MASTER'S PROGRAMME IN WATER AND ENVIRONMENTAL ENGINEERING (WAT) COURSES 2022-2024

Master's Programme in Water and Environmental Engineering (WAT)

WAT-E1100 - Water and Environmental Engineering
WAT-E2010 - Groundwater Hydrology D
WAT-E2020 - Environmental Hydraulics D
WAT-E2030 - Hydrological Modelling D
WAT-E2040 - Surface Water Resources D
WAT-E2060 - Sustainable Built Environment D
WAT-E2070 - Sustainable Global Technologies (SGT) Studio D
WAT-E2080 - Water and Governance D
WAT-E2090 - Water and People in a Changing World D
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WAT-E2110 - Design and Management of Water and Wastewater Networks D
WAT-E2120 - Physical and Chemical Treatment of Water and Waste D
WAT-E2130 - Modelling and Control of Water and Wastewater Treatment Processes D
WAT-E2180 - Biological Treatment of Water and Waste D
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WAT-E3010 - Special Course on Water & Environmental Engineering V D
WAT-E3020 - State of the World and Development D

WAT-E1100 - Water and Environmental Engineering

Basic fields
Name (EN): Water and Environmental Engineering
Responsible Organizations: Department of Built Environment: 100%
Scope: 15
Level: Advanced studies
Also qualifies to doctoral studies: No
Teaching language: English
Language of study attainment: English
Grading scale: 0-5
Teaching Periods: 2022-2023 Autumn I / 2023-2024 Autumn I
Responsible person(s): Marko Keskinen
Equivalences (EN): WAT-E1011 Water and Environment and WAT-E1030 Computational methods in Water and Environmental Engineering (together)
Prerequisite (EN): -
Description Fields
Learning outcomes (EN): 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 (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]
- is aware of the potential of using computational methods in solving water and environmental problems [identity]

Content (EN): The course introduces the key contents and principles of water and environmental engineering, with emphasis on water. The course covers the following themes: sustainability and global resources; environmental and water quality; hydrological cycle and water resources management; and water and environmental services and related infrastructures. The course also introduces the general setting for water and environmental engineering field. The course introduces the key computational methods related to water and environmental engineering: the use of spatial analysis/GIS in water and environment related problems; application of statistical methods; calibration, validation, and application of environmental simulation models; and 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.

Enrollment selection criteria (EN): Registration for Course on Sisu (sisu.aalto.fi). 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.

Further information (EN): -

SDG goals: Clean water and sanitation, Sustainable cities and communities, Life on land, Comprehensive approach to sustainability

Completion Methods

Participation in teaching

Assessment Type: Participation in teaching

Study Field: Fields of education (Ministry of Education and Culture), Engineering, manufacturing and construction

Study methods (en): Contact sessions, group work and individual assignments. Personal Learning Portfolio (for WAT students).

Evaluation criteria (en): Assessment is based on group work and individual assignments as well as on possible Peer and Self Assessment.

Learning material (en): Material given during the Contact Sessions and in MyCourses.

WAT-E2010 - Groundwater Hydrology D

Basic fields

Name (EN): Groundwater Hydrology D

Responsible Organizations: Department of Built Environment: 100%

Scope: 5

Level: Advanced studies

Also qualifies to doctoral studies: Yes
Teaching language: English
Language of study attainment: English
Grading scale: 0-5
Teaching Periods: 2022-2023 Spring V / 2023-2024 Spring V
Responsible person(s): Teemu Kokkonen
Equivalences (EN): -
Prerequisite (EN): WAT-E1100 Water and Environmental Engineering, or equivalent knowledge.
Description Fields
Learning outcomes (EN): 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 (EN): 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.
Enrollment selection criteria (EN): Registration for Courses: sisu.aalto.fi 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 (EN): -
SDG goals: Clean water and sanitation, Comprehensive approach to sustainability
Completion Methods
Participation in teaching
Assessment Type: Participation in teaching
Study Field: Fields of education (Ministry of Education and Culture), Engineering, manufacturing and construction
Study methods (en): -
Evaluation criteria (en): -
Lectures, weekly exercises, planning assgnment (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.
Learning material (en): Study material is announced in the first lecture and in the course home page in MyCourses.

WAT-E2020 - Environmental Hydraulics D

Basic fields
Name (EN): Environmental Hydraulics D
Responsible Organizations: Department of Built Environment: 100%
Scope: 5
Level: Advanced studies
Also qualifies to doctoral studies: Yes
Teaching language: English
Language of study attainment: English
Grading scale: 0-5
Teaching Periods: 2022-2023 Spring IV / 2023-2024 Spring IV

Responsible person(s): Juha Järvelä
Equivalences (EN): -
Prerequisite (EN): Links to and builds on the courses KJR-C2003 Basic course on fluid mechanics.
Description Fields
Learning outcomes (EN): 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 apply 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 (EN): 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 in experimental research. Basic principles related to hydro-environmental engineering solutions.
Enrollment selection criteria (EN): Registration for courses will take place on Sisu (sisu.aalto.fi). For organising the 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 (EN):
SDG goals: Clean water and sanitation, Life below water, Life on land, Comprehensive approach to sustainability
Completion Methods
Participation in teaching
Assessment Type: Participation in teaching
Study Field: Fields of education (Ministry of Education and Culture), Engineering, manufacturing and construction
Study methods (en): Contact sessions and assignments
Evaluation criteria (en): Individual and group assignments
Learning material (en): Material announced during the lectures and exercises

WAT-E2030 - Hydrological Modelling D

Basic fields
Name (EN): Hydrological Modelling D
Responsible Organizations: Department of Built Environment: 100%
Scope: 5
Level: Advanced studies
Also qualifies to doctoral studies: Yes
Teaching language: English
Language of study attainment: English
Grading scale: 0-5
Teaching Periods: 2022-2023 Spring III / 2023-2024 Spring III
Responsible person(s): Harri Koivusalo
Equivalences (EN): -
Prerequisite (EN): WAT-E1100 Water and Environmental Engineering, or equivalent knowledge.
Description Fields
Learning outcomes (EN): 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 (EN): 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.

Enrollment selection criteria (EN): Registration for courses will take place on Sisu (sisu.aalto.fi). 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. The course may not be organized if fewer than 5 students register to the course.

Further information (EN): -

SDG goals: Clean water and sanitation, Life on land, Comprehensive approach to sustainability

Completion Methods

Participation in teaching

Assessment Type: Participation in teaching

Study Field: Fields of education (Ministry of Education and Culture), Engineering, manufacturing and construction

Study methods (en): -

Evaluation criteria (en): Lectures, demonstrations, weekly exercises, exam. Assessment of the course is based on the exercises and the exam.

Learning material (en): Study material is announced in the first lecture and in the course home page in MyCourses.

WAT-E2040 - Surface Water Resources D

Basic fields

Name (EN): Surface Water Resources D

Responsible Organizations: Department of Built Environment: 100%

Scope: 5

Level: Advanced studies

Also qualifies to doctoral studies: Yes

Teaching language: English

Language of study attainment: English

Grading scale: 0-5

Teaching Periods: 2022-2023 Autumn II / 2023-2024 Autumn II

Responsible person(s): Eliisa Lotsari

Equivalences (EN): -

Prerequisite (EN): -

Description Fields

Learning outcomes (EN): 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 capable of modelling river flow situations, in addition to performing flood risk analyses [skills]
- 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 surface water resources and their distribution at present and in the future [knowledge/identity].

Content (EN): Frequency analysis in hydrology; Lake water balance and estimation of its components; Computational fluid dynamics with 1D model; Analyses of flood risk (both ice-covered and open-channel

conditions); Regulation of lakes and rivers; Climate variability and hydrology; Decision support in water resources management; Integrated water resources management.

Enrollment selection criteria (EN): Registration for courses will take place on Sisu (sisu.aalto.fi). 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 (EN): -

SDG goals: Clean water and sanitation, Sustainable cities and communities, Climate action, Life on land, Comprehensive approach to sustainability

Completion Methods

Participation in teaching

Assessment Type: Participation in teaching

Study Field: Fields of education (Ministry of Education and Culture), Engineering, manufacturing and construction

Study methods (en): -

Evaluation criteria (en): Lectures, demonstrations, exercises, case study work and reviews. Assessment of the course is based on the exercises and the case study report.

Learning material (en): Study material is announced in the first lecture and in the course home page in MyCourses.

WAT-E2060 - Sustainable Built Environment D

Basic fields

Name (EN): Sustainable Built Environment D

Responsible Organizations: Department of Built Environment: 100%

Scope: 5

Level: Advanced studies

Can be completed remotely: No

Teaching language: English

Language of study attainment: English

Grading scale: 0-5

Teaching Periods: 2022-2023 Autumn II / 2023-2024 Autumn II

Responsible person(s): Matleena Muhonen

Equivalences (EN): -

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

Description Fields

Learning outcomes (EN): 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 (EN): 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.

Enrollment selection criteria (EN): Registration on Sisu (sisu.aalto.fi) 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 (EN): Maximum number of students accepted in the course 60

SDG goals: No poverty, Zero hunger, Good health and well-being, Quality education, Gender equality, Clean water and sanitation, Affordable and clean energy, Decent work and economic growth, Industry, innovation and infrastructure, Reduced inequalities, Sustainable cities and communities, Responsible consumption and production, Climate action, Life below water, Life on land, Peace, justice and strong institutions, Partnerships for the goals, Comprehensive approach to sustainability

Completion Methods

Participation in teaching

Assessment Type: Participation in teaching

Study Field: Fields of education (Ministry of Education and Culture), Engineering, manufacturing and construction

Study methods (en): Lectures & Workshops 36h. 80% attendance required.

Independent study, incl. reading and individual assignment 99h.

Evaluation criteria (en): 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.

Learning material (en): Material given during the lecture and exercises.

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

Basic fields

Name (EN): Sustainable Global Technologies (SGT) Studio D

Responsible Organizations: Department of Built Environment: 100%

Scope: 10

Level: Advanced studies

Also qualifies to doctoral studies: Yes

Teaching language: English

Language of study attainment: English

Grading scale: 0-5

Teaching Periods: 2022-2023 Spring III-V / 2023-2024 Spring III-V

Responsible person(s): Matleena Muhonen

Equivalences (EN): -

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

Description Fields

Learning outcomes (EN): 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 global 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 multicultural teams
- recognize and analyze their 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 (EN): 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 studies on their selected theme. The lecturers and workshops introduce students to the general context of the course as well as to the process of multicultural project work and team work. In this course students will take part in real-life projects within research groups, civil society organizations or companies. The project work will be mentored by Aalto's research staff and practicing professionals.

Enrollment selection criteria (EN): Registration in SISU (sisu.aalto.fi) 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 in MyCourses**. The number of students accepted depends on the number of student projects available. Approximately five students are selected per project team. The course may not be organized if fewer than 5 students register to the course.

Further information (EN): -

SDG goals: No poverty, Zero hunger, Good health and well-being, Quality education, Gender equality, Clean water and sanitation, Affordable and clean energy, Decent work and economic growth, Industry, innovation and infrastructure, Reduced inequalities, Sustainable cities and communities, Responsible consumption and production, Climate action, Life below water, Life on land, Peace, justice and strong institutions, Partnerships for the goals, Comprehensive approach to sustainability

Completion Methods

Participation in teaching

Assessment Type: Participation in teaching

Study Field: Fields of education (Ministry of Education and Culture), Engineering, manufacturing and construction

Study methods (en): Joint collaborative workshops, team work with team assignments, independent study with independent assignments, project review clinics, presentations, field study (optional). Study methods combine problem-based learning (PBL), design thinking tools and student-centered approaches.

Evaluation criteria (en): To pass the course student must take part actively in the team project work, contact teaching sesssions, submit individual and team assignments in time and participate in peer- and self-evaluation.

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

WAT-E2080 - Water and Governance D

Basic fields

Name (EN): Water and Governance D

Responsible Organizations:

Department of Built Environment: 100%

Scope: 5

Level: Advanced studies

Also qualifies to doctoral studies: Yes

Teaching language: English

Language of study attainment: English

Grading scale: 0-5

Teaching Periods: 2022-2023 Spring III / 2023-2024 Spring III

Responsible person(s): Marko Keskinen

Equivalences (EN): -

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

Description Fields

Learning outcomes (EN): 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 (EN): 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 related implementation processes. Methodologically, the course introduces the student to basic approaches and methods related to governance analysis with a help of a Case study.

Enrollment selection criteria (EN): Registration for the course through Sisu. Limited amount of students will be accepted to the course, with preference given to WAT Master's Students. Other students may be selected based on Motivation Letter and/or other criteria.

Further information (EN): -

SDG goals: Clean water and sanitation, Sustainable cities and communities, Peace, justice and strong institutions, Partnerships for the goals, Comprehensive approach to sustainability

Completion Methods

Participation in teaching

Assessment Type: Participation in teaching

Study Field: Fields of education (Ministry of Education and Culture), Engineering, manufacturing and construction

Study methods (en): Contact Sessions, individual assignments, group work.

Evaluation criteria (en): Assessment of the course is based on individual and group work assignments as well as on possible Peer and Self Assessment.

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

WAT-E2090 - Water and People in a Changing World D

Basic fields

Name (EN): Water and People in a Changing World D

Responsible Organizations: Department of Built Environment: 100%

Scope: 5

Level: Advanced studies

Also qualifies to doctoral studies: Yes

Teaching language: English

Language of study attainment: English

Grading scale: 0-5

Teaching Periods: 2022-2023 Autumn II / 2023-2024 Autumn II

Responsible person(s): Matti Kummu

Equivalences (EN): -

Prerequisite (EN): -

Description Fields

Learning outcomes (EN): 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 (EN): 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 R, over different openly available global datasets. Moreover, advanced graph and map making is practised with Adobe Illustrator.

Enrollment selection criteria (EN): Registration for courses will take place on Sisu (sisu.aalto.fi). Enrollment closes one week 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.

Further information (EN): -

SDG goals: Zero hunger, Clean water and sanitation, Climate action, Life on land, Comprehensive approach to sustainability

Completion Methods

Participation in teaching

Assessment Type: Participation in teaching

Study Field: Fields of education (Ministry of Education and Culture), Engineering, manufacturing and construction

Study methods (en):

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

Evaluation criteria (en):

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

Grading: participation in lecture-training sessions (1/8), home assignments (5/8), individual final presentation (2/8)

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.

Learning material (en): Will be given during the course

WAT-E2100 - Urban Water Systems D

Basic fields

Name (EN): Urban Water Systems D

Responsible Organizations: Department of Built Environment: 100%

Scope: 5

Level: Advanced studies

Also qualifies to doctoral studies: Yes

Teaching language: English

Language of study attainment: English

Grading scale: 0-5

Teaching Periods: 2022-2023 Autumn II / 2023-2024 Autumn II

Responsible person(s): Riku Vahala

Equivalences (EN): -

Prerequisite (EN): -

Description Fields

Learning outcomes (EN): 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 legal framework and understands the management and performance requirements for the water

supply and wastewater services
- Knows how to conduct a project and present the results

Content (EN): This course gives an introduction to the urban water systems and services. Functions and basic technical components of the urban water systems. Technologies applied to operate, control and manage water supply and wastewater systems. Basic risk management and contingency planning measures of the water utility. Planning, procuring, constructing and commissioning the physical structures of urban water systems. Operation and maintenance of water supply and wastewater systems. General legal framework for providing water services. Concept and functions of benchmarking: performance indicators of water supply and wastewater services. Organisational models of water services. Planning the finance of a water utility.

Enrollment selection criteria (EN): Registration for courses takes place on Sisu (sisu.aalto.fi). 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 (EN): -

SDG goals: Clean water and sanitation, Sustainable cities and communities, Comprehensive approach to sustainability

Completion Methods

Participation in teaching

Assessment Type: Participation in teaching

Study Field: Fields of education (Ministry of Education and Culture), Engineering, manufacturing and construction

Study methods (en):

Lectures and exercises: 50 hours
Reading materials and preparing for lectures: 35 hours
Individual assignments: 25 hours
Project work: 25 hours
Total: 135 hours

Evaluation criteria (en): 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.

Learning material (en): Study material is announced in the first lecture and in the course home page in MyCourses.

WAT-E2110 - Design and Management of Water and Wastewater Networks D

Basic fields

Name (EN): Design and Management of Water and Wastewater Networks D

Responsible Organizations: Department of Built Environment: 100%

Scope: 5

Level: Advanced studies

Also qualifies to doctoral studies: Yes

Teaching language: English

Language of study attainment: English

Grading scale: 0-5

Teaching Periods: 2022-2023 Spring IV / 2023-2024 Spring IV

Responsible person(s): Riku Vahala

Equivalences (EN): -

Prerequisite (EN): WAT-E2100 Urban Water Systems, or equivalent knowledge

Description Fields

Learning outcomes (EN): 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 (EN): 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.
Lectures: Hydraulic modelling of water and wastewater networks, basics of hydraulics, management of pressure transients, water demand management, leakage, inflow and infiltration, sewer overflows, system optimization, pump design, Health and aesthetic aspects of water quality, water quality control in the networks.
Assignments: sewer and water supply modeling, hydraulics and management of pressure transients, modeling leakage, RDII, reducing energy use and leakage in water supply system, water quality modeling
Enrollment selection criteria (EN): Registration for courses will take place on Sisu (sisu.aalto.fi). 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 (EN): -
SDG goals: Clean water and sanitation, Sustainable cities and communities, Comprehensive approach to sustainability
Completion Methods
Participation in teaching
Assessment Type: Participation in teaching
Study Field: Fields of education (Ministry of Education and Culture), Engineering, manufacturing and construction
Study methods (en):
Contact hours
Lectures 22h
Exercise sessions 22h
Independent work
Simulation exercises 80h
Reading materials 7 h
Evaluation criteria (en): Lectures, exercises and group work.
Learning material (en): Material given during the lectures and exercises.

WAT-E2120 - Physical and Chemical Treatment of Water and Waste D

Basic fields
Name (EN): Physical and Chemical Treatment of Water and Waste D
Responsible Organizations: Department of Built Environment: 100%
Scope: 5
Level: Advanced studies
Also qualifies to doctoral studies: Yes
Teaching language: English
Language of study attainment: English
Grading scale: 0-5
Teaching Periods: 2022-2023 Spring III / 2023-2024 Spring III
Responsible person(s): Al-Juboori Raed
Equivalences (EN): -
Prerequisite (EN): -
Description Fields

Learning outcomes (EN): 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 (EN): 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).

Enrollment selection criteria (EN): Registration for courses will take place on Sisu (sisu.aalto.fi). 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 (EN): -

SDG goals: Good health and well-being, Clean water and sanitation, Sustainable cities and communities, Comprehensive approach to sustainability

Completion Methods

Participation in teaching

Assessment Type: Participation in teaching

Study Field: Fields of education (Ministry of Education and Culture), Engineering, manufacturing and construction

Study methods (en):

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

Evaluation criteria (en): 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.

Learning material (en): 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.

WAT-E2130 - Modelling and Control of Water and Wastewater Treatment Processes D

Basic fields

Name (EN): Modelling and Control of Water and Wastewater Treatment Processes D

Responsible Organizations: Department of Built Environment: 100%

Scope: 5

Level: Advanced studies

Also qualifies to doctoral studies: Yes

Teaching language: English
Language of study attainment: English
Grading scale: 0-5
Teaching Periods: 2022-2023 Spring V / 2023-2024 Spring V
Responsible person(s): Anna Mikola
Equivalences (EN): -
Prerequisite (EN): WAT-E2120 Physical & chemical treatment of water and waste and CHEM-E0190 Biological treatment of water and waste, or equivalent knowledge.
Description Fields
Learning outcomes (EN): 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 (EN): 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.
Enrollment selection criteria (EN): Registration for courses will take place on Sisu (sisu.aalto.fi). 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 (EN):
SDG goals: Clean water and sanitation, Sustainable cities and communities, Comprehensive approach to sustainability
Completion Methods
Participation in teaching
Assessment Type: Participation in teaching
Study Field: Fields of education (Ministry of Education and Culture), Engineering, manufacturing and construction
Study methods (en):
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
Evaluation criteria (en): 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.

Learning material (en): Study material is announced in the first lecture and in the course home page in MyCourses.

WAT-E2180 - Biological Treatment of Water and Waste D

Basic fields

Name (EN): Biological Treatment of Water and Waste D

Responsible Organizations: Department of Built Environment: 100%

Scope: 5

Level: Advanced studies

Also qualifies to doctoral studies: Yes

Teaching language: English

Language of study attainment: English

Grading scale: 0-5

Teaching Periods: 2022-2023 Spring IV / 2023-2024 Spring IV

Responsible person(s): Anna Mikola

Equivalences (EN): CHEM-E0190 Biological Treatment of Water and Waste

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

Description Fields

Learning outcomes (EN): 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 (EN): 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

Enrollment selection criteria (EN): Registration for courses will take place on Sisu (sisu.aalto.fi). 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 (EN): -

SDG goals: Clean water and sanitation, Sustainable cities and communities, Climate action, Comprehensive approach to sustainability

Completion Methods

Participation in teaching

Assessment Type: Participation in teaching

Study Field: Fields of education (Ministry of Education and Culture), Engineering, manufacturing and construction

Study methods (en):

Contact hours. 20-60 h

Independent work: 75-115 h

Evaluation criteria (en): Examination(s), exercises and reporting assessments, peer assessment

Learning material (en): Study material is announced in the first lecture and in the course home page in MyCourses.

WAT-E2200 - WAT Project Course D

Basic fields

Name (EN): WAT Project Course D

Responsible Organizations: Department of Built Environment: 100%

Scope: 5

Level: Advanced studies

Also qualifies to doctoral studies: Yes

Teaching language: English

Language of study attainment: English

Grading scale: 0-5

Teaching Periods: 2022-2023 Spring V / 2023-2024 Spring V

Responsible person(s): Meeri Karvinen

Equivalences (EN): This course replaces the course WAT-E2140 Sustainability in Environmental Engineering.

Prerequisite (EN): Recommendation is that students attending the course would have expertise from the WAT field based on a sufficient amount of previously completed WAT advanced courses.

Description Fields

Learning outcomes (EN): After the completion of the course the student is able to
- understand the general context of water and environmental engineering field and its relation to working life practices [knowledge]
- define the concept of sustainability and understand the scientific, political and regulative frameworks relating to its implementation [knowledge]
- identify, analyse and solve practical challenges in WAT field from a sustainability viewpoint [skill]
- apply the knowledge and skills gained from previous studies to a practical project [skill]
- define the elements of project management and implement a project in a given time frame [knowledge & skill]
- communicate with project stakeholders and disseminate own results with an entrepreneurial mindset [identity]

Content (EN): During the course students construct their own interpretations of sustainability based on given material and joint reflections on the topic. Based on their understanding of sustainability, student groups analyse a sustainability challenge / project related to the WAT field, develop solutions for it, and report the work in written form and orally. The group members are expected to work intensively together during the course. There will be some contact sessions for the whole class as well as tutorial sessions to guide the groups during their projects. Representatives from WAT field will tutor the student groups and disseminate the results in their own organisations.

Enrollment selection criteria (EN): Registration for Course on Sisu (sisu.aalto.fi). 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 (EN): -

SDG goals: Comprehensive approach to sustainability

Completion Methods

Participation in teaching

Assessment Type: Participation in teaching

Study Field: Fields of education (Ministry of Education and Culture), Engineering, manufacturing and construction

Study methods (en): Contact sessions including tutored group work, interactive lectures and a seminar. Independent studying: group assignments and individual tasks. Totally 135 h

Evaluation criteria (en): Course grade is based on group and individual assignments and final seminar presentation.

Learning material (en): Course material will be announced in the beginning of the course.

WAT-E3010 - Special Course on Water & Environmental Engineering V D

Basic fields
Name (EN): Special Course on Water & Environmental Engineering V D
Responsible Organizations: Department of Built Environment: 100%
Scope: 1 - 5
Level: Advanced studies
Also qualifies to doctoral studies: Yes
Teaching language: English; other languages upon agreement
Language of study attainment: English
Grading scale: 0-5
Teaching Periods: 2022-2023 Autumn - Spring (I,II,III,IV,V), 2023-2024 Autumn - Spring (I,II,III,IV,V)
Responsible person(s): Matti Kummu
Equivalences: -
Prerequisite: -
Description Fields
Learning outcomes: -
Content: Changing content as agreed with the Responsible Teacher and/or special course adviser.
Enrollment selection criteria (EN): Reregistration for courses will take place on Sisu (sisu.aalto.fi).
Further information: -
Completion Methods
Participation in teaching
Assessment Type: Participation in teaching
Study Field: Fields of education (Ministry of Education and Culture), Engineering, manufacturing and construction
Study methods: -
Evaluation criteria: -
Learning material: -

WAT-E3020 - State of the World and Development D

Basic fields
Name (EN): State of the World and Development D
Responsible Organizations: Department of Built Environment: 100%
Scope: 2
Level: Advanced studies
Also qualifies to doctoral studies: Yes
Teaching language: English
Language of study attainment: English
Grading scale: Pass/Fail
Teaching Periods: 2022-2023 Autumn I / 2023-2024 Autumn I
Responsible person(s): Muhonen Matleena
Equivalences (EN): -
Prerequisite (EN): Bachelor's degree
Description Fields
Learning outcomes (EN): 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 (EN): 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 high-level guest lecturers from different universities and organizations.

Enrollment selection criteria (EN): Registration on Sisu (sisu.aalto.fi). The course may not be organized if fewer than 5 students register to the course.

Further information (EN): -

SDG goals: No poverty, Zero hunger, Good health and well-being, Quality education, Gender equality, Clean water and sanitation, Affordable and clean energy, Decent work and economic growth, Industry, innovation and infrastructure, Reduced inequalities, Sustainable cities and communities, Responsible consumption and production, Climate action, Life below water, Life on land, Peace, justice and strong institutions, Partnerships for the goals, Comprehensive approach to sustainability

Completion Methods

Participation in teaching

Assessment Type: Participation in teaching

Study Field: Fields of education (Ministry of Education and Culture), Engineering, manufacturing and construction

Study methods (en):
Guest lectures 24h,
Reading and independent study 30h

Required attendance to lectures 80 %

Evaluation criteria (en): Pass/Fail.

To pass the course student must attend lectures minimum of 80%. Assignment must be completed by the end of the course.

Learning material (en): -