the course the student is able to

- understand the fundamentals of 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. Course provides multidisciplinary and multicultural learning environment.

Workload: Workload: (135 hours) The workload by activity type is presented on the MyCourses website in the course syllabus.

Assessment: To pass the course student must attend minimum of 80% of the lectures and workshops and the assignments must be completed by the end of the course. The final grade is based on the active attendance and assignment grades.

Material: Material given during the lecture and exercises.

Registration: Registration via Sisu. 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.

Further information: Course has close linkages with WAT-E3020, WAT-E2080 and WAT-E2090. Highly recommended prerequisite for WAT-E2070 Sustainable Global Technologies Studio and ARK-E2007 Interplay of Cultures Studio.

WAT-E2070 - Sustainable Global Technologies (SGT) Studio D

Departments: Department of Built Environment

Scope: 10 cr

Status: Water and Environmental Engineering Master's Programme (advanced course), Creative Sustainability Master's Programme

Level: Master, Doctoral

Also qualifies to postgraduate studies: Yes

Course can be repeated: No

Teaching language: English

Languages of attainment: English

Grading scale: 0-5

Teaching Periods: 2020-2021 Spring III-V / 2021-2022 Spring III-V

Teacher-in-Charge: Matleena Muhonen

SDG goals: No poverty, Clean water and sanitation, Affordable and clean energy, Decent work and economic growth, Industry, innovation and infrastructure, Sustainable cities and communities, Responsible consumption and production, Climate action, Life on land, Peace, justice and strong institutions, Partnerships for the goals

Substitute: -

Prerequisite: WAT-E3020 State of the World and Development (2cr) or WAT-E1100 Water and Environmental Engineering as well as, WAT-E2060 Sustainable Built Environment (5cr)

Outcome: 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 readings 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 teamwork, 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 teamwork. 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.

Workload:

- Contact teaching 60h
- Independent study 60h
- Team assignment 150h

Assessment: Project work, lectures, co-learning workshops and assignments, including possible 1-2 week field work and co-design trip to project site. To pass the course student must take part actively in the team project work, submit individual assignments in time and participate in peer- and self-evaluation.

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

Registration: Registration via Sisu. 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 application period to this course is usually organized during period I and II**. The course may not be organized if fewer than 5 students register to the course.

Further information: 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-E3020, WAT-E2060, and WAT-E2080.
The course is part of the Sustainable Global Technologies Programme (www.sgt.aalto.fi)

WAT-E2080 - Water and Governance D

Departments: Department of Built Environment
Scope: 5 cr
Status: Master Programme in Water and Environmental Engineering (advanced course)
Level: Master, Doctoral
Also qualifies to postgraduate studies: Yes
Course can be repeated: No
Teaching language: English
Languages of attainment: English
Grading scale: 0-5
Teaching Periods: 2020-2021 Spring III / 2021-2022 Spring III
Teacher-in-Charge: Marko Keskinen
SDG goals: Clean water and sanitation, Life on land, Peace, justice and strong institutions
Prerequisite: WAT-E1100 Water and Environmental Engineering, or equivalent knowledge.
Outcome: After completion of the course the student

- Understands the key characteristics of water governance and its link to sustainability [knowledge]
- Recognises the key institutions and actors related to water governance in different settings [knowledge]
- Understands the role of legislation in relation to water management and governance [knowledge]
- Can apply selected approaches and methods for water governance analysis [skill]
- Is able to work in an interactive manner as part of a group, including reading 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 through a Case Study.
Workload: See MyCourses page
Assessment: 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.
Material: Material given during the lectures and in MyCourses. Students are also expected to search for additional material during the group work.
Registration: Registration via Sisu. 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.
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 D

Departments: Department of Built Environment
Scope: 5 cr
Status: Advanced course at Master programme on Water and Environmental Engineering
Level: Master, Doctoral
Also qualifies to postgraduate studies: Yes
Course can be repeated: No
Teaching language: English
Languages of attainment: English

Grading scale: 0-5

Teaching Periods: 2020-2021 Spring V / 2021-2022 Spring V

Teacher-in-Charge: Matti Kummu

SDG goals: No poverty, Zero hunger, Clean water and sanitation, Responsible consumption and production, Climate action, Life on land

Prerequisite: -

Outcome: After the course a student is able to...

- 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 software (R, R Studio) 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~~ -> R (change for 2021-2022), over different global datasets. Moreover, advanced graph and map making is practised with Adobe Illustrator.

Workload:
Contact teaching (lecture-training sessions): 24h (6x4h)
Pre-assignment, orientation to lectures: 24h (6x4h)
Home assignments: 48h (6x8h)
Project work: 35h
TOTAL 131h

Assessment: 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~~) -> (1/4) (change for 2021-2022), home assignments (~~2/5~~) -> (2/4) (change for 2021-2022), individual project work (~~2/5~~) -> (1/4) (change for 2021-2022).
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.

Material: Will be given during the course

Registration: Enrollment closes one week (change for 2021-2022) prior the course starts. Within the enrollment you are asked to write short motivation letter; this will be used for student selection if needed. Note: Max 25 students can attend to the course; priority is given to WAT Master's students.

WAT-E2100 - Urban Water Systems D

Departments: Department of Built Environment

Scope: 5 cr

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

Level: Master, Doctoral

Also qualifies to postgraduate studies: Yes

Course can be repeated: No

Teaching language: English

Languages of attainment: English

Grading scale: 0-5

Teaching Periods: 2020-2021 Autumn II / 2021-2022 Autumn II

Teacher-in-Charge: Riina Liikanen
SDG goals: Good health and well-being, Clean water and sanitation, Sustainable cities and communities, Responsible consumption and production, Climate action, Life below water
Prerequisite: -
Outcome: After completing the course the student

- Knows the water supply and wastewater infrastructure and understands their role as a part of critical infrastructure
- Knows the elements and importance of the infrastructure's asset 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.
Workload:
Contact hours

- Lectures 25 h
- Exercise sessions 25 h

Independent work

- Reading materials and preparing for lectures 35 h
- Project work 25 h
- Homework 25 h

Assessment: Assessment of the course is based on the individual homework assignments and the project work done in groups. Relative weights of the different components are informed in the beginning of the course.
Material: Study material is announced in the first lecture and in the course home page in MyCourses.
Registration: Registration via Sisu. A limited number of students will be accepted to the course, with preference given to our own WAT 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.
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 D

Departments: Department of Built Environment
Scope: 5 cr
Status: Master Programme in Water and Environmental Engineering (advanced course).
Level: Master, Doctoral
Also qualifies to postgraduate studies: Yes
Course can be repeated: No
Teaching language: English
Languages of attainment: English
Grading scale: 0-5
Teaching Periods: 2020-2021 Spring IV / 2021-2022 Spring IV
Teacher-in-Charge: Riku Vahala
SDG goals: Clean water and sanitation, Sustainable cities and communities
Substitute: -
Prerequisite: WAT-E2100 Urban Water Systems, or equivalent knowledge
Outcome: 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, as well as wastewater and stormwater collection systems [skill]
- Estimate, forecast and manage water demand [skill]
- Design and operate water distribution, wastewater and stormwater 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. Additionally, the course incorporates multiple stormwater collection system aspects, including network design, evaluation of catchment parameters, and sensitivity analysis of the area representing changed land use and climate. 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, pump design, control of sewer overflows.

Workload:

Contact hours

- Lectures 22h
- Exercise sessions 22h

Independent work

- Simulation exercises 80h
- Reading materials 7 h

Assessment: Lectures, exercises and group work.

Material: Material given during the lectures and exercises.

Registration: Registration via Sisu. 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.

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 D

Departments: Department of Built Environment

Scope: 5 cr

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

Level: Master, Doctoral

Also qualifies to postgraduate studies: Yes

Course can be repeated: No

Teaching language: English

Languages of attainment: English

Grading scale: 0-5

Teaching Periods: 2020-2021 Spring III / 2021-2022 Spring III

Teacher-in-Charge: Anna Mikola

SDG goals: Good health and well-being, Clean water and sanitation, Affordable and clean energy, Industry, innovation and infrastructure, Sustainable cities and communities, Responsible consumption and production, Climate action, Life below water

Prerequisite:

Outcome: 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).

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

Assessment: 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.

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.

Registration: Registration via Sisu. A limited number of students will be accepted to the course, with preference given to our own WAT 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.

Further information: This course is closely linked to a parallel course to "WAT-E2180 Biological treatment of water and waste" and it , which is highly recommended to take also that course. 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 D

Departments: Department of Built Environment

Scope: 5 cr

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

Level: Master, Doctoral

Also qualifies to postgraduate studies: Yes

Course can be repeated: No

Teaching language: English

Languages of attainment: English

Grading scale: 0-5

Teaching Periods: 2020-2021 Spring V / 2021-2022 Spring V

Teacher-in-Charge: Anna Mikola

SDG goals: Clean water and sanitation, Affordable and clean energy, Industry, innovation and infrastructure, Sustainable cities and communities, Responsible consumption and production, Climate action, Life below water

Substitute: -

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

Outcome: 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.

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

Assessment: 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.

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

Registration: Registration via Sisu. 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.

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 D

Departments: Department of Built Environment

Scope: 5 cr

Status: Master's Programme in Water and Environmental Engineering (advanced course)

Level: Master, Doctoral

Also qualifies to postgraduate studies: Yes

Course can be repeated: No
Teaching language: English
Languages of attainment: English
Grading scale: 0-5
Teaching Periods: 2020-2021 Autumn II / 2021-2022 Autumn II
Teacher-in-Charge: Meeri Karvinen
SDG goals: Sustainable cities and communities, Responsible consumption and production, Climate action, Life below water, Life on land
Prerequisite:
Outcome: After the completion of the course the student is able to

- define the concept of sustainability and understand the scientific, political, regulative and societal frameworks relating to its implementation [knowledge]
- describe the principles of different types of methods and measures that can be used to assess sustainability and recognize their differences and limitations [knowledge]
- apply selected method(s) used in sustainability assessment [skill]
- promote sustainable development in the society trough his/her own field [identity]
- recognize his/her own strengths and weaknesses in group working [identity]

Content:

- Principles, definitions & dimensions of sustainability; sustainability science and policies; strategies, regulations and voluntary actions
- Means of sustainability implementation in the field of environmental engineering; sustainability measures, including indicators, footprints, indices, eco-labels, certificates; circular economy; life cycle thinking: environmental impact assessment
- Sustainability assessment methods with focus on LCA related techniques; data needs of sustainability assessment and LCA
- Implementing sustainability in the context of corporate responsibility
- Guest lecturers and cases

Workload: Contact sessions 30-40 h, including tutored group work, interactive lectures, seminar and potentially excursion. Independent studying: group assignments and individual tasks. In total 135 h.
Assessment: Course grade is based on scoring of different course activities: group and individual assignments, seminar and attendance in contact teaching/submitting compensatory tasks.
Material: Course material will be announced in the beginning of the course.
Registration: Registration via Sisu. 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.
Further information: Responsible teacher: Meeri Karvinen, meeri.karvinen@aalto.fi.

WAT-E2180 - Biological Treatment of Water and Waste D

Departments: Department of Built Environment
Scope: 5 cr
Status: Master's Programme in Water and Environmental Engineering, advanced studies (optional)
Level: Master, Doctoral
Also qualifies to postgraduate studies: Yes
Course can be repeated: No
Teaching language: English
Languages of attainment: English
Grading scale: 0-5
Teaching Periods: 2020-2021 Spring IV / 2021-2022 Spring IV
Teacher-in-Charge: Anna Mikola

SDG goals: Good health and well-being, Clean water and sanitation, Affordable and clean energy, Industry, innovation and infrastructure, Sustainable cities and communities, Responsible consumption and production, Climate action, Life below water

Substitute: CHEM-E0190 Biological Treatment of Water and Waste

Prerequisite: WAT-E1100 Water and Environmental Engineering or CHEM-E6125 Environmental Management in Industry or similar knowledge in environmental engineering as well as the basic knowledge in chemistry are recommended prerequisites.

Outcome: 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

Workload:

Contact hours. 20-60 h

Independent work: 75-115 h

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

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

Registration: Registration via Sisu. A limited number of students will be accepted to the course, with preference given to our own WAT 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.

Further information: This course is closely linked to course to "WAT-E2120 Physical and chemical treatment of water and waste" and it is highly recommended to take also that course. 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-E3020 - State of the World and Development D

Departments: Department of Built Environment

Scope: 2 cr

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

Level: Master, Doctoral

Also qualifies to postgraduate studies: Yes

Course can be repeated: No

Teaching language: English

Languages of attainment: English

Grading scale: Pass/Fail

Teaching Periods: 2020-2021 Autumn I / 2021-2022 Autumn I

Teacher-in-Charge: Olli Varis, Matleena Muhonen

SDG goals: No poverty, Clean water and sanitation, Affordable and clean energy, Decent work and economic growth, Industry, innovation and infrastructure, Sustainable cities and communities, Responsible consumption and production, Climate action, Life on land, Peace, justice and strong institutions, Partnerships for the goals

Prerequisite: Bachelor's degree

Outcome: After the course student is familiar with the main principles of 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.

Workload:

- Lectures 24h
- Reading and independent study 30h

Required attendance to lectures 80 %

Assessment: Pass/Fail. To pass the course student must attend lectures minimum of 80%. Assignment must be completed by the end of the course.

Registration: Registration via Sisu. The course may not be organized if fewer than 5 students register to the course.

Further information: Course is part of the Sustainable Global Technologies Programme (www.sgt.aalto.fi)