United Nations Educational, Scientific and Cultural Organization

IHE DELFT
Institute for Water Education
in partnership with UNESCO

Study Guide

Academic programme 2017 - 2019

Programme information

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Introduction

Problems and challenges

Unsustainable management of natural resources hampers the development of mankind and contributes to the unequal distribution of economic welfare. Pollution, depletion of resources and disintegration of ecological functions are of global, regional and local concern. Considering the anticipated economic development and increase in standards of living in developing regions, these issues will become even more urgent in the future. Thus it is not surprising that wise management of our precious (water) resources, environmental conservation, alleviation of poverty and sustainable development are high on the agenda of global concerns [1]

It is now widely acknowledged that, to prevent continued environmental degradation and the decline of human society, interactions between man and the environment have to be sustainable. Sustainability depends on the delicate balance between the use and the conservation of our environmental resources. The challenge to sustainable development, then, is to stimulate further expansion of living standards worldwide while minimising and counteracting the negative impacts on the environment.

Aim of the programme

The aim of the Environmental Science programme is to provide professionals with the knowledge and skills necessary to contribute, directly or indirectly, to the conservation and wise-use of natural resources for the benefit of society. Successful participants will

(i) develop the capacity to carry out independent scientific and technical research and assessments on environmental issues,
(ii) learn to analyse and assess environmental systems and problems,
(iii) be able to propose sustainable solutions to environmental problems and
(iv) contribute to the development of policies and strategies for environmental planning.

Our Approach

To address environmental problems and find sustainable solutions, we must understand the processes that sustain the natural systems, how the systems function and how they interact with each other and with human society. A thorough understanding of how natural systems respond to human actions and interventions is crucial. Through knowledge of the dynamics, functioning and processes of natural systems and an appreciation of the delicate balance between the use and the conservation of our natural resources, improvement of quality of life for human society and sustainable development can be achieved. To equip professionals with the required capacities, the Environmental Science programme offers a systems approach that investigates different subsystems and the interactions between them at the global, regional and local scale, but without losing sight of the overall picture. In exploring the complexities of the human-environmental system the programme seeks a balance between the disciplines taught and the added value of bringing these disciplines together in one coherent programme. Furthermore, the approach of IHE is problem-oriented with a primary focus towards developing countries. This means that the value of the achieved knowledge and skills is measured in terms of applicability of the science, technology, engineering, planning and policies to environmental management. Planning and good policy-making in Environmental Science is based on an understanding of how ecosystems work, how they respond to defined human actions and what remediation actions may be taken to reinvigorate the dynamism of sustainability and biodiversity conservation. As the concept of sustainable development needs its own unique elaboration in contexts where living conditions of large populations are in a critical stage and environmental protection is seen as a luxury, the programme provides tailored approaches and specific knowledge to serve these conditions. In environmental science education, the development of knowledge together with skills is essential. In the IHE approach, lectures by experts in the field are complemented by assignments, exercises, laboratory and fieldwork and group-work. Innovative distance learning and

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electronic interactive educational tools support the programme, while further innovations and developments to link up with IHE's global network of partner institutions are ongoing.

Academic skills development
Throughout the programme the following academic skills will be trained and practiced in the various modules:

module	scientific ethics	information literacy	critical reading	scientific writing	oral presentation	discussion and debating	research skills
ES01	x	x	x	x	x		x
ES02	x	x	x	x	x		x
ES03		x		x	x		x
ES04	x	x	x	x	x	x	x
ES05T	x	x	x	x	x	x	x
ES06TM	x	x	x	x	x	x	x
ES06W				x	x	x	x
ES07T	x	x	x	x	x	x	x
ES07M	x	x	x	x	x	x	x
ES07W	x	x	x	x	x	x	
ES08T				x	x	x	x
ES08MW	x	x	x	x	x	x	x
ES09TMW					x		x
ES09L	x	x	x	x	x	x	x
ES10TWL	x	x	x	x	x	x	x
ES10M	x	x	x	x	x	x	x
ES11T		x			x	x	x
ES11MW	x	x	x	x	x	x	x
ES11X		x			x	x	x
ES11LM	x	x	x	x	x	x	x
ES13TMW	x	x	x	x	x	x	
ES14	x	x	x	x	x	x	x

During various assignments these skills will be assessed and will thus contribute to the module marks. Depending on the specialization, specific research skills will be developed, which can be applied during the final thesis research

Scope of the programme and specializations
Environmental Science is a broad field; any Master Programme in this field is necessarily limited. The IHE Master Programme in Environmental Science provides an overview of the field with emphasis on aquatic and wetland ecosystems and water related issues such as water quality management, nutrient cycles, water pollution control, natural systems for wastewater treatment, and the functioning and use of wetlands. Within this scope the programme offers four specializations that lead to a Master of Science (MSc) Degree.

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Specializations
The Environmental Science programme has the following specializations:

- Environmental Science & Technology (EST)
- Environmental Planning & Management (EPM)
- Water Quality Management (WQM)
- Limnology & Wetland Management (LWM)

EST
Objectives
To provide an integrated course for scientists, technologists and engineers who have an interest in research and development, with the knowledge and skills to address environmental problems and interact with stakeholders, managers and policy makers for appropriate remedial actions.

Subjects (electives in italics between brackets)
Introduction to environmental science (natural processes, human dimensions, analytical tools), Integrated project, Industrial resource management and cleaner production, Environmental systems analysis, Environmental engineering, Environmental monitoring & modelling, International fieldtrip and fieldwork, (*Aquatic ecosystems processes and applications/Environmental assessment for water-related policies and developments), (Strategic planning for river basins and deltas/IWRM as a tool for adaptation to climate change/Solid waste management/Wetlands for livelihood and conservation, or a module from another programme),* Summer course, Group work, MSc Proposal writing, MSc Thesis.

EPM
Objectives
To provide scientists and engineers who wish to specialise in environmental planning and management with the know-how and skills for strategic development, policymaking and decision-making in the environmental arena.

Subjects (electives in italics between brackets)
Introduction to environmental science (natural processes, human dimensions, analytical tools), Integrated project, Water and environmental law, Environmental systems analysis, Water and environmental policy making, Environmental planning and implementation, International fieldtrip and fieldwork, (*Environmental assessment for water-related policies and developments/Aquatic ecosystems processes and applications), (Strategic planning for river basins and deltas/IWRM as a tool for adaptation to climate change/Solid waste management/Wetlands for livelihood and conservation, or a module from another programme),* Summer course, Group work, MSc Preparatory course, MSc Thesis.

WQM
Objectives
To provide an integrated course for scientists and engineers responsible for water quality maintenance/improvement in the catchment, urban and rural environments, with the technical knowledge and management skills for decision-making and environmental planning.

Subjects (electives in italics between brackets)
Introduction to environmental science (natural processes, human dimensions, analytical tools), Integrated project, Water and environmental law, Water quality assessment, Constructed wetlands for wastewater treatment, Environmental planning and implementation, International Fieldtrip, (*Aquatic ecosystems processes and applications/Environmental assessment for water-related policies and developments), (Strategic planning for river basins and deltas/IWRM as a tool for adaptation to*

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climate change/Solid waste management/Wetlands for livelihood and conservation, or a module from another programme), Summer course, Group work, MSc Preparatory course, MSc Thesis.

LWM

Objectives

To provide scientists and engineers, interested in aquatic research and development, with a knowledge and understanding of the structure and functioning of aquatic and wetland ecosystems for their management and wise use, and interact with stakeholders, managers and policy makers for the development of best practices.

Subjects (electives in italics between brackets)

Programme at BOKU.

Programme at Egerton: Lake ecology, Stream and river ecology, Tropical wetlands for water quality, Fisheries and aquaculture.

Programme at IHE: Data analysis and modelling for aquatic ecosystems, Aquatic ecosystems processes and applications, Wetlands for livelihoods and conservation, Summer course, Group work, MSc Preparatory course, MSc Thesis.

[1] World Summit, Johannesburg 2002; World Water Vision, The Hague 2000; UNCED Conference, Rio de Janeiro 1992; UN Conference on the Human Environment, Stockholm1972

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1. IHE Delft

1.1 Introduction

IHE Delft continues the work that was started in 1957 when IHE first offered a postgraduate diploma course in hydraulic engineering to practicing professionals from developing countries. Over the years, IHE has developed into an international education institute providing a host of postgraduate courses and tailor-made training programmes in the fields of water, environment and infrastructure; conducting applied research, implementing institutional capacity building and human resources development programmes, participating in policy development, and offering advisory services world-wide.

The Institute has gradually expanded its academic base to include disciplines such as sociology, economics, and environmental and management sciences. The range of activities has broadened accordingly, from identifying solutions to engineering problems to designing holistic and integrated approaches in the development and management of water and environmental resources, and urban infrastructure systems. The services of the Institute now also include integrated water resources management, effective service delivery and institutional reform, all of which aim to enhance full stakeholder involvement, equity, accountability and efficiency in water sector development and management.

The mission of the Institute is to contribute to the education and training of professionals and to build the capacity of sector organisations, knowledge centres and other institutions active in the fields of water, the environment and infrastructure, in developing countries and countries in transition.

IHE is located in Delft, an internationally renowned centre of excellence in civil engineering and in water related sciences. The Delft University of Technology, the laboratories of Deltares, and The Netherlands Organisation for Applied Scientific Research are situated nearby. IHE Delft maintains intensive relations with national and international institutions to ensure a continuous exchange of knowledge and experience.

1.2 MSc Degree Programmes

The backbone of the Institute are the postgraduate programmes in the fields of:

- Environmental Science
- Urban Water and Sanitation
- Water Management and Governance
- Water Science and Engineering

Each year, these programmes are attended by hundreds of engineers, chemists, biologists, earth scientists, and other professionals from all over the world. The graduates are awarded a Master of Science degree. The programmes are subject to accreditation under Dutch law.

1.3 Research and PhD Programmes

IHE Delft carries out scientific research, often in co-operation with universities and research institutes in developing countries. A number of positions are available for PhD research.

The PhD programme has a nominal duration of 4 years and can be carried out either in Delft or in a sandwich construction. The PhD degrees are awarded by IHE Delft together with a Dutch university. Candidates should preferably hold an IHE Delft MSc degree, but an equivalent degree from another reputed university may also be acceptable.

1.4 Organisation

The Rectorate of the Institute consists of a Rector, a vice rector Academic Affairs and a Business Director.

There are three academic departments:

- Water Science and Engineering
- Environmental Engineering and Water Technology
- Integrated Water Systems and Governance

These departments have one or more chair groups in major fields, led by a professor, who is assisted by academic staff and research fellows.

Process management support units and an education bureau provide administrative support.

Besides the academic staff of IHE Delft, education is provided by selected guest lecturers, who are experts employed by universities, research institutes, government agencies, consulting firms, international organisations, etc. in the Netherlands and abroad.

2 Programme framework

2.1 Introduction

The Institute offers the following Master of Science degree programmes:

- the master programme in Environmental Science;
- the master programme in Urban Water and Sanitation;
- the master programme in Water Management and Governance; and
- the master programme in Water Science and Engineering.

Each programme has several distinct specialisations, in which students follow a curriculum best suited to their preference. Some specialisations are offered jointly with one or more partner institutes in the world. Details of each programme and its (joint) specialisations are given in the programme descriptions of the study guide.

2.2 Academic Regulations

The *Examination Regulations* describe the precise details of how examinations are assessed and marked, the procedures and rules for re-examinations, procedures for appeal, and which results are required for awarding the Master of Science degree.
Special examination regulations are drafted for the joint specialisations.

Students are strongly advised to familiarise themselves with these procedures at an early stage during their study.

2.3 Structure of the Programmes

All Delft based curricula follow a modular structure.
The Delft-based curricula of the MSc Programmes have a duration of 18 months, and consist of 106 ECTS credit points divided between a Taught Part (61 ECTS credit points) and a Thesis Research Part (45 ECTS credit points).

The Taught Part consists of 13 modules.
A module consists of a teaching period (usually 3 weeks) and an exam period (within the exam week following each two consecutive modules). Modules may be shared between or among specializations and/or programmes.

The Thesis Research Part consists of two modules on research methodology and MSc proposal drafting and defence, followed by a period of six months of individual research and writing of the thesis. The MSc thesis is defended publically at the end.

The curricula of the joint specialisations consist of modules offered at IHE Delft and courses at the partner institutes.

2.4 Final Qualifications

Each programme specialisation has a set of final qualifications that state the knowledge, insight and skills achieved by students who successfully complete the programme. A distinction is made between discipline-specific qualifications, which are required by the field of study, and general academic skills, which are expected from university education graduates.
Similarly, each module of the curriculum has a set of learning objectives, which detail the specific outcomes if the student completes that part of the programme. The individual topics in the modules usually aim to achieve a further detailed subset of the module learning objectives.

2.5 Curriculum Information

All components of the curriculum are described in the module plans of the study guide providing the following information:
the name and code of the module;
the learning objectives;
the pre-requisite knowledge or skills;
the study load hours and credit points;
the lecture, exercise and examination contact hours;
the nature and weights of the examination parts;
the responsible lecturers/examiners;
a concise description of the contents and working methods; and
the required and recommended literature, and other materials.

2.6 Teaching Methods

All education activities are conducted using a combination of lectures, exercises, assignments and assessments.
Lectures serve one or more of the following functions:

- to impart information;
- to introduce and explore a topic;
- to build-up complex structures step-by-step;
- to clarify and illustrate concepts and ideas detailed in the literature or lecture notes; and
- to provide a framework for further independent study and reading.

An exercise takes one of the following forms:

- a design or practical exercise;
- a computer or other workshop;
- a laboratory session;
- a fieldwork or fieldtrip; and
- a group work discussion.

Assignments are carried out independently by the students and consist of all required activity to:

- study or practice the lecture material;
- prepare a report, thesis or presentation;
- work out the results of an exercise;
- conduct an experiment or test;
- prepare for an examination; and
- conduct a research or other study.

2.7 Assessments

Assessments serve to test if and how far students have achieved the learning objectives of a module, and ultimately those of the programme itself. The assessment for a module may consist of multiple parts. For example, a combination of a written or oral test and one or more assignments to be handed in separately. Examination work can also be produced by (small) groups of students working together on an assignment, e.g. the group work report.
Assessment of examination material is carried out by appropriate examiners, which are usually the involved lecturers. Students who successfully complete a module will be granted the credit points for that module. Fieldtrips may require active participation instead of an examination in order to receive the credit points.

For each assessment, students are informed about the results via e-mail. When all assessments have been passed, the student has successfully completed the so-called programme examination and will be awarded the degree.

2.8 Study Load

All scheduled education activity taking place in the presence of a lecturer or an assistant is designated as contact time. All other time spent by students in relation to the study programme is designated as independent study time. The study load for (a part of) a programme is the cumulative contact time and independent study time that is nominally required to successfully complete that (part of the) programme. Study load is expressed in whole ECTS credit points, where one ECTS credit point is equivalent to 28 working hours.
The study load credits for a curricular activity indicate the notional time spent by an average learner to achieve the required outcomes for that activity, as specified by the learning objectives. The nominal time expenditure for a 5 ECTS credit points module is therefore 140 hours.
Where study load involves scheduled class-based activity, one lecture period is taken equal to two hours of contact time.

2.9 Planning and Scheduling

Education activities taking place inside the Institute are, in principle, scheduled into 'periods' of two hours each, for which the following times are available:
Period 1 08:45 – 09:30 and 09:45 – 10:30
Period 2 10:45 – 11:30 and 11:45 – 12:30
Period 3 13:45 – 14:30 and 14:45 – 15:30
Period 4 15:45 – 16:30 and 16:45 – 17:30
Throughout the academic year, the student will receive the following information and materials:

- schedules of the education activities;
- required lecture notes, textbooks and other course-related material;
- announcements of assessment planning details; and
- statements on assessment results and study progress.

2.10 Participation in coursework and lunch seminars

Active participation and attendance by students is required for all curricular activities on the schedule. Special attention is required for lunch seminars. During the academic programme lunch seminars are organised focussing on a specific topic. Participants are required to attend these seminars as well Students have to inform their programme coordinator as early as possible when they are not able to attend a scheduled programme activity.

2.11 Evaluation of the Programme by Students

As part of the quality assurance procedures of the Institute the programmes are routinely evaluated in order to obtain feedback from the students regarding the quality of the content and the performance of the lecturers. The evaluations are based on a module questionnaire, which the students complete in separate class sessions. The questionnaire asks the students to provide a rating for achievement of the learning objectives, the study load feasibility, the contents of the subject matter, the balance between the various working and examination methods, the quality of the lecture materials, and the presentation by the lecturers. Furthermore, additional written comments and an overall rating for the module may be provided.
The module evaluations are carried after the examination, but before the results have been announced. Students can also request to address specific programme related issues in a group or individual discussion with the involved coordinator or lecturers.

Feedback on the programmes from the students is much appreciated. The Institute uses the results of the evaluations to improve the academic programmes where necessary, in order to maintain high standards of education.

3 Regulations

3.1 Examination regulations

See for the Examination regulations the separate part of the study guide.

3.2 Library regulations

Fair use of on-line information resources at the IHE Delft Library.

The IHE Delft Library Services provides access to a large number of on-line information resources and databases. Access to these resources is provided to all computer users within the premises at Westvest and through remote authentication via the IHE Delft portal. By using these on-line resources you agree with the following conditions:

1) Systematic downloading of electronic journals articles using manual means is permitted only within reasonable amounts; no more than 50 downloads per user within 24 hours.

2) Programmatic downloading / 'web crawling' is not allowed. In addition to systematic downloading of files manually, the use of a spider (web crawler), the intention of which is to programmatically download data within a specific website, is prohibited.

3) Copyright/reproduction. It is prohibited to reproduce entire or parts of publications in your own publication without the consent of the publisher. You are obliged to provide a correct source reference of all of the material at all times.

4) Selling and providing material to third parties is strictly forbidden. The re-sale of material purchased subject to license to third parties is prohibited; this applies both within and outside of the Institute for which the materials have been purchased.

5) Permanent archiving. Large-scale archiving is not permitted on the local servers or your hostel personal computer nor is the continued use of these servers as an archive, in collaboration with third parties or otherwise. The temporary storage of archive material for personal use is permitted for a period not longer than 120 days.

6) Making changes to an original work. Infringing upon an original work by merging various original texts into a document or by amending original texts is prohibited. Processing materials in such a way is an infringement upon the copyright that is held by the publisher or the author him/herself.

Infringement of one or all of the above mentioned stipulations will be considered as academic misconduct and will result in disciplinary measures, which will be proportionate to the seriousness of the infraction. The Rector will decide upon the disciplinary measures which will be taken. These measures may include temporary or permanent suspension from attending class.

3.3 Code of conduct

THE RECTORATE OF IHE Delft

- In consideration of the need for rules and regulations concerning the safety and the proper use of the buildings, grounds and facilities of IHE Delft by students and visitors;
- In accordance with article 7.57h and article 9.2, first paragraph, of the Higher Education and Scientific Research Act of the Netherlands;
- Having heard the Student Association Board;

RESOLVES to establish the following Regulations:

Article 1 Definitions

1.1 WHW	Higher Education and Scientific Research Act of the Netherlands (Staatsblad Bulletin of Acts and Decrees 1992, 593);
1.2 the Rector:	the rector of IHE Delft
1.3 the Rectorate:	the rector, the deputy rector Academic affairs and the business director
1.4 Central services department	the central services department of IHE Delft
1.5 Facilities	the institute buildings, the interior and equipment as well as rented office and accommodation facilities
1.6 Buildings	the buildings of IHE Delft, located at Westvest, Delft
1.7 Student	anyone who is enrolled at IHE Delft for the purpose of education provided by IHE Delft and who uses the educational and examination facilities of IHE Delft for this purpose;
1.8 Visitor	anyone who is not a student nor is employed by IHE-Delft as referred to in article 1.1 of the Collective Labour Agreement (CAO) for Dutch Universities.

Article 2 Compliance requirement for rules, guidelines and instructions

2.1 Any student or visitor making use of the grounds, buildings or facilities of IHE Delft is required to comply with all rules, instructions and/or directions issued by the Rectorate and delegated staff with regard to maintaining order and proper social conventions of the host country within the buildings and on the grounds. According to the in the institutes code of undesirable behaviour the following is considered to be undesirable behaviour: sexual harassment, aggression, or violence, both verbal and non-verbal towards course participants, staff, visitors or contracted staff. Furthermore all participants, staff, visitors and contracted staff are to observe and comply with the rules and regulations with regard to appropriate and legitimate use of the facilities of IHE Delft scrupulously and without delay, and is required to deport him or herself such that:

a. he or she does not cause direct or indirect damage to IHE Delft or to other persons who are present on the grounds or in the buildings of IHE Delft or who make use of the facilities of IHE Delft, nor that he or she causes nuisance or annoyance;

b. he or she does not infringe on the rights of IHE Delft or of other persons who are present on the grounds or in the buildings of IHE Delft or who make use of the facilities of IHE Delft;

c. he or she does not act contrary to statutory obligations;

d. he or she does not act contrary to appropriate and proper social conventions with regard to people or property.

2.2 It is prohibited to wear clothing that covers the face or to wear other clothing and/or accessories that severely interfere with communication between teaching staff and students or between students themselves or between members of the teaching staff. When sitting an examination it is prohibited to wear clothing that covers the face or to wear other clothing and/or accessories that severely limit the ability to establish the identity of the person in question.

2.3 The Head of the Central Services department may, on behalf of the Rectorate, issue instructions and directions for the purpose of ensuring the smooth and proper use and functioning of buildings and grounds of IHE Delft entrusted to him/her.

Article 3 Disciplinary Measures

The Rectorate may take the following measures against any student or visitor who fails to comply with the contents of these Regulations, with due observance of the procedure described in these Regulations:

a. excluding the student or visitor from the buildings and grounds of IHE Delft or from one or more parts of IHE Delft, with the provision that a student may only be excluded from buildings or grounds in whole or in part for a period not to exceed one year;
b. excluding the student or visitor from the use of the facilities of IHE Delft;
c. fining the student if such fine has been agreed on or follows from the statute;
d. issuing a written reprimand;
e. retribution for damages to properties and or facilities.

Article 4 Exclusion Order by the Rectorate

4.1 The Rectorate may immediately issue an exclusion order for the buildings or grounds, or for parts of those buildings or grounds, to a student or visitor who commits an infringement on these Regulations or the rules referred to in article 2, or it may issue an exclusion order for the institute facilities.

4.2 Anyone who is subjected to measures as referred to in the first paragraph will be given the opportunity for a subsequent hearing as soon as possible by or on behalf of the Rectorate if this was not previously possible due to the urgent nature of the matter at hand.

4.3 The exclusion order will contain at least the following:

a. an indication of the buildings and/or grounds or the parts of the buildings and/or grounds of IHE Delft and/or the facilities or use of the facilities of IHE Delft to which the exclusion order applies;
b. the duration of the exclusion order;
c. the reasons for the exclusion order;
d. any conditions which will result in the effectuation of the exclusion order in case of noncompliance.

Article 5 Termination of the exclusion order

5.1 The Rectorate may, of its own accord or in response to a request by a person who is subject to a disciplinary measure in the form of an exclusion order as referred to in these Regulations, choose to terminate the exclusion order or alter its scope before it has elapsed if there is sound reason to do so according to the judgement of the Rectorate.

5.2 The Rectorate may attach special conditions to the termination or alteration of the exclusion order.

5.3 If in the judgment of the Rectorate the person subject to the exclusion order, and on behalf of whom a proposal to terminate said order has been forwarded, has not met the special conditions set by the Rectorate, then the original exclusion order will once again be put into force; the period of time that has passed since the termination or alteration of the exclusion order will not be deducted from the originally specified period in this case.

Article 6 Entry into force

These Regulations enter into force on October 1st 2007

Article 7 Method of Citation

These Regulations may be cited as “Regulations for the use of buildings, grounds and facilities by students and visitors of IHE Delft”. Approved in the rectorate meeting of September 25th 2007

3.4 Plagiarism

NOTE: FAILURE TO COMPLY WITH THE TERMS OF THIS SECTION COULD JEOPARDISE YOUR DEGREE. PLEASE READ AND DIGEST CAREFULLY.

It is very important that all students understand IHE Delft rules about plagiarism.

Students sometimes break these rules unintentionally because they do not realise that some of the ways in which they have incorporated other people's work into their own, before they came to IHE Delft, may be against the rules here.

At the beginning of the programme, and before submitting any assessments, you will be required to agree to an 'own work declaration'. You will also be invited to give consent for the scanning of your work by plagiarism detection software. Work cannot be submitted unless these conditions are agreed to.

What is plagiarism?

Plagiarism is the practice of taking someone else's work or ideas and passing them off as one's own. This act is considered as academic fraud. When there is a strong presumption of plagiarism, whether occurring during the course of the study or after the completion of the study, cases will be investigated by the Examination Board. The Examination Board shall examine the cases of alleged plagiarism on their individual merits. After examining all the evidence, the Examination Board shall establish whether plagiarism and implicitly fraud has been committed. When fraud has been established the offender will be given the mark of 1.0 for the examination work.

Plagiarism detection

IHE Delft uses a computer program called Turnitin ® to assist with the detection of plagiarism. The plagiarism detection service is an online service that enables IHE Delft and its staff to carry out electronic comparison of students' work against electronic sources including other students' work. Turnitin ® works by executing searches of the World Wide Web, and extensive databases of reference material, as well as content previously submitted by other IHE Delft students.

Each new submission is compared with all the existing information. The software makes no decisions as to whether a student has plagiarised, it simply highlights sections of text that are duplicated in other sources. All work will continue to be reviewed by the course coordinator.

Once work has been submitted to the system it becomes part of the ever growing database of material against which subsequent submissions are checked.

The software is used as a tool to highlight any instance where there is a possible case of plagiarism. Passages copied directly or very closely from existing sources will be identified by the software and both the original and the potential copy will be displayed for the examiner to view. Where any direct quotations are relevant and appropriately referenced, the examiner will be able to see this and will continue to consider the next highlighted case.

Citing references

The key to avoiding plagiarism is to make sure that you give correct references for anything that you have taken from other sources to include in your academic work. This might include, for example, any ideas, theories, findings, images, diagrams or direct quotations that you have used. At IHE Delft the house style for references is based on the Hydrogeology Journal output. If you take any material word for word from another source, it is essential that you make it clear to your reader that this is what you have done.

If you take material from another source, change a few words and then include the reference you may still have committed a plagiarism offence because you have not made it clear to your reader that you have essentially reproduced part of the original source. You should either express the ideas fully in your own words and give the reference or else use clearly labelled direct quotes. Bear in mind that if you include too many direct quotes in your work this may reduce your grade, as the marker will find

it difficult to see evidence of your own understanding of the topic. You must also include a bibliography and references section at the end of your work that provides the full details of all of the sources cited within the text. You should be aware that, for work done in other subject areas, you might be expected to use a different referencing system.
The process of referencing may seem rather complicated and arbitrary, if it is new to you, but it should begin to make more sense as you progress through your studies. In order to assess your work and to give you useful feedback your marker needs to have a clear sense of what ideas you have developed for yourself and what comes from elsewhere. To be fair to all of the students on the course it is important that each student is given grades that accurately reflect their own efforts. As you learn to produce work at a Master standard, you are developing the skills that will allow you to participate within wider communities of scholars. In these communities new knowledge and understanding is often developed by building on the work of others. By properly acknowledging earlier work you give credit where it is due and help to maintain the integrity and credibility of academic research in this area. Clear referencing also allows readers to learn about the wider literature through your work. It is often the case that understanding the ways in which particular scholars have contributed to the development of the literature makes it much easier to make sense of the current state of play.

Team work, accidental and self-plagiarism plagiarism
Students sometimes wonder where to draw the line between discussing their ideas with their peers (which can be an excellent learning experience) and unacceptable collusion. The time to be particularly careful is when you are preparing work for assessment. You need to be certain that the work you submit represents your own process of engagement with the task set. You may get into difficulty if, for example, reading another student's plan for their work influences you, or if you show them your plan. Assisting another student to plagiarise is a cheating offence.
In addition to giving references for all of the materials that you have actually included within your assignments, it is important to appropriately acknowledge other sources of guidance you have used when preparing your work.
Accidental plagiarism is sometimes a result of a student not yet having fully come to terms with how to study effectively at university. For example, the ways in which students take their notes sometimes makes it difficult for them to later distinguish between verbatim quotes, paraphrased material and their own ideas. A student may also plagiarise unintentionally because they have been feeling daunted by a piece of work and so have put it off for so long that they have had to rush to meet the deadline. If you think these kinds of wider issues may be relevant to you then you should contact your module coordinator.

Plagiarism guide's references
The following sources were used in the development of the plagiarism guide:
Blum, S. D. (2009). My word! : plagiarism and college culture. Ithaca: Cornell University Press.
Carroll, J. and Appleton, J. (2001). Plagiarism: A Good Practice Guide. Oxford: Oxford Brookes University and Joint Information Systems Committee
Eisner, C., & Vicinus, M. (2008). Originality, imitation, and plagiarism : teaching writing in the digital age. Ann Arbor: University of Michigan Press.
Sutherland-Smith, W. (2008). Plagiarism, the Internet and student learning : improving academic integrity. New York: Routledge.
Harvard University Guide to Plagiarism
http://isites.harvard.edu/icb/icb.do?keyword=k70847&pageid=icb.page355322
Purdue University Writing Lab
http://owl.english.purdue.edu/
University of Princeton Academic Integrity
Site http://www.princeton.edu/pr/pub/integrity/pages/plagiarism/
University of Teesside Plagiarism Guidance http://dissc.tees.ac.uk/Plagiarism/Plag-4.htm

4 Facilities

4.1 Location

The IHE Delft buildings and facilities are located on a single compound at the Westvest 7 in the centre of Delft. The buildings provide an efficient atmosphere for optimal learning and creativity, direct communication with lecturers and other staff, as well as meeting with fellow students. The building is open during the following times:
Monday to Friday 07:30 – 20:00
Saturday 08:00 – 12:30

4.2 Student Affairs (office)

The Student Affairs office provides non-academic support to students. The SA office takes care of student applications and student registration. The new students are also assisted with formalities such as applications for residence permits, insurance, bank accounts, and fellowship issues. Housing arrangements in one of the hostels are being made immediately upon arrival.
Throughout their study period, students can contact the staff during office hours for information or questions related to health, religion or other issues related to the student's wellbeing. Personal matters can be discussed with the student counsellor and will be dealt with strictly confidential.
During the entire academic year, SA organizes a number of social and cultural activities including the weekly movie night, social evenings and the annual Christmas dinner. Other activities include cultural excursions to interesting cities and places in the Netherlands and other countries in Europe. Furthermore, the students are given opportunity to actively practice sports on a regular basis. From October to May, the Institute arranges accommodation in Delft for such sports as soccer, volleyball, basketball and badminton. The SA office organizes sports events and tournaments, in which the teams can compete internally, but also against players from other international institutes.

4.3 Student Association Board

The Student Association Board (SAB) is composed of representatives who are elected by the students in annual elections that take place several weeks after the opening of the academic year.
The SAB provides a forum through which students can share their experiences, problems and general issues on study-related matters. If necessary, the SAB will bring these matters forward in discussions with the executive levels of the Institute. The board can be contacted directly via its members or the general e-mail address sab@unesco-ihe.org. The SAB closely co-operates with the Student Affairs office in organizing social and sporting events.

4.4 ICT services

IHE Delft provides modern computing (IT) facilities for education and research. A local wired- and wireless network is available in the building. Through the network all computers have access to a fast Internet connection. Besides that, participants have unlimited access to Internet in all hostels provided by IHE Delft.
All desktop and laptop PCs are Intel based with Microsoft Windows operating system. The laptop PC will be provided in order to get access to the IT facilities.
The laptop is on loan for use during studying at IHE Delft. At the end of the study, the institute offers the possibility to buy the laptop. The contract given clearly states the terms and conditions for borrowing the laptop. Bringing one's own laptop is allowed; however, laptops other than the IHE Delft laptop might not give access to all the required IT-facilities and might not be supported by IT-service desk.
A wide range of software packages is available, ranging from standard PC-software, like Microsoft Office (Word, Excel, etc.) to special modelling software used for the education programmes. Upon registration you will receive an IHE Delft e-mail account which enables you to make use of all relevant

computing facilities at the Institute.. A web-based E-learning and collaborative system is accessible for all participants to exchange learning information and documents.
For specific applications during the thesis study, it may be possible to use specialist software packages on the laptop PCs. This is, however, dependent on the particular type of licence agreement that the Institute has with the supplier. Enquiries for specific software should be made at the computer helpdesk.

4.5 General Facilities in the Building

In the reception area of the building, students have their own locker for the distribution of schedules, lecture notes and other study-related papers, and private mail. Two monitor screens opposite the reception desk are regularly updated with news or information on events taking place at IHE Delft.
The restaurant provides a wide variety of reasonable-priced multicultural meals and beverages during lunchtime. The meals can be paid using the bank-card or cash. Coffee, tea and soft drinks can be obtained from machines throughout the day.
The building houses a number of fully-equipped lecture rooms and theatres, which can accommodate groups of all sizes from 15 to 300 persons. Rooms for facilitating computer classes and workshops are present and can be used freely by students outside class hours.
Furthermore, the Institute has its own printing and reproduction facilities and also contains an in-house distance learning and video conferencing centre. Photocopy services are available to students.
In the building also a meditation room is available, which is located on the third floor.

4.6 IHE Delft Library and Information Services

IHE Delft's Library provides access to over 35,000 printed titles, among which the complete collection of IHE Delft Master thesis and PHD dissertations. Furthermore the collection contains over 8.000 online journals. The online journals collection is accessible on the network at the Westvest premises or through remote authentication through the portal. For more information please visit the Library's Internet page http://www.unesco-ihe.org/library
The library is open to all IHE Delft participants and staff, and to visitors by appointment.
The services provided by the library include lending out books, requesting articles and other materials through the inter-library loan system and providing assistance in searching the electronic catalogue.

Membership
Upon registration participants receive a registration card which can also be used to borrow items from the library collection.

The catalogue
The library collection is accessible through an electronic catalogue, which is searchable by author, title (word) and subject, as well as by Boolean operators. Please visit http://www.unesco-ihe.org/library for more information.

Borrowing library items
A maximum of ten items may be borrowed from the library at any one time. The maximum loan period is 21 days, renewable up to a maximum of 42 days. Renewals can be made online, http://www.unesco-ihe.org/library by using the borrower information function within the catalogue or by email (library@unesco-ihe.org). Please note that the loan period can be extended only if the items have not already been reserved by another person.
Reference works, MSc theses, bound and non-bound periodicals and materials bearing a green sticker may not be borrowed. By using their library card to borrow items from the library, borrowers agree to be responsible for those items, including the cost of replacing lost or damaged items.

Opening Hours
Monday 09:00–18.30
Tuesday-Friday 09:00–19.00
Saturday 09:30–12:30
Please note that the Library opening hours are subject to change. Visit the Library webpage for regular updates. For further information please contact the library reference desk.
Email: library@unesco-ihe.org
Tel: +31 (0)15 215 1714
Fax: +31 (0)15 212 2921

4.7 Laboratories

Modern educational and research laboratories are available in the fields of chemistry, process technology, microbiology, aquatic ecology and soil science. A wide range of standard analytical tests can be performed for chemical, physical and microbiological water, air and soil quality analyses.
Elemental analyses, various kinds of microscopy and analytical techniques such as spectrophotometry, gas- and ion chromatography, and atomic absorption can be carried out. A wide range of laboratory and bench-scale reactors, temperature and light controlled growth chambers, and various constant temperature rooms are available for research in one of the departmental research programs, including waste water management using aquatic macrophytes and wetlands, the adsorption and/or (an-)aerobic degradation of micropollutants, self-purification in drains and filtration. Through close co-operation with the DelftUniversity of Technology and other educational and research institutions, researchpossibilities are quite extensive.
In addition to the in-house facilities, the laboratory has a range of instrumentation and equipment available for field instruction and for conducting hydrological or environmentalfield experiments and measurements.

4.8 Study Materials

Study materials such as textbooks, lecture notes and hand-outs are provided by the Institute.
Students receive the lecture notes either on paper in their personal locker or via the electronic repository 'eCampusXL', before the start of the involved lecture series. Additional material (on paper or electronically) can be provided by the lecturers in the form of hand-outs. Also other materials, such as for example PowerPoint presentations or exercise materials used by the lecturers, can be accessed or downloaded from the electronic repository. Reference works are available from the Institute library or the library of the Delft University of Technology (see above).
Students can login to the electronic repository from any location via the Internet web page located at http://ecampusxl.unesco-ihe.org
Students are expected to bring in other materials, such as electronic calculators and language dictionaries on their own account.

4.9 English support courses

Introduction
A variety of academic writing courses are offered to students during the first 12 months of study. Students are allocated a place on these courses according to their language level, not their specialization. Writing courses are available from ‘lower-intermediate’ to ‘advanced’ level, consisting of about 20 hours contact time. These courses run parallel to scheduled lectures, and are not limited to one programme specialization or module.

Placement Test for everyone
Every student must take the English Placement Test. Based on the result, the student may be required to follow an academic writing course. Placement tests are held in October and January. Participants

with weakest English skills are strongly advised to take the test in October, as they will receive support courses first. All remaining participants will be tested in January. Places on writing courses are allocated according to the student's placement test score. A student cannot join a writing course unless s/he has taken the placement test.
Students whose test score is at A1, A2 or B1 level CEFR (The Council of Europe's *Common European Framework* of Reference for Languages is a basis for recognising language qualifications. A1-A2 = Basic; B1-B2 = Intermediate; C1-C2 = Advanced), are obliged to attend a support course: attendance is required. Students whose test score is B2 are strongly recommended to attend a course. If students who score B2choose to take a support course, regular attendance is required. Those with score levels C1 and C2 are exempt from academic writing courses.

Scheduling and attendance
Academic Writing courses are given throughout the year, with the first courses starting in October and the last courses ending in August/September. Students are assigned a course based on their Placement Test performance.
English support courses usually consist of about 20 hours contact time, approximately 13 or 14 lectures. English support courses are always scheduled at the following times:
Tuesdays 3.45pm-5.30pm
Thursdays 8.45am-10.30am
Occasionally classes are given on Saturday mornings. In special cases, evening classes may be necessary.
A Certificate of Attendance will be provided on completion of an academic writing course, provided attendance requirements have been met. If a student does not turn up for the allocated course without giving notification of absence, s/he forfeits their place on the course. An alternative course is not provided.

Summary descriptions of writing courses:
1.First Steps in Academic Writing: lower intermediate
Based on textbook '*First Steps in Academic Writing*', Longman
This course provides low-intermediate students with essential tools to master basic academic writing. It focuses on paragraph organization, sentence structure, and grammar. Students are guided through the writing process to produce well-organized, clearly developed paragraphs.
Simple explanations are supported by clear examples to help students through typical rough spots, and numerous practices help students assimilate each skill.

2.New Headway Academic Skills: intermediate
Based on textbook *'New Headway Academic Skills',* Oxford University Press
This course combines reading, writing, and study skills, and is suited to those who have reasonable English but have not studied for a while. It aims to refresh and consolidate existing language through practice, as well as to learn new language. There is guided writing practice and relevant grammatical structures are explained. In addition, skills and strategies which develop good vocabulary learning and recording are included.

3.Academic Writing: upper intermediate
Based on textbook '*Focus on Academic Skills for IELTS'*, Pearson-Longman
· Focuses on academic writing skills
· Includes vocabulary building and reading techniques relevant to research.
· Specific writing skills include: collocations; useful phrases and language of research; the language of change (increase, decrease, etc); interpreting and comparing information from diagrams; presenting arguments and opinions; justifying solutions (modal verbs, conditionals) and much more to improve academic writing.

· Life-long learning. This textbook offers systematic preparation for the IELTS exam, hence it can help any student who wishes to gain this internationally-recognised certificate, or improve their existing score.

4.Advanced Academic Writing: advanced
Based on textbook '*Academic Writing, A Handbook for International Students*' Routledge
Specifically aimed at improving key academic writing skills, this is a very practical and thorough course. Three main areas are covered:
The Writing Process – from making an outline to proofreading;
Elements of Writing – writing skills such as making comparisons, describing results and paraphrasing;
Accuracy in Writing – to improve common problems, e.g. articles, passives, prepositions.

The above courses follow a workshop approach and are designed to provide maximum hands-on practice. There is a strong emphasis on collaborative writing activities for students, with the lecturer adopting the role of facilitator.

5.MSc Thesis Writing: for all participants. A reader is provided.
In August/September a series of lectures is given, open to all MSc participants, on thesis writing. The lectures aim to make participants aware of the conventions and structures used to write a proposal, literature review and thesis, and how to present their judgements in a persuasive and reasoned argument. Topics will include proposal writing, literature review, thesis chapters, argument structure, paragraph writing, editing skills, etc.

United Nations Educational, Scientific and Cultural Organization

Institute for Water Education in partnership with UNESCO

Education and Examination Regulations 2017– 2019

For:

- the Master Programmes in
    a. Urban Water and Sanitation
    b. Environmental Science
    c. Water Management
    d. Water Science and Engineering
- short and online courses which are part of these programmes (starting between 1 Sep 2017 and 31 Aug 2018)
- Graduate professional diploma programmes

Approved by the Rectorate of IHE Delft, 11 July 2017

Table of Contents

Chapter 1. Definition of terms

The following terms are defined in the context of these regulations:

Act: the Higher Education and Scientific Research Act (*Wet op Hoger Onderwijs en Wetenschappelijk Onderzoek*);

Assessment: is the evaluation of a student's achievement on a course or topic. Assessments can have different formats, such as (written and oral) examinations, assignments, presentations etc.

Blind marking: the student information is hidden from the examiner while they are marking the examination;

Co- mentor: a staff member from an external institute or different chair group within IHE Delft involved in the daily direction of a student during the MSc thesis research phase;

Degree: a degree as stipulated in article 7.10a. of the Act;

Double (multiple) degree programme: a master programme offered by multiple institutes of higher education leading to multiple degrees;

Diploma: a written proof of evidence as stipulated in art 7.11 of the Act that a student has passed all programme requirements;

Diploma supplement: a written document as stipulated in art 7.11/4 giving information about nature and content of the programme and the results obtained by the student for each component of the programme;

ECTS: the European Credit Transfer and Accumulation System: a standard for comparing the study attainment and performance of students of higher education across the European Union and other collaborating European countries;

Examination: an assessment for a part of the module as stipulated in art 7.10/1 of the Act;

Examination Board: the committee as stipulated in article 7.12 of the Act;

Academic Appeals Board: the committee as stipulated in article 7.60 of the Act;

(External) Examiner: a person who sets and marks examinations to test students knowledge or proficiency

Fraud: a deception deliberately practiced in order to secure unfair or unlawful gain;

Joint programme: a master programme offered by two or more institutes of higher education leading to a joint or multiple degree(s);

Mentor: staff member involved in the daily direction of a student during the MSc thesis research phase;

Module: a self-contained programme unit with specified learning objectives, as stipulated in article 7.3 of the Act; can also be offered as a short- or online course.

Module plan: a document describing a.o. the learning objectives, content, didactic methods and assessments. Modules plans are part of the study guide;

Observer: a person who is present at an oral examination in order to monitor and listen to what happens;

Online short course: a module offered as an online certificate course;

Peer review: is the evaluation of work by one or more people of similar competence to the producers of the work (peers);

Plagiarism: the practice of taking someone else's work and passing them off as one's own;

Practical: a practical educational activity as stipulated in article 7.13, paragraph 2, clause d of the Act, taking one of the following forms:

- the writing of a report or thesis;
- producing a report, study assignment or design;
- conducting a test or experiment;
- performing an oral presentation;
- participating in groupwork, fieldwork or a fieldtrip;
- conducting a research assignment; or
- participation in other educational activities that aim to develop specific skills;

Programme evaluation: the formal evaluation of the student performance before graduation (in the Act: *examen*);

Study Guide: a reference document for a specific programme containing generic and programme specific information, which students need to know throughout their programme;

Short course: a module offered as a face-to face certificate course;

Student: a person who is registered in a study programme and sits for assessments;

Supervisor: professor responsible for the work of student during the MSc thesis research phase.

Taught part: part of the study programme consisting of taught modules and courses;

Transfer of credit points: the procedure of granting credits to a student for studies completed at another institute;

Research part: part of the study programme consisting of an individual research work by the student leading to a MSc thesis, based on an approved research proposal.

Chapter 2. General Information

Article 1 Scope of the regulations

1.1 The present regulations apply to the education offerings and examinations within:

I. the Master programmes in:
   i. Urban Water and Sanitation
   ii. Environmental Science
   iii. Water Management and Governance
   iv. Water Science and Engineering

II. Short and online courses which are part of these master programmes

III. Graduate Professional Diploma Programmes (GPDP)

referred to hereafter as 'the programmes'.

The programmes are executed by the IHE Delft Institute for Water Education, Delft, the Netherlands, referred to hereafter as 'the Institute' and several partner institutes in various countries.

1.2 For the following 3 specialisations separate examination regulations apply as they lead to a joint MSc degree:
- Urban Water Engineering and Management (UWEM);
- Limnology and Wetland Management (LWM);
- Environmental Technology for Sustainable Development (ETSuD).

1.3 In case a joint specialisation (see art. 1.4) leads to a double or multiple degrees, the rules and regulations of the partner institute will be applicable for those parts of the programme organised and implemented by the partner.

1.4 The following Master of Science programmes and specialisations are offered:

1. Urban Water and Sanitation programme:

Specialisation	Offered by	Type of degree
1. Water Supply Engineering	IHE Delft	IHE Delft degree
2. Sanitary Engineering	IHE Delft	IHE Delft degree
	• IHE Delft • Universidad de Valle, Cali, Colombia	Double degree
3. Urban Water Engineering and Management	• IHE Delft • Asian Institute of Technology,Thailand	Joint degree

2. Environmental Science programme:

Specialisation	Offered by	Type of degree
1. Environmental Science and Technology	IHE Delft	IHE Delft degree
2. Environmental Planning and Management	IHE Delft	IHE Delft degree
3. Water Quality Management	IHE Delft	IHE Delft degree
4. Limnology and Wetland Management	• IHE Delft • BOKU - University of Natural Resources and Life Sciences, Vienna, Austria • Egerton University, Egerton, Kenya	Joint degree
5. Environmental Technology for Sustainable Development	• IHE Delft • Asian Institute of Technology, Thailand	Joint degree

3. Water Management and Governance programme:

Specialisation	Offered by	Type of degree
1. Water Management and Governance	IHE Delft	IHE Delft degree
2. Water Resources Management	IHE Delft	IHE Delft degree
3. Water Services Management	IHE Delft	IHE Delft degree
4. Water Quality Management	IHE Delft	IHE Delft degree
5. Water Conflict Management	IHE Delft	IHE Delft degree
6. Water Cooperation and Diplomacy	• IHE Delft • Oregon State University, USA • UPEACE, Costa Rica	Triple degree

4. Water Science and Engineering programme:

Specialisation	Offered by	Type of degree
1. Hydrology and Water Resources	IHE Delft	IHE Delft degree
2. Hydraulic Engineering - River Basin Development	IHE Delft	IHE Delft degree
	• IHE Delft • University of Kuala Lumpur	Double degree
3. Coastal Engineering and Port Development	IHE Delft	IHE Delft degree
4. Land and Water development	IHE Delft	IHE Delft degree
	• IHE Delft • Asian Institute of Technology Thailand	Double degree
	• IHE Delft • University of Nebraska -Lincoln, USA	Double degree
5. Hydroinformatics- Modelling and information systems for water management	IHE Delft	IHE Delft degree
6. Flood Risk Management (Erasmus Mundus programme).	• IHE Delft • Technische Universität Dresden, Germany • Universitat Politècnica de Catalunya, Spain • University of Ljubljana, Slovenia	Multiple degree
7. Groundwater and Global Change - Impacts and Adaptation (Erasmus Mundus programme).	• IHE Delft • TU Dresden, Germany • University of Lisbon, Portugal	Multiple degree

5. **Graduate professional diploma programmes**:

Name	Offered by	
Sanitation and Sanitary Engineering	• IHE Delft	Diploma

Article 2 Aim of the programmes and courses

2.1 The aim of the master programmes is for students to acquire knowledge, insight and skills that are required for them to function as independent professionals within their field of study and to be appropriate candidates for further study towards a research career.

2.2 The final qualifications of the master programme graduates are listed in Appendix A.

2.3 The aim of a short course or an online course is for students to acquire knowledge, insight and skills of a particular field of study.

2.4 The aim of the GPDP is to convey to the students the knowledge, insight and skills of a particular field of study and consists of a number of online modules, regular master modules or a combination of both.

Article 3 Full-time/part-time

3.1 The master programmes and short courses are offered on a full-time basis.

3.2 Online courses are offered on a part-time basis.

3.3 The GPDP is executed on a part-time basis.

Chapter 3. Content of the Programme

Article 4 Constitution of the specializations and joint specializations

4.1 The constitution of each programme specialization and diploma programme is described in the study guides of IHE Delft and the partner institutes (in case of joint or double / multiple degree programmes)

4.2 The learning objectives of all modules (face to face and online), the content and assessment methods are described in the module plans.

Article 5 Participation

5.1 The attendance and active participation of students is required for all scheduled curricular activities, examinations and the practicals of the programme in which they are registered.

Chapter 4. Assessments

Article 6 Timing, formats and duration of assessments

6.1 Assessments tests whether a student has met the learning objectives.

6.2 A module is assessed through (a combination of) written and/or oral examinations, assignments and presentations as described in the module plans of the study guide.

6.3 The sequence of the modules and its assessments will take place according to the order described in the study guide.

6.4 Students cannot sit for a module assessment more than twice per academic year.

6.5 The date and time of the written and oral assessments are announced in the programme schedules. Written and oral assessments take place during the examination periods indicated in the academic calendar.

6.6 Written and oral assessments for short and online course participants are held within two weeks after the end of the module. Dates are determined in consultation between the module/course coordinator and the students

6.7 The format for the final assessment of a short course can deviate from the assessment format for the corresponding module.

6.8 Students of short courses or online courses (including GPDP) are eligible to sit for the assessment and one (1) re-assessment of the course they are registered for provided that the fee to sit for these assessments has been paid.

6.9 The duration of a written examination may not exceed three hours and is scheduled to take place in a morning or afternoon session. In case the examination consists of two or more different parts, a break of 15 minutes is allowed, provided that all examination work of the first part(s) is collected by the invigilators before the break.

6.10 In the case of a combination of an oral and written assessments of a module during the examination week, the maximum total duration of the combined examination shall not exceed three hours.

Article 7 Re- assessments

7.1 Re-assessment consists of re-taking one or more failed assessments as described in the assessment part of the module plan, as is required to achieve a successful module result.

Taking part in re-assessments is required if:
- one of the assessments is ≤ 4.9 or marked as a ‘fail’;
- the module mark is a fail (≤ 5.9). In this case one or more assessments for which a mark < 6.0 has been obtained can be re-taken.

Taking part in re-assessments is not allowed if:
- the module mark is a pass (≥ 6.0) and all assessments are ≥ 5.0

7.2 The first written and oral re- assessments take place in the examination period immediately following the examination period of the first attempt, except for the re-examinations of modules 10 and 11 which take place on the first Friday of module 14.

Dates and times of written re-examinations are announced in the programme schedules.

7.3 The dates and times of further written and oral re- assessments during the thesis period are set by the module coordinator in collaboration with the programme coordinator and the Education Bureau.

7.4 Students are not allowed to sit for further assessments during the programme period they are registered for, if they failed three separate modules (after re-assessments) of the taught part of the programme ('modules' does not include the MSc proposal defence).

7.5 The format of a re- assessment may deviate from that of the first assessments for the same module.

7.6 The latest moment to sit for a re- assessment is one month before the submission date of the MSc thesis.

Article 8 The organisation of the assessments

8.1 Assessments are carried out according to the Examination Procedures as described in annex B of these regulations.

8.2 In the case of an oral or written assessments for an online course, the student has to provide proof of identity (e.g. passport) to the examiner.

8.3 Students are expected to be in the examination room 10 minutes before the scheduled start of the exam. They will not be allowed to enter the examination room after the scheduled start of the examination.

8.4 Misreading the date, time or room allocation are not accepted as legitimate reasons for absence from an examination or for arriving too late.

8.5 Students who suffer from a physical or sensory impairment are offered the opportunity to take examinations such that, as much as possible, account is taken of their disability. If required, an expert will be consulted for advice.

Article 9 Oral assessments

9.1 Oral assessments are taken individually (only one student at a time). During oral assessments, a second staff member is present as an observer. In case of absence of a second staff member, the oral assessment is recorded for reference purposes and kept on file for 12 weeks.

9.2 During oral assessments for online courses a second staff member as observer is not required. The oral assessment has to be digitally recorded and kept on file for 12 weeks.

9.3 Oral assessments are non-public, unless stated otherwise in the module plan or current regulations.

Article 10 MSc proposal defence

10.1 The MSc thesis proposal examination is an oral examination during the examination period indicated in the academic calendar. The examination consists of a presentation of the proposal, and a discussion with the examining committee. The examining

committee consists of the supervisor and the mentor of the student. The examination is open to public attendance and discussion.

10.2 To be allowed to sit for the MSc proposal defence, students must have successfully completed all but with a maximum of 2 failed modules.

10.3 The MSc thesis proposal defence is assessed as a pass or a fail. In the case of a fail, the student may defend his/her thesis proposal one more time within one month after the first attempt before the same examining committee as stipulated in article 10.1. In the case of an unsuccessful second attempt the student is not allowed to embark on their MSc thesis work.

Article 11 Replacement of modules and transfer of credit points

11.1 Replacement of a module by a course followed elsewhere and transfer of credit points is generally not granted. In exceptional cases, the Examination Board may evaluate a request and conclude to grant a transfer of credit points, after receiving a favourable recommendation from the programme committee.

11.2 For joint specializations credits obtained at the partner institute are accepted on the basis of the credit transfer agreements made in the cooperation documents.

Article 12 Absence from examinations and late submission of assignments

12.1 Absence from an examination or late submission of an assignment must be reported by the student to the programme coordinator as early as possible. Absence is only allowed if the student missed a substantial part of the education relevant for the examination and/or the examination itself due to:

a. medical reasons, to be confirmed by student counsellor or a statement by a doctor;
b. serious personal circumstances beyond control of the student which should be supported by written evidence as far as possible.

12.2 For cases in which the programme coordinator, in agreement with the module coordinator, decides that the absence from an examination or the late submission of the assignment is justified, the student shall sit the examination or submit the assignments as soon as is reasonably possible.

12.3 For cases in which the programme coordinator, in agreement with the module coordinator, decides that the absence from an examination or the late submission of the assignment is not justified, a mark of 1.0 will be recorded.

Article 13 Fraud

13.1 If a student is caught in an attempt to take unfair advantage during an examination, the invigilators or examiners will inform the Academic Registrar who will submit a written report to the Examination Board after investigation of the incident, and after having had a discussion with the student.

13.2 Plagiarism is an act of fraud.

13.3 An examiner who observes or suspects fraud during the marking of examination work is required to submit a substantiating report to the Examination Board via the module coordinator.

13.4 If the Examination Board, after investigation of the incident as described in articles 13.1-13.3, concludes that there has been a case of fraud, the offender will be given a mark of 1.0 for the examination work.

13.5 If a student commits severe or repeated fraud, the Examination Board may decide to withdraw the student the right to sit for one or more examinations for a determined period with a maximum period of one year.

13.6 In case of severe or repeated fraud the rectorate, upon advice of the Examination Board, may also decide to permanently terminate the registration of the student concerned.

Chapter 5. Results of Assessments

Article 14 Assessment and notice of assessment results

14.1 Assessment results (including the thesis examination) are represented on a scale of 1.0 to 10.0, with one decimal of accuracy. Marks 6.0 and higher indicate a pass. The following grading scale is used:

9.0 - 10.0	Excellent
8.0 - 8.9	Very good
7.0 - 7.9	Good
6.0 - 6.9	Sufficient
5.9 and below	Fail

14.2 Assessment results (including the thesis examination) obtained at partner institutes are represented according to the descriptions in annex C of these regulations.

14.3 The mark for a module is determined by the weighted average of the results of the various assessments. The weights for each assessment are stated in the module plan. The minimum mark that should be obtained for each assessment is 5.0. Marks between 5.0 and 5.9 can be compensated by higher marks of other assessments in the same module.

14.4 After a successful re-sit of an assessment, the mark for the module is recalculated according to the weighted average of the assessment results. The highest mark obtained (first assessment or re-sit) for an assessment will be used. However, the maximum module mark which can be awarded when there has been a re-assessment is 7.0.

14.5 Students will be informed on the outcome of their module mark and assessments as soon as possible, but at least three weeks before the planned re-assessments.

14.6 Students will be informed on the outcome of their module mark and re-assessments as soon as possible, but maximum three weeks after the re-assessments.

14.7 The examination committee for the thesis examination shall determine the result immediately after the defence. The mark shall be formally communicated to the student before the diploma awarding by the Education Bureau.

Article 15 Period of validity

15.1 The result of a module, if successful, is valid for an unlimited period of time.

15.2 Notwithstanding paragraph 1 of this article, the period of validity for which the Examination Board takes module results into account for the programme evaluation is four years.

Article 16 Right to inspection of assessments

16.1 Students may, upon their own request, peruse their assessment work within ten working days after they were notified of the result.

16.2 Where a practical is part of a module, the work for that part may be returned to the students when all assessments of the module are fully completed.

16.3 Written examination work is archived for a minimum of 7 years.

Article 17 Study progress and study advice

17.1 All study results that are required for evaluating the performance of the students, are recorded by the Education Bureau on behalf of the Examination Board.

17.2 Upon request, students will be provided with a written summary of the study results obtained in the programme to date.

Chapter 6. Thesis Examination

Article 18 The organisation of the thesis examination

18.1 Students can sit the thesis examination only if all other modules required to obtain the degree have been successfully completed one month before the thesis examination.

18.2 All students have to submit the examination version of the thesis report on or before the date as annually announced by the Examination Board, and defend their thesis in the designated period.

18.3 The thesis will be assessed by a thesis examination committee, consisting of three members: a professor as the chairperson, the mentor and maximum one external independent examiner.

In special circumstances the committee may consist of more than three members:

a) If the IHE Delft mentor is a PhD fellow, an additional staff member is to be appointed in the committee.

b) If the research work is carried out outside IHE Delft a co-mentor from that institute may be appointed.

c) If the research work is co-mentored by a staff member from another chair group at IHE Delft;

d) In the case of a double degree or joint degree programme, where the MSc research work is carried out under co-supervision of staff members of the partnering institutes.

External examiners:
- to avoid conflict of interest, external examiners are not involved in the preparation of the thesis work and have to be able to give an independent judgment.
- are from outside the institute or are in exceptional cases from a chair group within the institute, but not involved in the supervision of the research work.
- have to possess at least a Master degree.

18.4 After submission, the thesis will be assessed by the members of the examination committee, including a check on plagiarism. If the examination committee concludes that the thesis is unfit to be successfully defended, they may propose to the student to accept a fail without the thesis defence. The student is given the opportunity to re-sit as per Article 18.5. The student can also decline the offer and ask for the thesis defence to be organised anyhow.

18.5 If the outcome of the thesis examination, including the defence, is a fail, the examination can be repeated once. The examination committee will detail the reasons for the failure in writing and clarify what is required to pass the exam. The student has to finalize the work without further supervision without financial support.
The thesis shall be re-submitted and the defence shall be done within three months after the date of the first defence session and will, in principle, be done in front of the same MSc Examination Committee as for the first attempt. The examination can take place via videoconference.

18.6 The maximum recorded mark for a re-sit of the thesis examination is 6.0.

18.7 The MSc thesis work shall be assessed according to the MSc thesis assessment criteria as outlined in appendix E.

18.8 The mark for the thesis examination is based on the following components: written MSc thesis report, oral presentation, and examination. The latter includes the ability of the student to satisfactorily answer questions from the examination committee. The oral presentation of the thesis research has a maximum duration of 30 minutes and is followed by a maximum 30 minutes examination discussion with the examining committee.
The oral presentation is open to public attendance and discussion.

18.9 The decision on a final mark for the thesis examination in principle will be based on a consensus of the examining committee. In the case of insurmountable disagreements the chair of the examining committee takes a decision.

18.10 The maximum duration of the MSc research phase is six months for full-time study. In the case of a *force majeure,* as supported by substantiating documents, extension of this period may be granted by the Examination Board on request by the student through his/her mentor.

Chapter 7. Criteria, degrees and certificates

Article 19 Evaluation of the programme

19.1 The student has fulfilled the requirements for the programme evaluation if s/he has met the following criteria:

1. Urban Water and Sanitation programme:

Specialisation	Offered by	Type of degree	Criteria for diploma awarding			
1. Water Supply Engineering	IHE Delft	IHE Delft degree	Successfully completed all modules at IHE Delft	Obtained a minimum of 106 ECTS		
2. Sanitary Engineering	IHE Delft	IHE Delft degree	Successfully completed all modules at IHE Delft	Obtained a minimum of 106 ECTS		
	• IHE Delft • Universidad de Valle, Cali, Colombia	Double degree	Successfully completed all modules at IHE Delft	Obtained a minimum of 113.36 ECTS.	GPA of 3.5 or higher for the course work done at Univalle	Achieved a mark '6' or higher for the thesis examination
3. Urban Water Engineering and Management	• IHE Delft • Asian Institute of Technology,Thailand	Joint degree	Successfully completed all modules at IHE Delft	48 AIT credits or 120 ECTS	minimum CGPA of 2,75 for courses at AIT	Has obtained a grade 'fair' or higher for the Master thesis at AIT

2. Environmental Science programme:

Specialisation	Offered by	Type of degree	Criteria for diploma awarding			
1. Environmental Science and Technology	IHE Delft	IHE Delft degree	Successfully completed all modules at IHE Delft	Obtained a minimum of 106 ECTS		
2. Environmental Planning and Management	IHE Delft	IHE Delft degree	Successfully completed all modules at IHE Delft	Obtained a minimum of 106 ECTS		
3. Water Quality Management	IHE Delft	IHE Delft degree	Successfully completed all modules at IHE Delft	Obtained a minimum of 106 ECTS		
4. Limnology and Wetland Management	• IHE Delft • BOKU - University of Natural Resources and Life Sciences, Vienna, Austria • Egerton University, Egerton, Kenya	Joint degree	Successfully completed all modules at IHE Delft, BOKU, and Egerton	Obtained a minimum of 120 ECTS		
5. Environmental Technology for Sustainable Development	• IHE Delft • Asian Institute of Technology,Thailand	Joint degree	Successfully completed all modules at IHE Delft	48 AIT credits or 120 ECTS	minimum CGPA of 2,75 for courses at AIT	Has obtained a grade 'fair' or higher for the Master thesis at AIT

3. Water Management and Governance programme:

Specialisation	Offered by	Type of degree	Criteria for diploma awarding			
1. Water Management and Governance	IHE Delft	IHE Delft degree	Successfully completed all modules at IHE Delft	Obtained a minimum of 106 ECTS		
2. Water Resources Management	IHE Delft	IHE Delft degree	Successfully completed all modules at IHE Delft	Obtained a minimum of 106 ECTS		
3. Water Services Management	IHE Delft	IHE Delft degree	Successfully completed all modules at IHE Delft	Obtained a minimum of 106 ECTS		
4. Water Quality Management	IHE Delft	IHE Delft degree	Successfully completed all modules at IHE Delft	Obtained a minimum of 106 ECTS		
5. Water Conflict Management	IHE Delft	IHE Delft degree	Successfully completed all modules at IHE Delft	Obtained a minimum of 106 ECTS		
7. Water Cooperation and Diplomacy	IHE Delft Oregon State University U-Peace	Triple degree	Successfully completed all modules at IHE Delft, at OSU and U-Peace	Obtained a minimum of: Option 2a: 113.9 ECTS Option 2b: 116.1 ECTS Option 2c: 119.3 ECTS		

4. Water Science and Engineering programme:

Specialisation	Offered by	Type of degree	Criteria for diploma awarding			
1. Hydrology and Water Resources	IHE Delft	IHE Delft degree	Successfully completed all modules at IHE Delft	Obtained a minimum of 106 ECTS		
2. Hydraulic Engineering - River Basin Development	IHE Delft	IHE Delft degree	Successfully completed all modules at IHE Delft	Obtained a minimum of 106 ECTS		
	• IHE Delft • University of Kuala Lumpur	Double degree	Successfully completed all modules of the programme	Obtained a minimum of 108.7 ECTS		
3. Coastal Engineering and Port Development	IHE Delft	IHE Delft degree	Successfully completed all modules at IHE Delft	Obtained a minimum of 106 ECTS		

4. Land and Water development	IHE Delft	IHE Delft degree	Successfully completed all modules at IHE Delft	Obtained a minimum of 106 ECTS		
	• IHE Delft • Asian Institute of Technology Thailand	Double degree	Successfully completed all modules at IHE Delft	48 AIT credits or 120 ECTS	minimum CGPA of 2,75 for courses at AIT	Has obtained a grade 'fair' or higher for the Master thesis at AIT
	• IHE Delft • University of Nebraska -Lincoln, USA	Double degree	Successfully completed all modules at IHE Delft and at Nebraska	Obtained a minimum of 112 ECTS		
5. Hydroinformatics-Modelling and information systems for water management	IHE Delft	IHE Delft degree	Successfully completed all modules at IHE Delft	Obtained a minimum of 106 ECTS		
6. Flood Risk Management (Erasmus Mundus programme).	• IHE Delft • Technische Universität Dresden, Germany • Universitat Politècnica de Catalunya, Spain • University of Ljubljana, Slovenia	Multiple degree	Successfully completed all modules of the programme, according to the grading rules of TU-Dresden, University of Ljublijana, TU-Catalonia and IHE Delft	Obtained a minimum of 120 ECTS		
7. Groundwater and Global Change - Impacts and Adaptation (Erasmus Mundus programme).	• IHE Delft • TU Dresden, Germany • University of Lisbon, Portugal	Multiple degree	Successfully completed all modules of the programme, according to the grading rules of the University of Lisbon, Technical University Dresden, and IHE Delft	Obtained a minimum of 120 ECTS		

5. **Graduate professional diploma programmes**:

Name	Offered by		Criteria for diploma awarding			
Sanitation and Sanitary Engineering	• IHE Delft	Diploma	Successfully completed all modules at IHE Delft	Obtained a minimum of 20 ECTS for the programme		

19.2 The student has fulfilled the requirements for the short or online course if s/he successfully completed all assessments of the course.

19.3 The student has successfully completed the programme evaluation or short / online course evaluation if the Examination Board takes a decision to that effect.

Article 20 Awarding of degrees and certificates

20.1 Master of Science degree.
Students who have successfully completed the programme evaluation requirements will be awarded the Master of Science degree. The degree is signed by the Chair of the Examination Board, the Rector of the Institute and the Academic Registrar. In addition to the degree certificate, the graduate receives a degree supplement stating the results achieved and credit points for each component of the programme.

20.2 Certificate of Graduate Study.
Students who fail to meet the master programme evaluation requirements and have accumulated a minimum of 45 credits will be awarded a certificate of graduate study in the programme for which they are registered. Registration as student will be terminated.

20.3 Certificate of attendance.
Students who fail to meet the master programme evaluation requirements, or who suspend or terminate their registration, will be issued a certificate stating the result achieved and credit points for each successfully completed component of the programme, and the period of registration. The Certificate of Attendance is signed by the Course coordinator and the Academic Registrar.

20.4 If a student re-registers within 4 years after termination and meets (after assessment(s)) the requirements of an MSc degree, s/he is obliged to return the certificate as mentioned under art 20.2 and art 20.3.

20.5 With reference to art 20.4, if a student re-registers within 4 years with the aim to obtain an MSc degree, s/he has to re-take in full all failed and missed modules. Re-registration is only possible for a subsequent academic period.

20.6 Certificate for short or online course.
Students who have successfully completed a credited short or online course including all its assessments, will be awarded a certificate. The certificate is signed by the Course coordinator and the Academic Registrar. In addition to this certificate, the graduate receives an academic transcript stating the result achieved and credit points awarded.

20.7 Certificate of Attendance.
Students who have successfully completed the short or online course without assessments, and who have demonstrated an active participation in the course throughout the whole study period, will be awarded a Certificate of Attendance.
The Certificate of Attendance is signed by the Course coordinator and the Academic Registrar.

20.8 GPDP diploma
Students who have successfully collected a minimum of 20 ECTS for the programme will be awarded a Postgraduate Professional Diploma in Sanitation and Sanitary Engineering.
The diploma is signed by the Rector of the Institute, the Chair of the Examination Board and the Academic Registrar. In addition to this diploma the graduate receives a diploma supplement stating the learning objectives, the composition of the programme, the results achieved and the associated credit points.

20.9 Students who fail to meet the requirements for the awarding of the GPDP diploma will receive a Certificate (art 20.4) for those courses which were successfully completed.

Article 21 Criteria for MSc degree with distinction

21.1 The chair of the examination committee may consider to make a recommendation to the Examination Board for an MSc degree with distinction if the following conditions are met:

For single degree programmes:
- the candidate obtained a mark of 8.5 or higher for the thesis examination, and
- an arithmetic average mark at IHE Delft of 8.0 or higher for all modules that are assessed on a numerical scale, conform article 14.1,
- there were no re-assessments during the taught part, and
- a recommendation is made by the chair of the examination committee.

For double / multiple degree programmes where student sits for the thesis examination at IHE Delft:
- the candidate obtained a mark of 8.5 or higher for the thesis examination, and
- an arithmetic average mark at IHE Delft of 8.0 or higher for all modules that are assessed on a numerical scale, conform article 14.1.
- a recommendation is made by the chair of the examination committee.

The recommendation should also be based on the results for the courses obtained at the partner institute(s).

For double / multiple degree programmes where student sits for the thesis examination at a partner institute:
- the candidate obtained an arithmetic average mark at IHE Delft of 8.0 or higher for all modules that are assessed on a numerical scale, conform article 14.1.
- a recommendation is made by the professor responsible for the specialization concerned.

The recommendation should also be based on the results for the courses and thesis obtained at the partner institute(s).

21.2 The student will be awarded an MSc degree with distinction if the Examination Board takes a decision to that effect.

Chapter 8. Appeals

Article 22 Grounds for appeal

22.1 Students have the right to appeal against an assessment result, if
a. the performance of the student suffered through illness or other factors;
b. a material administrative error in the conduct of an assessment occurred;
c. the assessment or evaluation was not conducted in accordance with the regulations;
d. some other material irregularity occurred;
e. there is a serious unsolved conflict with the supervisor or the mentor.

Article 23 Procedure for appeal

23.1 A student shall first attempt to resolve the problem with the body or person that has taken the disputed decision.

23.2 If the appeal concerns a decision taken by an Examiner or an MSc Examination Committee, the appeal shall be submitted to the Examination Board within 3 weeks following the date on which the decision was made known. It should be submitted by the student in writing, stating the grounds for appeal and enclosing appropriate documentation, including an account of the attempt to resolve the case amicably.

23.3 If the appeal concerns a decision taken by the Examination Board - not being an appeal as referred to in Article 23.2 - or a decision taken by the Academic Registrar, the appeal shall be submitted to the Academic Appeals Board within 3 weeks following the date on which the decision was made known. It should be submitted by the student in writing, stating the grounds for appeal and enclosing appropriate documentation, including an account of the attempt to resolve the case amicably.

23.4 Pending the outcome of the appeal procedure, the initial (contested as per appeal) decision will remain in force and will be implemented

23.5 Reference is made to Appendix F for a detailed description of the appeal procedure.

Chapter 9. Final Articles

Article 24 Amendments

24.1 Amendments to these regulations are made by separate decision of the Rectorate.

24.2 No amendments shall be made in relation to the ongoing academic year, unless there is reasonable expectation that the amendment will not disadvantage the students.

Article 25 Unforeseen situations

25.1 Situations which are not foreseen by the present regulations will be decided on by the Examination Board, where necessary after consultation with the programme committee concerned.

Article 26 Publication

26.1 The Rectorate is responsible for the timely publication of these Examination Regulations, and any amendments thereof.

Article 27 Period of application

27.1 These regulations take effect for the cohort 2017 – 2019. Approved by the Rectorate of IHE Delft on 11 July 2017

Appendix A Qualifications of Graduates

1. Urban Water and Sanitation Programme

1.1 Water Supply Engineering

After successful completion of the programme, graduates will be able to:

Knowledge and understanding	1. understand the structure of drinking water supply systems, including water transport, treatment and distribution; 2. understand water quality criteria and standards, and their relation to public health, environment and urban water cycle; 3. understand in-depth occurring physical, chemical and biological phenomena and their mutual relationships, within water supply systems; 4. understand water quality concepts and their effect on treatment process selection; 5. understand the interaction of water quality and materials applied; 6. understand hydraulic concepts and their relationship to water transport in treatment plants, pipelines and distribution networks; 7. understand the importance and methods for operation and maintenance of water supply systems; 8. understand options for centralised and urban systems versus decentralized and rural systems; 9. understand water supply engineering within a watershed context.
Applying knowledge and understanding	1. design and to rehabilitate raw water abstraction, transport, treatment and distribution processes and systems; 2. use statistical and modelling tools for simulating, prediction of performance and operation of water supply system components; 3. conduct independent research, including formulation of hypotheses, selection and application of research methodologies, and the formulation of conclusions and recommendations
Making judgements	1. define and evaluate project alternatives on basis of chosen selection criteria.
Communication	1. communicate effectively in oral and written presentations to technical and non-technical audiences.
Lifelong learning skills	2. posses the learning skills to acquire continual knowledge in an independent manner.

1.2 Sanitary Engineering

After successful completion of the programme, graduates will be able to:

Knowledge and understanding	1. understand and explain the role of sanitation in urban water cycle and its relation to public health and environment; 2. develop rational approaches towards sustainable waste(water) management via pollution prevention, appropriate treatment, resources recovery and re-use on both centralized and decentralized level; 3. understand in-depth relevant physical, chemical and biological processes, and their mutual relationships within various sanitation components.
Applying knowledge and understanding	1. apply gained knowledge and skills in practice; 2. prepare conceptual engineering and process design of sanitation components; 3. apply modern tools for technology selection and carry out modelling of sanitation components; 4. identify, develop and conduct independent research including formulation of hypotheses selection and application of research methodologies, and the formulation of conclusions and recommendations; 5. carry out desk studies, field work, and laboratory based research; 6. contribute to the development of innovative approaches to the provision of adequate and sustainable sanitation services in developing countries and countries in transition.
Making judgements	1. define and critically analyse, assess and evaluate various urban drainage and sewerage schemes, and wastewater, sludge and solid waste treatment process technologies; 2. analyse, synthesise, integrate, interpret, and discuss both scientific and practical information in the context of various research and engineering projects including preparation of Master plans, feasibility studies and preliminary designs;.
Communication	1. clearly communicate concerning both oral and written skills.
Lifelong learning skills	1. continuously acquire knowledge and assimilate and implement innovative learning methods and skills in an independent manner; 2. operate both autonomously and in a multidisciplinary and multinational environment.

1.3 Urban Water Engineering and Management

After successful completion of the programme graduates will be able to:

Knowledge and understanding	1. understand the urban water cycle and its water system components, their characteristics and functioning within greater urban infrastructure systems; 2. understand urban water management problems including ability to: identify water systems' demand; deal with climatic and hydrologic uncertainties and/or extremes; institutional limitations; and work within a data-constrained environment; 3. understand water infrastructure/asset planning, financing and management, and utility management; 4. familiarise with the concept of integrated water resources management (IWRM) and its application to a variety of water management problems at the urban catchment scale.
Applying knowledge and understanding	1. make appropriate and critical use of methods, techniques and tools necessary to monitor, analyze and design urban water systems including: water supply infrastructure; drinking water treatment and distribution; wastewater collection, treatment, transport and disposal systems; drainage systems; 2. identify, articulate, analyse and solve problems of the urban water cycle and systems, integrating theory and applications; 3. collect, summarise, analyse and interpret technical data/materials in a structured form to gain knowledge on urban water system design and operation and maintenance; 4. work with a range of information technology tools available for solving urban water management problems and for effectively communicating with fellow water managers, researchers, scientists, planners, and policy-makers.
Making judgements	1. critically recognize and assess the need for continued-education and research on planning, design, maintenance and management of urban water systems.
Communication	2. reporting and give presentation.
Lifelong learning skills	1. learn independently; 2. demonstrate having improved IT skills; 3. work independently and / or as part of a team; 4. manage time effectively.

2. Environmental Science Programme

2.1 Environmental Science & Technology

After successful completion of the programme, graduates will be able to:

Knowledge and understanding	1. demonstrate understanding of natural environmental processes, the socio-economic concepts underlying functioning and exploitation of environmental systems, and of the complex inter-relationship between the protection and wise use of environmental resources; 2. describe the rationale for an integrated and interdisciplinary approach for the sustainable management of water and environmental resources; 3. identify the impacts of human activities on the environment, under different levels of environmental stress and in different socio-economic contexts; 4. name and explain concepts, instruments and technologies for pollution prevention and remedial actions in a national and international context.
Applying knowledge and understanding	1. design, optimise and interpret environmental monitoring and assessment schemes (including statistics and modelling) in order to gain an understanding of problems, trends, causes and effects; 2. apply general methods (including statistics and modelling) in scientific and technological approaches, concepts and interventions; 3. contribute as a flexible and creative member in interdisciplinary teams in developing solutions for prevention or remediation of environmental problems, by linking scientific knowledge to engineering interventions and to management decisions in different cultural and socio-economic contexts, and using different levels of available knowledge and information.
Making judgements	1. critically analyse and evaluate a range of options and alternatives for the prevention or remediation of environmental problems, under different socio-economic, cultural and legal contexts, and under often data-poor conditions; 2. conduct research, independently or in a multidisciplinary team, including the formulation of research questions and hypotheses, the selection and application of research methodologies and techniques and the formulation of well-founded conclusions and recommendations.
Communication	1. communicate, debate and defend, clearly and systematically, findings and generated insights, and provide rational underpinning of these in oral and written presentations to a variety of audiences.
Lifelong learning skills	1. demonstrate academic attitude and learning skills (including thinking in multidisciplinary dimensions and distinguishing main issues from minor ones), to enhance and keep up-to-date the acquired knowledge and application skills in a largely independent manner.

2.2 Environmental Planning & Management

After successful completion of the programme, graduates will be able to:

Knowledge and understanding	1. demonstrate understanding of natural environmental processes, the socio-economic concepts underlying functioning and exploitation of environmental systems, and of the complex inter-relationship between the protection and wise use of environmental resources; 2. describe the rationale for an integrated and interdisciplinary approach for the sustainable management of water and environmental resources; 3. understand the environmental policy cycle and planning process and to analyse and prepare environmental policy strategies, taking into account the impact that society has on water and environmental resources; 4. name and explain principles, concepts and instruments of major national and international water and environmental legislation and common and desired institutional and management arrangements.
Applying knowledge and understanding	1. design, optimise and interpret environmental monitoring and assessment schemes (including statistics and modelling) in order to gain an understanding of problems, trends, causes and effects; 2. apply general scientific methods (including statistics and environmental modelling) to processes of water and environmental resources allocation and use at different scales in order to gain an understanding of problems, trends, causes and effects; 3. apply environmental scientific methods (including environmental impact assessment, policy analysis, resource valuation, environmental economics) and models for institutional development with emphasis on policy development, functional decentralisation and good governance; 4. design and facilitate consultation- and decision-making processes between stakeholders, users and their representatives, water managers, politicians and other decision-makers.
Making judgements	1. critically analyse and evaluate a range of options and alternatives for the prevention or remediation of environmental problems, under different socio-economic, cultural and legal contexts, and under often data-poor conditions; 2. identify and critically assess the different ecological and socio-economic functions and values of the environmental system and the, often competing, interests of the various stakeholders; 3. conduct research, independently or in a multidisciplinary team, including the formulation of research questions and hypotheses, the selection and application of research methodologies and techniques and the formulation of well-founded conclusions and recommendations; 4. design comprehensive environmental resources policies and strategies that aim to enhance the sustainable use of the environment especially focusing on water, and that include a suitable combination of technical, legal, administrative and financial measures.
Communication	1. communicate, debate and defend, clearly and systematically, findings and generated insights, and provide rational underpinning of these in oral and written presentations to a variety of audiences;
Lifelong learning skills	1. demonstrate academic attitude and learning skills (including thinking in multidisciplinary dimensions and distinguishing main issues from minor ones), to enhance and keep up-to-date the acquired knowledge and application skills in a largely independent manner;

2.3 Water Quality Management

After successful completion of the programme, graduates will be able to:

Knowledge and understanding	1. demonstrate understanding of natural environmental processes, the socio-economic concepts underlying functioning and exploitation of environmental systems, and of the complex inter-relationship between the protection and wise use of environmental resources; 2. describe the rationale for an integrated and interdisciplinary approach for the sustainable management of water and environmental resources; 3. identify the impacts of human activities on aquatic ecosystems; 4. name and explain principles, concepts and instruments of main national and international water and environmental legislation and common and desired institutional and management arrangements.
Applying knowledge and understanding	1. design, optimise and interpret environmental monitoring and assessment schemes (including statistics and modelling) in order to gain an understanding of problems, trends, causes and effects; 2. interpret, design and optimise water quality monitoring and assessment schemes in the watershed; 3. apply experimental, statistical and modelling tools for interpreting and designing water quality management programmes; 4. conduct research, independently or in a multidisciplinary team, including the formulation of research questions and hypotheses, the selection and application of research methodologies and techniques and the formulation of well-founded conclusions and recommendations.
Making judgements	1. critically analyse and evaluate a range of options and alternatives for the prevention or remediation of environmental problems, under different socio-economic, cultural and legal contexts, and under often data-poor conditions; 2. contribute as a flexible and creative member in interdisciplinary teams in developing solutions for water quality management problems in different cultural and socio-economic contexts, and using different levels of available knowledge and information; 3. critically analyse and evaluate alternative water quality management programmes in the watershed under different socio-economic and legal contexts, often in data-poor conditions.
Communication	1. communicate, debate and defend, clearly and systematically, findings and generated insights, and provide rational underpinning of these in oral and written presentations to a variety of audiences.
Lifelong learning skills	1. demonstrate academic attitude and learning skills (including thinking in multidisciplinary dimensions and distinguishing main issues from minor ones), to enhance and keep up-to-date the acquired knowledge and application skills in a largely independent manner.

2.4 MSc programme in Environmental Science with specialisation Limnology and Wetland Management

After successful completion of the programme, graduates will be able to:

Knowledge and understanding	1. to demonstrate understanding of natural environmental processes, the socio-economic concepts underlying functioning and exploitation of environmental systems, and of the complex interrelationship between protection and wise use of environmental resources; 2. to describe the rationale for an integrated and interdisciplinary approach for the sustainable management of water and environmental resources; 3. to identify the impacts of human activities on freshwater ecosystems in different socio-economic contexts; 4. to demonstrate knowledge and understanding of the international water quality guidelines; 5. to name and explain concepts, instruments and technologies for protection and remedial actions of freshwater ecosystems.
Applying knowledge and understanding	1. to design, optimise and interpret environmental monitoring and assessment schemes (including statistics and modelling) in order to gain an understanding of problems, trends, causes and effects; 2. to design, optimise and interpret environmental monitoring and assessment schemes for freshwater ecosystems; 3. to apply general scientific methods (including statistics and environmental modelling) for the development and application of scientific and technological approaches, concepts and interventions to address problems of freshwater ecosystems; 4. to conduct research, independently/in multidisciplinary teams, incl. formulation of research questions and hypotheses, selection and application of research methodologies and techniques and the formulation of well-founded conclusions and recommendations.
Making judgements	1. to critically analyse and evaluate a range of options and alternatives for the prevention or remediation of environmental problems, under different socio-economic, cultural and legal contexts, and under often data-poor conditions; 2. to critically analyse and evaluate a range of options and alternatives for the prevention or remediation of problems related with freshwater ecosystems, under different socio-economic and legal contexts, and under often data-poor conditions; 3. to contribute in interdisciplinary teams in developing solutions for prevention/remediation of aquatic ecosystem problems by linking scientific knowledge to engineering interventions and management decisions in different cultural/socio-economic contexts.
Communication	1. to communicate, debate and defend, clearly and systematically, findings and generated insights, and provide rational underpinning of these in oral and written presentations to a variety of audiences.
Lifelong learning skills	1. to demonstrate academic attitude and learning skills (incl. thinking in multidisciplinary dimensions and distinguishing main issues from minor ones), to enhance and keep up-to-date the acquired knowledge and application skills in an independent manner.

2.5 Joint MSc programme in Environmental Science with specialisation Environmental Technology for Sustainable Development with AIT, Bangkok

After successful completion of the programme, graduates will be able to:

Knowledge and understanding	1. to demonstrate understanding of natural environmental processes, the socio-economic concepts underlying functioning and exploitation of environmental systems, and of the complex interrelationship between protection and wise use of environmental resources; 2. to describe the rationale for an integrated and interdisciplinary approach for the sustainable management of water and environmental resources; 3. to identify the impacts of human activities on the environment, under different levels of environmental stress and in different socio-economic contexts; 4. to name and explain concepts, instruments and technologies for pollution prevention and remedial actions in a national and international context.
Applying knowledge and understanding	1. to design, optimise and interpret environmental monitoring and assessment schemes (including statistics and modelling) in order to gain an understanding of problems, trends, causes and effects; 2. to apply general methods (including statistics and modelling) in scientific and technological approaches, concepts and interventions; 3. to contribute in interdisciplinary teams in developing solutions for prevention/remediation of environmental problems by linking scientific knowledge to engineering interventions and to management decisions in different cultural/socio-economic contexts; 4. to conduct research, independently/in multidisciplinary teams, incl. formulation of research questions and hypotheses, selection and application of research methodologies and techniques and the formulation of well-founded conclusions and recommendations.
Making judgements	1. to critically analyse and evaluate a range of options and alternatives for the prevention or remediation of environmental problems, under different socio-economic, cultural and legal contexts, and under often data-poor conditions.
Communication	1. to communicate, debate and defend, clearly and systematically, findings and generated insights, and provide rational underpinning of these in oral and written presentations to a variety of audiences.
Lifelong learning skills	1. to demonstrate creativity and critical, multidisciplinary thinking for problem-solving and decision-making; 2. to demonstrate responsibility and own initiative; 3. to demonstrate capacity to work in an international, multi-cultural team; 4. to demonstrate academic attitude and learning skills (incl. thinking in multidisciplinary dimensions and distinguishing main issues from minor ones), to enhance and keep up-to-date the acquired knowledge and application skills in an independent manner.

3. Water Management and Governance Programme

3.1 Water Management and Governance

After successful completion of the programme, graduates will be able to:

Knowledge and understanding	1. describe and predict for a given water resources system the main hydrological, hydraulic, chemical and ecological processes and how these processes are dynamically linked with human activities, including land and water use. 2. describe and explain the main concepts and instruments for analysing and influencing formal and informal arrangements over water, including policies, laws and institutions, and by adopting a historical perspective. 3. explain the key concepts for integrated, multi-disciplinary and interdisciplinary analyses of water systems and describe the challenges of such approaches. 4. comprehend the broader scientific, engineering, socio-economic and environmental context in which water management and governance issues are manifested and addressed.
Applying knowledge and understanding	1. formulate and apply water management and governance frameworks / tools / methods to water related issues in a given context in a social inclusive and environmental sustainable manner. 2. apply different concepts and methods in a coherent way and through a process of triangulation synthesize results and draw well reason conclusions and recommendations. 3. conduct, independently or in a multidisciplinary team, research including the formulation of research questions and hypotheses, the selection and application of adequate research methodologies and techniques and the formulation of well-founded conclusions.
Making judgements	1. compare and contrast different ideas and approaches to make sound judgement based on available information, and assess the potential for application, integration and further development. 2. apply suitable techniques, tools and procedures for a given context in order to evaluate the consequences of different development and intervention scenarios. 3. reflect critically on ho how different activities impact on the sustainable use of water in a given context. 4. reflect on own professional and educational background relate to this knowledge and skills needed to build a solid career in the water sector, and on this basis identify a coherent personal learning trajectory.
Communication	1. clearly and systematically communicate, argue and defend findings in oral and written presentations to a variety of audiences.
Lifelong learning skills	1. think in multidisciplinary and integrated dimensions and be able to distinguish main issues from side issues. 2. have the academic attitude and learning skills to enhance and keep up-to-date the acquired knowledge and application skills in a largely independent manner. 3. Have the ability to reflect on own performance and advance own career within the water sector.

3.2 Water Resources Management

After successful completion of the programme, graduates will be able to:

Knowledge and understanding	1. describe and predict for a given water resources system the main hydrological, hydraulic, chemical and ecological processes and how these processes are dynamically linked with human activities, including land and water use. 2. describe and explain the main concepts and instruments for analysing and influencing formal and informal arrangements over water, including policies, laws and institutions, and by adopting a historical perspective. 3. explain the key concepts for integrated, multi-disciplinary and interdisciplinary analyses of water systems and describe the challenges of such approaches. 4. characterize and explain water resource issues using economic concepts and theory for addressing water issues and describe how economic concepts and tools including valuation support integrated water resources management.
Applying knowledge and understanding	1. model processes of the water system (rainfall-runoff, flooding, water allocation, water accounting), validate models, critically interpret model outcomes in order to derive insight in trends, causes and effects, and define and explain model limitations. 2. formulate and critically evaluate governance frameworks related to water resources management and apply tools for policy analysis with the emphasis on social inclusion and sustainability. 3. Apply and develop integrated tools / methods to support water resources assessment / planning / management at different scales and accounting for aspects relating to quality and quantity and upstream / downstream linkages. 4. conduct, independently or in a multidisciplinary team, research including the formulation of research questions and hypotheses, the selection and application of adequate research methodologies and techniques and the formulation of well-founded conclusions.
Making judgements	1. analyse a given water resources system in order to quantify the water flows over space and time, accounting for and describing the interdependencies between many (competing) water users. 2. critically evaluate technical and/or institutional water resources interventions (policie actions / agreements) through analysis of implications for the water resources system, its users and their interrelations at various spatial and temporal scales.
Communication	1. clearly and systematically communicate, argue and defend findings in oral and written presentations to a variety of audiences.
Lifelong learning skills	1. think in multidisciplinary and integrated dimensions and be able to distinguish main issues from side issues. 2. have the academic attitude and learning skills to enhance and keep up-to-date the acquired knowledge and application skills in a largely independent manner.

3.3 Water Services Management

After successful completion of the programme, graduates will be able to:

Knowledge and understanding	1. describe for a given water resources system the interplay between the main biophysical processes and social dynamics, in analyzing service delivery modalities. 2. describe and explain the main concepts and instruments for analysing and influencing formal and informal arrangements concerning water supply and sanitation services, including policies, laws and institutions, and by adopting a historical perspective. 3. explain the key concepts for integrated, multi-disciplinary and interdisciplinary analyses of water services management and describe challenges of providing water supply and sanitation services at different levels (from global to local). 4. summarize the current debates relevant for water supply and sanitation services, using institutional and management theories from different academic disciplines (e.g. economics, public administration, sociology, political science, law).
Applying knowledge and understanding	1. design and apply analytical tools to research issues of water services management and describe, modify and apply management tools (e.g. with the benchmarking, cost benefit analysis, management information systems) with the aim of improving water supply and sanitation provision. 2. formulate and critically evaluate governance frameworks related to water services management and apply tools for policy analysis with the emphasis on social inclusion and sustainability. 3. combine different types of method and through a process of triangulation synthesize outcomes in a coherent manner. 4. conduct, independently or in a multidisciplinary team, research including the formulation of research questions and hypotheses, the selection and application of adequate research methodologies and techniques and the formulation of well-founded conclusions.
Making judgements	1. analyze and evaluate governance processes and utility management arrangements in the water services sector, integrating technical, legal administrative, social and financial components. 2. critically evaluate technical and/or institutional interventions (e.g. policies actions, agreements) through analysis of implications for water supply and sanitation services, its users and their interrelations at various spatial and temporal scales.
Communication	1. clearly and systematically communicate, argue and defend findings in oral and written presentations to a variety of audiences.
Lifelong learning skills	1. think in multidisciplinary and integrated dimensions and be able to distinguish main issues from side issues. 2. have the academic attitude and learning skills to enhance and keep up-to-date the acquired knowledge and application skills in a largely independent manner.

3.4 Water Quality Management

After successful completion of the programme, graduates will be able to:

Knowledge and understanding	1. describe and predict for a given water resources system the main hydrological, hydraulic, chemical and biological processes and how these processes are dynamically linked with aquatic ecosystems as well as with human activities such as land and water use and pollution. 2. describe and explain the main concepts and instruments for analysing and influencing formal and informal arrangements for water quality management, including policies, laws and institutions, and by adopting a historical perspective. 3. explain the key concepts for integrated, multi-disciplinary and interdisciplinary analyses of aquatic ecosystems and describe the challenges of such approaches. 4. describe concepts to determine the value of water for various uses and users in (amongst others) economic and ecological terms and explain how these concepts can be used in water resources planning at various spatial and temporal scales.
Applying knowledge and understanding	1. interpret, design and optimize water quality assessment and monitoring programmes by applying experimental, statistical and modelling tools. 2. formulate and critically evaluate governance frameworks related to water quality management and apply tools for policy analysis with the emphasis on social inclusion and sustainability. 3. combine different types of method and through a process of triangulation synthesize outcomes in a coherent manner. 4. conduct, independently or in a multidisciplinary team, research including the formulation of research questions and hypotheses, the selection and application of adequate research methodologies and techniques and the formulation of well-founded conclusions.
Making judgements	1. define a given water resources system, and compose the water and pollution flows across time and space, including the various water uses, and describe the interdependencies these create between the various water users. 2. critically evaluate technical and/or institutional interventions focused on water quality (projects/ programmes/ policies/ agreements) through analysis of implications for the water resources system, its users and their interrelations at various spatial and temporal scales.
Communication	1. clearly and systematically communicate, argue and defend findings in oral and written presentations to a variety of audiences.
Lifelong learning skills	1. think in multidisciplinary and integrated dimensions and be able to distinguish main issues from side issues. 2. have the academic attitude and learning skills to enhance and keep up-to-date the acquired knowledge and application skills in a largely independent manner.

3.5 Water Conflict Management

After successful completion of the programme, graduates will be able to:

Knowledge and understanding	1. describe for a given water resources system the interplay between the main biophysical processes and social dynamics, in analyzing, anticipating, preventing and managing conflicts. 2. describe and explain the main concepts and instruments for analysing and influencing formal and informal arrangements over water for collaboration, including policies, laws and institutions, and by adopting a historical perspective. 3. explain the key concepts for integrated, multi-disciplinary and interdisciplinary analyses of water systems and describe the challenges of such approaches at sector, intersectoral and transboundary levels. 4. name and critically discuss theories, concepts and tools of conflict management and cooperation building techniques in the context of natural resources and water in particular.
Applying knowledge and understanding	1. design and facilitate inclusive consultation and conflict management processes, such as consensus building, public participation, negotiation and mediation between actors at different levels. 2. formulate and critically evaluate governance frameworks related to water conflict management and apply tools for policy analysis with the emphasis on social inclusion and sustainability. 3. combine different types of method and through a process of triangulation synthesize outcomes in a coherent manner. 4. conduct, independently or in a multidisciplinary team, research including the formulation of research questions and hypotheses, the selection and application of adequate research methodologies and techniques and the formulation of well-founded conclusions, recommendations and limitations.
Making judgements	1. appraise the different functions of the water resources system, and the associated competing interests of water using sectors and actors, describe the inter-dependencies between these, and finally assess the possibilities and limitations of cooperation. 2. critically evaluate technical and/or institutional interventions focused on conflict management (projects/ programmes/ policies/ agreements) through analysis of implications for the water resources system, its users and their interrelations at various spatial and temporal scales.
Communication	1. clearly and systematically communicate, argue and defend findings in oral and written presentations to a variety of audiences. 2.
Lifelong learning skills	1. think in multidisciplinary and integrated dimensions and be able to distinguish main issues from side issues. 2. have the academic attitude and learning skills to enhance and keep up-to-date the acquired knowledge and application skills in a largely independent manner.

3.6 Water Cooperation and Diplomacy

After successful completion of the programme, graduates will be able to:

Knowledge and understanding	1. Articulate the complexities of socio-natural processes 2. Discuss and compare theories and dimensions of conflict and its avoidance, management and resolution
Applying knowledge and understanding	1. Use an interdisciplinary approach to critically assess and evaluate conflict management tools and techniques available to deal with water-related disputes 2. Apply conflict management tools and design conflict resolution processes with the aim of mitigating water management disputes
Making judgements	1. Critically analyse water disputes (including actors, policies, institutions, historical, social and bio-physical processes) 2. Identify and analyse issues, challenges and potential conflicts of water allocation and access to water resources at different scales
Communication	
Lifelong learning skills	1. Research the selection and application of adequate methodologies and techniques of water conflict management tools and formulate well-founded conclusions and recommendations

4. Water Science and Engineering Programme

4.1 Hydrology and Water Resources

After successful completion of the programme, graduates will be able to:

Knowledge and understanding	1. have in-depth understanding of the current theories and concepts in both surface and subsurface hydrology, the relevant physical, chemical and biological process interactions between the hydrosphere, the lithosphere, the biosphere and the atmosphere, and have a thorough awareness of the natural and human-induced variability in space and time of hydrological systems; 2. master the major hydrological methodologies and applications with regard to both water quantity and water quality, including techniques for data collection, processing and analysis, and the application of catchment hydrological modelling and aquifer modelling techniques; 3. have a good knowledge of the relevant literature and the contemporary research questions in the field of hydrology.
Applying knowledge and understanding	1. apply and integrate the relevant physical, chemical, applied mathematical, computational and earth-scientific principles and concepts, and to use information and communication technology within a hydrological context; 2. design and conduct hydrological research and experiments for both application and scientific purposes, either independently or within a team-based framework.
Making judgements	1. evaluate and analyse hydrological systems and processes at a wide range of scales in both space and time for the purpose of water resources assessment, natural hazards assessment and mitigation, and environmental planning and management; 2. critically judge and evaluate their own work and results, as well as prior research or investigations carried out by others.
Communication	1. adequately communicate methodologies, results, evaluations, conclusions and recommendations in oral, written and graphical form to a wide variety of audience.
Lifelong learning skills	1. be aware of the importance of hydrology to society, the relationship of hydrology with related disciplines such as ecology, meteorology and climatology, and be able to co-operate within a multidisciplinary and interdisciplinary framework with due consideration of ethical and social aspects related to the application of their knowledge and skills; and 2. have adopted the academic attitude and learning skills to enhance and broaden the acquired knowledge and application skills in a largely independent manner.

4.2 Hydraulic Engineering and River Basin Development

After successful completion of the programme, graduates will be able to:

Knowledge and understanding	1. have in-depth understanding of physical processes and natural phenomena in river basin systems, development of river basins by human interference, such as designing river structures and training works, and the management of floods and droughts; 2. master the major hydraulic methodologies and applications for river structures and river modelling techniques with regard to techniques for data collection, processing and analysis; 3. have knowledge of contemporary research (questions) and relevant literature in the field of hydraulic engineering and river basin development; 4. have acquired sufficient skills in using information and communication technology for conducting studies and analyses, in addition to presentation and communication.
Applying knowledge and understanding	1. evaluate and analyse river basin systems and processes at a wide range of scales for the purpose of water resources, including morphological assessments, impact analysis of hydraulic structures and natural hazards assessment and mitigation taking into account relevant aspects of environmental, economical and social planning and management; 2. design and conduct hydraulic research, experiments and tests for both practical and scientific purposes, either independently or within a team-based framework; by intelligent use of engineering and scientific principles, develop and undertake critical evaluations of strategies for the implementation of river engineering works; 3. have the skills to apply and integrate relevant concepts and methodologies in the area of hydraulic, hydrological and geotechnical engineering and research as well as applying computational principles within the context of hydraulic engineering.
Making judgements	1. critically judge and evaluate their own work and results, as well as the information of prior research or investigations.
Communication	1. adequately communicate methodologies, results, evaluations, conclusions and recommendations in written, oral and graphical form to a wide variety of audience.
Lifelong learning skills	1. be aware of the importance of hydraulic engineering to society and be able to co-operate within a multidisciplinary and interdisciplinary framework with due consideration of ethical and social aspects related to the application of their knowledge and skills; 2. have adopted the academic attitude and learning skills to enhance and broaden the acquired knowledge and applications in an independent manner.

4.3 Coastal Engineering and Port Development

After successful completion of the programme, graduates will be able to:

Knowledge and understanding	1. have advanced level of understanding of the hydraulics, coastal processes and nautical and logistic aspects and their interactions with the nearshore and offshore structure; 2. develop strategies to cope effectively with problems related to natural hazards (e.g. coastal floods) and shoreline erosion problems and understand the conflict between coastal developments and natural coastal processes; 3. develop an understanding of the application of modern analysis and design techniques to coastal problems and gain the expertise necessary to make effective engineering interventions in the coastal environment; 4. be equipped with various analytical and computational expertise necessary to solve problems in coastal and port engineering.
Applying knowledge and understanding	1. apply sophisticated design techniques using theoretical concepts of coastal hydraulics and various principles and approaches of coastal engineering design to advance the needs of society for shelter, infrastructure and a safe environment and be able to evaluate and implement the solutions in a multidisciplinary and interdisciplinary environment; 2. apply hydraulic and nautical, logistic and economic theories in the planning and design of coastal and ports layout and port logistics; 3. have the skills to undertake academic research that contributes to the better understanding of coastal and/or port engineering; 4. have developed the talents and skills for problem formulation and solutions synthesizing different fields of knowledge to formulate solutions to relevant technical problems using modern engineering tools.
Making judgements	1. place a coastal engineering and/or port project in its environment (social, ecological and physical environment), be able to quantify and understand the interactions between the project and the environment, and is able to communicate the interactions with experts of a different background.
Communication	
Lifelong learning skills	1. have developed the skills to undertake independent creative academic activities and research and the ability to extend them leading to new knowledge that addresses problems of national and international importance; 2. have experienced different aspects of learning which are integrated through different teaching methods and through independent study experiences; 3. possess critical thinking skills, the ability of both independent and team problem-solving and the sense of engineering creativity and design; 4. have acquired sufficient skills in using information and communication technology for conducting research, studies and analyses, in addition to presentation and communication; 5. develop a sense of professionalism and an appreciation for the obligations of a professional engineer; 6. be aware of the professional and ethical issues encountered in engineering practice

4.4 Land and Water Development

After successful completion of the programme graduates will be able to:

Knowledge and understanding	1. Describe the latest concepts and theories of irrigation and drainage design, modernisation and management, flood protection and land reclamation for sustainable development and food security; 2. Explain the cross-sectoral linkages related to land and water development comprehending wider aspects of society, economy, human health and environment and its contributions to food security; 3. Acquire knowledge and understanding of contemporary research issues in the field of land and water development for food security.
Applying knowledge and understanding	1. Apply the latest hydraulic engineering and hydrological methods in planning, design and implementation of irrigation and drainage schemes, independently or in a multidisciplinary team; 2. Apply innovative tools like Remote Sensing and GIS in planning and performance management of land and water development schemes for enhanced food security.
Making judgements	1. Identify options for participatory land and water development, and critically assess their technical, socio-economic and environmental performance; 2. Evaluate aspects of planning, design, modernization, operation & maintenance and financing of irrigation and drainage schemes. 3. Identify, develop and conduct independent research including formulation of hypotheses, selection and application of research methodologies, planning and executing of data gathering and analysis, and formulation of conclusions and recommendations.
Communication	1. Clearly and systematically communicate, argue and defend research proposal and findings orally and written to a wide variety of audience.
Lifelong learning skills	1. Independently acquire knowledge, critically assess data, and acquire critical reading and writing skills whereby distinguishing between minor and major issues. 2. Contribute to the development of innovative approaches for adequate and sustainable land and water development for food security.

4.5 Learning objectives Agricultural Water Management for Enhanced Land and Water Productivity (joint specialisation with AIT)

After successful completion of the programme, graduates will be able to:

Knowledge and understanding	1. have in-depth understanding and specific knowledge of the latest concepts and theories of irrigation, drainage, flood management, land reclamation and consolidation technologies for increased returns from land and water resources in a sustainable manner; 2. have in-depth understanding and specific knowledge of the cross-sectoral linkages between land and water development and wider aspects of society, economy and the environment 3. acquire knowledge and understanding of contemporary research issues in the fields of land and water development and agricultural water management.
Applying knowledge and understanding	1. use latest hydraulic engineering and hydrological methods to apply in planning, design, implementation and management of irrigation, drainage and flood protection schemes, independently or in a multidisciplinary team; 2. identify and cross-evaluate alternative land and water development options for areas under different land uses and assess their technical, economical, institutional and environmental feasibility; 3. engage in or advise the developers, system managers and water users on the participatory development, management and modernisation, including planning, design, implementation, operation and maintenance, as well as on modernisation of the irrigation, drainage and flood management schemes; 4. formulate and conduct hydraulic and agronomic research, plan development and designs in the field of enhanced land and water productivity, experiments and tests for both practical and scientific purposes, either independently or within a team-based framework.
Making judgements	
Communication	1. formulate research questions, articulate research methodologies, develop study plans, and adequately communicate research results and conclusions in written and oral forms to a wide variety of audience.
Lifelong learning skills	1. develop the academic attitude and learning skills to enhance and broaden the acquired knowledge and application skills in a largely independent manner.

4.6 Learning objectives of the Advanced Water Management for Food Production Program specialization, (joint specialisation with Nebraska)

After successful completion of the programme, graduates will be able to:

Knowledge and understanding	1. understand in-depth the latest concepts and theories of irrigation, drainage, flood protection, land reclamation and consolidation technologies for food production; 2. describe the cross-sectoral linkages comprehending wider aspects of society, economy and the environment; 3. understand and formulate water management methodologies to enhance crop production with limited water supplies; 4. acquire knowledge and understanding of contemporary research issues in the field of land and water development and water for food. 5. identify and develop available water resources for food production;
Applying knowledge and understanding	1. use latest hydraulic engineering and hydrological methods to apply in planning, design and implementation of irrigation, drainage and flood protection schemes, independently or in a multidisciplinary team; 2. enhance the of on-farm irrigation systems through better design and management;
Making judgements	1. identify and cross-evaluate alternative land and water development options for areas under different land uses and assess their feasibility; technologically, economically, and environmentally; 2.
Communication	1. engage in or advise developers, system managers and water users on the participatory development and management, including operation and maintenance of the irrigation, drainage and flood protection schemes;
Lifelong learning skills	1. formulate research questions, articulate research methodologies, develop study plans, and adequately communicate research results and conclusions in written and oral forms to a wide variety of audience.

4.7 Hydroinformatics– Modelling and Information Systems for Water Management

After successful completion of the programme, graduates will be able to:

Knowledge and understanding	1. have in-depth understanding of the information cycle in relation to the management of water based systems, and have a thorough awareness of the flow of information from data acquisition to modelling, to support for decision making; 2. have a critical understanding of the theories and concepts of physical, chemical and biological processes relating to the flow of water in the natural environment, including river basins, coastal waters and urban water systems, as necessary to generate safe and reliable models for water based systems; 3. have an understanding of advanced and appropriate information and communication technologies and their application to manage information relating to water management; 4. have a good knowledge of the relevant literature and the contemporary research questions in the field of Hydroinformatics.
Applying knowledge and understanding	1. master the theory and practice of different modelling paradigms, and, in particular, physically based and data driven modelling, and be able to integrate them in hydroinformatics systems applied to a wide variety of hydraulic, hydrological and environmental situations; 2. to select and apply software tools available on the market, and critically assess their advantages and disadvantages in application to water resources management, hazard risk assessment and forecasting, environmental planning and asset management; 3. provide considered advice to managers and users of advanced Hydroinformatics tools; 4. appreciate and discuss the ethics and nature of the postmodern society and the role of water within it as a "right" and an "asset".
Making judgements	1. make critical use of advanced theories and concepts in Hydroinformatics to research creative solutions for new problems and situations, either independently or within a team; 2. critically judge and evaluate their own work and results, as well as prior research or investigations carried out by others.
Communication	1. develop a range of personal and communication skills, including the use of appropriate information and communication technologies, for oral and written presentation of methodologies, results, evaluations, conclusions and recommendations to a wide variety of audiences.
Lifelong learning skills	1. be aware of the importance of the relationship of Hydroinformatics with related disciplines such as hydraulics, hydrology, ecology and information science, and be able to co-operate within a multidisciplinary and interdisciplinary framework; 2. have adopted the academic attitude and learning skills to enhance and broaden the acquired knowledge and application skills in a largely independent manner; 3. be aware of the professional and ethical issues encountered in Hydroinformatics practice directed towards issues facing developing countries and countries in transition.

4.8 Flood Risk management

After successful completion of the programme, graduates will have:

Knowledge and understanding	1. a broad and cross-boundary scientific knowledge on flood risk management; 2. a comprehensive knowledge base and understanding of the current theory and practice relating to flooding and flood management; 3. the fundamental knowledge leading to the understanding of socio-economic issue related to flooding; 4. a broad scientific knowledge about conservation, restoration and management measures to overcome challenges imposed on water by humans and by climate change, and; 5. an extended knowledge on a basin-wide approach to flood risk management.
Applying knowledge and understanding	1. analyse the reciprocal relationships between the physical system, the institutional framework and the socio-economic environment, identifying future social and climatic pressures and needs and the consequent trends in system management; 2. apply specific practical skills, such as identifying the major physical processes in a given river basin or coastal zone and their interaction with the associated assets and receptors; 3. identify the links between all issues related to flooding in order to apply an integrated approach using the best tools to support decision making for the sustainable management of floods; 4. review scientific literature and carry out independent research (such as writing a state of the art paper based on research and practice literature); 5. apply sophisticated hydroinformatics and modelling tools and best practices to address the problems of flood risk management.
Making judgements	
Communication	1. communicate his/her knowledge and research results to the scientific and non-scientific communities (such as presenting papers/posters to scientific congresses, general lectures to policy makers and interested non-specialists).
Lifelong learning skills	1. occupy an independent and responsible position as a flood risk professional; 2. acquire independently further knowledge and techniques, and 3. operate in a team.

4.9 Groundwater and Global Change - Impacts and Adaptation

At the end of the programme students are able to:

Knowledge and understanding	1. explain in detail how groundwater systems function; 2. describe the interactions between groundwater systems, climate, surface waters and land use.
Applying knowledge and understanding	1. use modelling tools for climate and groundwater systems; 2. plan groundwater-related adaptation solutions for global change.
Making judgements	1. identify the consequences of global and climate change impacts for groundwater management under uncertainty.
Communication	1. effectively transfer knowledge, through written and oral communication, using the English language, within the scientific discipline.
Lifelong learning skills	1. demonstrate creativity and critical, multidisciplinary thinking for problem-solving and decision-making; 2. take responsibility, show initiative and have the capacity to work in an international, multi-cultural team.

5. Graduate professional diploma programme

Upon completion of the programme participants will be qualified to:

- perform as a competent professional in the field of sanitation and/or sanitary engineering
- to contribute to the development of innovative approaches to the provision of sustainable sanitation services especially under challenging conditions usually prevailing in developing and countries in transition.

Students are able to:

Knowledge and understanding	1. Understand and explain the role of sanitation in the urban water cycle and its relation to public health and environment; 2. Understand the relevant physical, chemical and biological processes and their mutual relationships within various sanitation components;.
Applying knowledge and understanding	1. Develop rational approaches towards sustainable wastewater management via pollution prevention, appropriate treatment, and resource recovery and re-use at both centralized and decentralized setting; 2. Apply modern tools for technology selection and to model sanitation components.
Making judgements	1. Define and critically analyze, assess and evaluate various urban drainage and sewerage schemes, and wastewater, sludge (including feacal sludge) and solid waste treatment process technologies; 2. Analyze, synthesize, integrate, interpret, and discuss scientific and practical information in the context of preparing research and engineering projects including preparation of master plans, feasibility studies and preliminary designs.
Communication	
Lifelong learning skills	

Appendix B Examination Procedures

GENERAL RULES

Students taking part in an examination are expected to have taken notice of these procedures and are expected to understand the implied meaning of these procedures.

WRITTEN EXAMINATIONS

PROCESS:

1. the students brings his / her student card and displays it on the table;
2. the invigilator verifies the card and confirms attendance by the student by ticking the box of the student on the attendance list;
3. students hand in their exam papers at the end of the session; this is their own responsibility;
4. invigilators bring the exam papers to the Education Office (immediately after the exam);
5. Education Officers verify which exam papers have been received and record this on a list;
6. the list produced by the Education Officers serves as the evidence that the exam papers have been handed in;
    a. if exam papers get lost and they have been recorded on the list of Education Office, IHE Delft has the responsibility to propose an adequate alternative assessment to the student.
    b. if a student claims that an exam paper got lost and the exam paper is not recorded on the list of Education Office, then the Institute considers the exam paper not to have been handed in by the student. There will be no alternative assessment proposed.

Invigilators: The invigilators (examination supervisors) ensure proper conduct of the examination and maintain order in the examination room. They will announce the beginning and the duration of the examination, and will warn the students 10 minutes before the ending of the examination.

Communication: During the examination, students are not allowed to exchange materials or to communicate with other students. If something is unclear, students have to inform the invigilator, who will contact the programme coordinator, the examiner or education officer if necessary.

Attendance list: Students are considered to have taken part in an examination from the moment they receive the examination papers from the invigilators, whether or not they submit any answers.

Bags: Bags and carrying cases, including penholders, are to be placed along the side of the room before the start of the examination.

Exam paper: Answer and scratch paper will be provided to the students
Students provide the answers in clearly readable English, with proper indication of the question label. All answer papers must carry the student number and locker number of the student. Unreadable answers or unidentified answer papers may be discarded for assessment by the examiner.

Pen: Students are required to bring the necessary writing and drawing tools. The answer papers to be submitted must be written with a pen, a pencil is not allowed.

Dictionary: The use of a printed language dictionary without any additional written annotations is allowed (all languages are allowed). Invigilators are allowed to check the dictionaries for hand-written annotations during the exam (spot checks while they are walking around).
Electronic dictionaries are not allowed.

Calculators: Only self contained calculators with a single-line display or dual-line display are allowed, provided that these devices are battery operated, that any audio functions are switched off, and that these devices are exclusively built for calculation purposes only and do not have internet access.

Cell phones: Use of cell phones is not allowed and must be switched off

Other materials: The use of materials other than listed above, including blank paper, texts, laptops, computing and communication devices, personal audio and video devices, of any kind, is not allowed.
Examiners may nevertheless allow students to use specified text matter or other effects in a so-called 'open book' examination. These materials shall not include previous or example examinations and solutions.

Toilet visit: Only one student at a time will be allowed by the invigilator to leave the examination room for a short visit to the lavatory, except during the first 15 and the last 15 minutes of the examination. Examination materials and requirements may not be taken outside the examination room. Before leaving the examination room, students have to hand over their cell phone to the invigilator.

Submission of exam papers: Students who finish the examination at least 15 minutes after the start and at least 15 minutes before the ending of the examination are allowed to submit their work to the invigilator and quietly leave the examination room.
Students have to ensure that all required papers are submitted to the invigilator. Papers cannot be submitted after the student has left the examination room.

ASSIGNMENT REPORTS AND INDIVIDUAL DISCUSSIONS

For designated subjects students have to submit an assignment report, which will be assessed as part of the subject examination. The examiner may discuss the assignment report with the student as part of the assessment.

The examiner will set a deadline for submitting assignment reports. The deadline cannot be set at a date after the examination period for the subject, as indicated in the academic calendar. Students submit assignments to either the lecturer or the responsible coordinator.

Appendix C GRADING SYSTEMS used by partner institutes

1. Asian Institute of Technology

Grade	Grade Points	Description
A	4	Excellent
B+	3.5	
B	3	Good
C+	2.5	
C	2	Fair
D	1	Deficient
F	0	Fail
I		Incomplete

2. Universidad del Valle

Grade	Description
0.0	Given when absent from the exam without valid reason, when blank exam is submitted, or when caught cheating.
1.0 – 2.9	Non-pass, resit needed
3.0	Acceptable
4.0	Good
5.0	Excellent

Degree is awarded when

- GPA for the taught part is 3.5 or higher, and
- a pass is obtained for the thesis. (pass / non-pass)

3. Egerton University

Grade	Grade Points	Description
A	70% and above	Excellent
B	60-69%	Good
C	50-59%	Average
F	0-49%	Fail

Grading systems approved by the University Senate, with 50% as the pass mark.

4. BOKU

Austrian grade	ECTS Grade	Description
1	A/B	excellent/very good
2	C	good
3	D	satisfactory
4	E	pass

5. TU Dresden:

Grade	Grade Points	Description
A	1	very good
B	2	good
C	3	satisfactory
D	4	sufficient
E	5	insufficient

All courses have to be lower than 4 for a degree.

6. University of Ljubljana

Grade	Description
10	excellent: outstanding results with negligible mistakes
9	very good: high pass with minor mistakes
8	very good: sound knowledge
7	good: sound knowledge with major mistakes
6	satisfactory: adequate knowledge suiting minimum criteria
5 - 1	insufficient: failure, poor knowledge below minimum criteria

Candidates with grades satisfactory (6) or more, have passed the examinations successfully.
The student has two grades per subject: separately theory and lab exercise (seminar work). For thesis there are also two grade: written report and presentation, both should be more than 6. Finally we have one grade for thesis and common final grade of study (special formula).

7. TU-Catalonia

Grade	Description
9.0 - 10.0	excellent
7.0 - 8.9	very good
5.0 - 6.9	satisfactory
4.0 - 4.9	marginal fail
0.0 - 3.9	fail
NP	not examined
R	recognition

MH Honors (is given on exceptional cases)

8. University of Lisbon

Grade	Grade Points	Description
A	20-18	excellent
B	17-16	very good, with few errors
C	15-14	good, with some errors
D	13-12	satisfactory, with many errors
E	11-10	sufficient

Appendix D MSc modules: names, credits & assessment methods

The tables on the next pages give an overview of the module in each specialisation, including the ways these modules are assessed.

1. Urban Water and Sanitation programme

SANITARY ENGINEERING		C1349									
Module number	Module Name	Code	Module coordinator	Workload	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)
1	Introduction to UWS 1	M3188	Slokar	149	5	60		35		5	
2	Introduction to UWS 2	M3192	Salinas	76	5	75		25			
3	Introduction to UWS 3	M3189	vd Steen	167	5	85				15	
4	Urban drainage and sewerage	M3190	Vojnovic	142	5	60		40			
5	Conventional wastewater treatment	M1802	Lopez	148	5	80		20			
6	Resource oriented wastewater treatment and sanitation	M2384	Ronteltap	157	5	80		20			
7	Wastewater treatment plants design and engineering	M2373	Lopez	142	5	50	25	25			
8	Modelling of wastewater treatment processes and plants	M3054	Hooymans	132	5	60		40			
9	International fieldtrip and fieldwork	M1421	Slokar	150	5			100			
12	Summer course										
13	Groupwork Sint Maarten	M3114	Petrusevski	132	5			60	40		
14	MSc research proposal development	M3239	Slokar	40	9		100				
15	MSc research, thesis and defence	M2927	various	1008	36			100			
	Electives modules:										
10	Industrial effluents treatment and residuals management	M3102	Garcia	146	5	60		40			
10	Water treatment processes and plants	M2371	Sharma	140	5		60	40			
10	Urban water systems	M3006	Voijnovic	142	5	40		60			
11	Solid waste management	M3270	Hullebusch	140	5	60		4			
11	Strategic Planning for River Basins and Deltas	M3211	Evers	140	5	50		50			
11	IWRM as a tool for adaptation to climate change	M3207	de Ruyter	140	5	70			30		
11	Wetlands for livelihoods and conservation	M3214	Hes	140	5			80	20		
11	Urban water governance	M3261	Acevedo Guerre	139	5			100			
11	Advanced water transport and distribution	M3250	Trifunovic	139	5	60		40			
11	Faecal Sludge Management	M3217	Ronteltap	116	5	85		15			
11	Decentralised Water Supply and Sanitation	M2810	Sharma	140	5	60		30	10		
11	Hydroinformatics for Decision Support	M3233	Jonoski	136	5			100			
11	Water Sensitive Cities	M3048	Pathirana	160	5		25	50	25		
11	Modelling river systems and lakes	M3277	Cattapan	142	5	40		60			
11	Flood Protection in Lowland Areas	M3251	Roelvink	140	5	60		40			
11	Remote sensing for agricultural water management	M3237	Karimi	140	5	40		60			

WATER SUPPLY ENGINEERING		C1352									
Module number	Module Name	Code	Module coordinator	Workload	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)
1	Introduction to UWS 1	M3188	Slokar	149	5	60		35		5	
2	Introduction to UWS 2	M3192	Salinas	76	5	75		25			
3	Introduction to UWS 3	M3189	vd Steen	167	5	85				15	
4	Surface water treatment I	M2550	Kennedy	140	5	60		20		20	
5	Surface water treatment II	M1577	Ferrero	150	5	70		10		20	
6	Groundwater resources and treatment	M3033	Petrusevski	141	5	70		15		15	
7	Water transport and distribution	M3245	Trifunovic	139	5	60		40			
8	Desalination and membrane technology	M3225	Salinas	123	5	70		20		10	
9	International fieldtrip and fieldwork	M1421	Slokar	150	5			100			
12	Summer course										
13	Groupwork Sint Maarten	M3114	Petrusevski	132	5			60	40		
14	MSc research proposal development	M3239	Slokar	40	9		100				
15	MSc research, thesis and defence	M2927	various	1008	36			100			
	Electives modules:										
10	Industrial effluents treatment and residuals management	M3102	Garcia	146	5	60		40			
10	Water treatment processes and plants	M2371	Sharma	140	5		60	40			
10	Urban water systems	M3006	Voijnovic	142	5	40		60			
11	Solid waste management	M3270	Hullebusch	140	5	60		4			
11	Strategic Planning for River Basins and Deltas	M3211	Evers	140	5	50		50			
11	IWRM as a tool for adaptation to climate change	M3207	de Ruyter	140	5	70			30		
11	Wetlands for livelihoods and conservation	M3214	Hes	140	5			80	20		
11	Urban water governance	M3261	Acevedo Guerre	139	5			100			
11	Advanced water transport and distribution	M3250	Trifunovic	139	5	60		40			
11	Faecal Sludge Management	M3217	Ronteltap	116	5	85		15			
11	Decentralised Water Supply and Sanitation	M2810	Sharma	140	5	60		30	10		
11	Hydroinformatics for Decision Support	M3233	Jonoski	136	5			100			
11	Water Sensitive Cities	M3048	Pathirana	160	5		25	50	25		
11	Modelling river systems and lakes	M3277	Cattapan	142	5	40		60			
11	Flood Protection in Lowland Areas	M3251	Roelvink	140	5	60		40			
11	Remote sensing for agricultural water management	M3237	Karimi	140	5	40		60			

URBAN WATER ENGINEERING AND MANAGEMENT			C1036									
Location	Module number	Module Name	Code	Module coordinator	Workload	AIT credits / ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)
AIT		Watershed hydrology	CE74.11			3 (7.5)	x		x			
		Drinking water treatment	ED78.36			3 (7.5)	x					
		Wastewater treatment				3 (7.5)	x		x			
		Integrated water resources management	CE74.54			3 (7.5)	x		x			
U-IHE	4	Urban drainage and sewerage	M3190	Vojnovic	142	5	60		40			
	5	Asset management	M3047	Pathirana	150	2 (5.0)		50	50			
	6	Managing water organisations	M3170	Tutusaus Luque	96	2 (5.0)			100			
	7	Water transport and distribution	M3245	Trifunovic	139	2 (5.0)	60		40			
	8	Urban flood management and disaster risk mitigation	M1710	Vojinovic	140	2 (5.0)	40		60			
	9	International fieldtrip and fieldwork	M1421	Slokar	150	2 (5.0)			100			
		Electives:										
	10	Industrial effluents treatment and residuals management	M3102	Garcia	146	5	60		40			
	10	Water treatment processes and plants	M2371	Sharma	140	5		60	40			
	10	Urban water systems	M3006	Voijnovic	142	5	40		60			
		Summer course				0.4 (1)						
		Total coursework				26 (65)						
						0			x	x		
AIT		MSc thesis work				22 (55)			x	x		
		Grand total (coursework + thesis)				48 (120)						

Joint MSc programme in Urban Water and Sanitation with specialisation Sanitary Engineering with Universidad del Valle, Colombia			C1033									
Location	Module number	Module Name	Code	Module coordinator	Workload	UVC /ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)
Univalle	C1	C1 Chemistry of Environmental Pollution	C1			3 /5.13	50		20		30	
	C2	C2 Environmental Pollution Microbiology	C2			3 /5.13	x		x	x	x	
	C3	C3 Fundamentals of Environmental Processes	C3			3 /5.13	60		20		20	20
	C4	C4 Environmental and Development	C4			3 /5.13	35		30	35		
	C5	C5 Engineering Research Introduction	C5			2/3.42			100		20	
U-IHE	4	Urban drainage and sewerage	M3190	Vojnovic	142	5	60		40			
	5	Conventional wastewater treatment	M1802	Lopez	148	5	80		20			
	6	Resource oriented wastewater treatment and sanitation	M2384	Ronteltap	157	5	80		20			
	7	Wastewater treatment plants design and engineering	M2373	Lopez	142	5	50	25	25			
	8	Modelling of wastewater treatment processes and plants	M3054	Hooymans	132	5	60		40			
	9	International fieldtrip and fieldwork	M1421	Slokar	150	5			100			
	12	Summer course										
	13	Groupwork Sint Maarten	M3114	Petrusevski	132	5			60	40		
		Electives modules:										
	10	Industrial effluents treatment and residuals management	M3102	Garcia	146	5	60		40			
	10	Water treatment processes and plants	M2371	Sharma	140	5		60	40			
	10	Urban water systems	M3006	Voijnovic	142	5	40		60			
						5						
Univalle	C9	Engineering research I (4 UVC)	C9			4/6.84						
	C10	Engineering Research II (8 UVC)	C10			8/13.68						
		MSc thesis (14 UVC)				14/23.94						

2. Environmental Science programme

ENVIRONMENTAL SCIENCE AND TECHNOLOGY		C1140										
Module number	Module Name	Code	Module coordinator	Workload	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
1	Introduction to environmental science 1	M3172	de Ruyter	140	5	100						
2	Introduction to environmental science 2	M3173	de Ruyter	140				100				
3	Introduction to environmental science 3	M3194	de Ruyter	140		60		40				
4	Integrated project environmental science	M3031	vd Steen	140	5			70	30			
5	Industrial Resource Management & Cleaner Production	M3179	Raj	140	5	60		35	5			
6	Environmental systems analysis	M3171	Irvine	140	5	40		50	10			
7	Environmental engineering	M3081	Raj	140	5	75		25				
8	Environmental monitoring and modelling	M3187	Zuijdgeest	140	5	55		45				
9	Foreign fieldtrip and fieldwork ES	M1766	de Ruyter	140	5			100				
12	Summer courses				1			100				
13	Groupwork ES	M3197	Zuijdgeest	140	5			100				
14	Thesis Research Proposal Development for ES	M3283	Mendoza	250	9			100				
15	MSc research, thesis and defence	M2927	various		36			100				
	Elective modules:											
10	Aquatic ecosystems: processes and applications	M3202	Gettel	140	5			90	10			
10	Environmental assessment for water related policies and develo	M3080	Mendoza	140	5	50		50				
11	Solid waste management	M3270	Hullebusch	140	5	60		4				
11	Strategic Planning for River Basins and Deltas	M3211	Evers	140	5	50		50				
11	IWRM as a tool for adaptation to climate change	M3207	de Ruyter	140	5	70			30			
11	Wetlands for livelihoods and conservation	M3214	Hes	140	5			80	20			
11	Urban water governance	M3261	Acevedo Guerre	139	5			100				
11	Advanced water transport and distribution	M3250	Trifunovic	139	5	60		40				
11	Faecal Sludge Management	M3217	Ronteltap	116	5	85		15				
11	Decentralised Water Supply and Sanitation	M2810	Sharma	140	5	60		30	10			
11	Hydroinformatics for Decision Support	M3001	Jonoski	136	5			100				
11	Water Sensitive Cities	M3048	Pathirana	160	5		25	50	25			
11	Modelling river systems and lakes	M3277	Cattapan	142	5	40		60				
11	Flood Protection in Lowland Areas	M3251	Roelvink	140	5	60		40				
11	Remote sensing for agricultural water management	M3237	Karimi	140	5	40		60				

ENVIRONMENTAL POLICY MAKING		C1127										
Module number	Module Name	Code	Module coordinator	Workload	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
1	Introduction to environmental science 1	M3172	de Ruyter	140	5	100						
2	Introduction to environmental science 2	M3173	de Ruyter	140				100				
3	Introduction to environmental science 3	M3194	de Ruyter	140		60		40				
4	Integrated project environmental science	M3031	vd Steen	140	5			70	30			
5	Water and environmental law	M1003	Jaspers	132	5	70		30				
6	Environmental systems analysis	M3171	Irvine	140	5	40		50	10			
7	Water and environmental policy analysis	M3212	Mendoza	140	5	50		50				
8	Environmental planning and implementation	M3021	Evers	140	5	50		50				
9	Foreign fieldtrip and fieldwork ES	M1766	de Ruyter	140	5			100				
12	Summer courses				1			100				
13	Groupwork ES	M3197	Zuijdgeest	140	5			100				
14	Thesis Research Proposal Development for ES	M3283	Mendoza	250	9			100				
15	MSc research, thesis and defence	M2927	various		36			100				
	Elective modules:											
10	Aquatic ecosystems: processes and applications	M3202	Gettel	140	5			90	10			
10	Environmental assessment for water related policies and develo	M3080	Mendoza	140	5	50		50				
11	Solid waste management	M3270	Hullebusch	140	5	60		4				
11	Strategic Planning for River Basins and Deltas	M3211	Evers	140	5	50		50				
11	IWRM as a tool for adaptation to climate change	M3207	de Ruyter	140	5	70			30			
11	Wetlands for livelihoods and conservation	M3214	Hes	140	5			80	20			
11	Urban water governance	M3261	Acevedo Guerre	139	5			100				
11	Advanced water transport and distribution	M3250	Trifunovic	139	5	60		40				
11	Faecal Sludge Management	M3217	Ronteltap	116	5	85		15				
11	Decentralised Water Supply and Sanitation	M2810	Sharma	140	5	60		30	10			
11	Hydroinformatics for Decision Support	M3001	Jonoski	136	5			100				
11	Water Sensitive Cities	M3048	Pathirana	160	5		25	50	25			
11	Modelling river systems and lakes	M3277	Cattapan	142	5	40		60				
11	Flood Protection in Lowland Areas	M3251	Roelvink	140	5	60		40				
11	Remote sensing for agricultural water management	M3237	Karimi	140	5	40		60				

WATER QUALITY MANAGEMENT		C1166										
Module number	Module Name	Code	Module coordinator	Workload	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
1	Introduction to environmental science 1	M3172	de Ruyter	140	5	100						
2	Introduction to environmental science 2	M3173	de Ruyter	140				100				
3	Introduction to environmental science 3	M3194	de Ruyter	140		60		40				
4	Integrated project environmental science	M3031	vd Steen	140	5			70	30			
5	Water and environmental law	M1003	Jaspers	122	5	70		30				
6	Water quality assessment	M3169	Zuijdgeest	140	5	40		60				
7	Constructed wetlands for wastewater treatment	M2216	vd Vossenberg	140	5	60		40				
8	Environmental planning and implementation	M3021	Evers	140	5	50		50				
9	Foreign fieldtrip and fieldwork ES	M1766	de Ruyter	140	5			100				
12	Summer courses				1			100				
13	Groupwork ES	M3197	Zuijdgeest	140	5			100				
14	Thesis Research Proposal Development for ES	M3283	Mendoza	250	9			100				
15	MSc research, thesis and defence	M2927	various		36			100				
	Elective modules:											
10	Aquatic ecosystems: processes and applications	M3202	Gettel	140	5			90	10			
10	Environmental assessment for water related policies and develo	M3080	Mendoza	140	5	50		50				
11	Solid waste management	M3270	Hullebusch	140	5	60		4				
11	Strategic Planning for River Basins and Deltas	M3211	Evers	140	5	50		50				
11	IWRM as a tool for adaptation to climate change	M3207	de Ruyter	140	5	70			30			
11	Wetlands for livelihoods and conservation	M3214	Hes	140	5			80	20			
11	Urban water governance	M3261	Acevedo Guerre	139	5			100				
11	Advanced water transport and distribution	M3250	Trifunovic	139	5	60		40				
11	Faecal Sludge Management	M3217	Ronteltap	116	5	85		15				
11	Decentralised Water Supply and Sanitation	M2810	Sharma	140	5	60		30	10			
11	Hydroinformatics for Decision Support	M3001	Jonoski	136	5			100				
11	Water Sensitive Cities	M3048	Pathirana	160	5		25	50	25			
11	Modelling river systems and lakes	M3277	Cattapan	142	5	40		60				
11	Flood Protection in Lowland Areas	M3251	Roelvink	140	5	60		40				
11	Remote sensing for agricultural water management	M3237	Karimi	140	5	40		60				

LIMNOLOGY AND WETLAND MANAGEMENT			C1155										
Location	Module number	Module Name	Code	Module coordinator	Workload	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab report (%)	Home work (%)	Integrated in modules (%)
BOKU		Limnology (812340)											
		Aquatic Biomonitoring and -Assessment (812384)											
		Ecology of Aquatic Ecosystems (812342)											
		Water Legislation (812348)											
		Taxonomy and Ecology of Benthic Invertrebrates (812343)											
		Human Impacts in Riverine Landscapes (812347)											
		Ecology of Fishes (812344)											
		Statistical Analyses of Ecological Data (812352)											
		Scientific Reading and Presentation in Aquatic Ecology (812351)											
		Physical Environment of Riverine Landscape (812345)											
		Applications in River Landscape Management (812350)											
		Limnochemistry and Nutrient Cycling (812341)											
		Ecological River Landscape Management (812349)											
EGERTON		Ecology of Streams and Rivers (LIWM714)											
		Lake Ecology (LIWM713)											
		Wetlands for Water Quality (LIWM721)											
		Fisheries & Aquaculture (LIWM722)											
		MSc Thesis: Research and Thesis writing (LIWM736)											
		MSc Proposal; Research Plan, logistics, site assessment, application & societal relevance (LIWM735)											
UNESCO-IHE	9	Data Analysis and Modeling for Aquatic Ecosystems	M3273	van Dam		5	40		40	20			
	10	Aquatic ecosystems: processes and applications	M3202	Gettel	140	5			90	10			
	11	Wetlands for livelihoods and conservation	M3214	Hes	140	5			80	20			
	12	Summer courses				1			100				
	13	Groupwork ES	M3197	Zuijdgeest	140	5			100				
	14	MSc research methodology and proposal development	M3283	Mendoza	250	9			100				
	15	MSc research, thesis and defence	M2927	various		36			100				
		TOTAL				120							

3. Water Science and Engineering programme

RIVER BASIN DEVELOPMENT		C1477										
Module number	Module Name	Code	Module coordinator	Workload	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
1	Introduction to Water Science and Engineering	M2131	Foppen	132	5	55		45				
2	Hydrology and hydraulics	M2208	Maskey	142	5	80		20				
3	River basin hydraulics, geotechnics and remote sensing	M3129	Paron	136	5	75		25				
4	River morphodynamics	M2730	Crosato	140	5	80		20				
5	Data collection and analysis and design	M3090	Werner	138	5	70		30				
6	River Basin Development and EIA	M1703	Masih	140	5	50		50				
7	River structures	M1171	Cattapan	140	5	100						
9	Fieldtrip and Fieldwork	M3167	Duker	140	5			100				
12	Summer courses				1			100				
13	Groupwork WSE	M1284	Veerbeek	140	5				100			
14	Thesis Research Proposal Development for WSE	M3284	Foppen	196	9			100				
15	MSc research, thesis and defence	M2927	various		36			100				
	Elective modules:											
8	Integrated hydrological and river modelling	M1309	Maskey	138	5			85	15			
8	Climate change impacts and adaptation in coastal areas	M3204	Alvaro	140	5			100				
8	Dams and hydropower	M3009	Marence	149	5	90		10				
8	Planning and delivery of flood resilience	M3275	Gersonius	132	5			30	50		20	
8	River Flood Analysis and Modelling	M2709	Popescu	134	5	50		50				
8	Urban flood management and disaster risk mitigation	M1710	Vojnovic	140	5	40		60				
8	International Port Seminar	M3166	Dastgheib	140	5				100			
8	Management of irrigation and drainage systems	M3203	Duker	142	5	60		40				
10	Applied Groundwater Modelling	M2841	Zhou	142	5			100				
10	Flood Risk Management	M3243	Bhattacharya	132	5	30		70				
10	Drought Management and Reservoir Operations	M3036	Werner	138	5	60		40				
10	Geotechnical Engineering and Dredging	M2214	vd Wegen	140	5		60	40				
10	Innovative Water Systems for Agriculture	M3238	Karimi	132	5	40		60				
11	Solid waste management	M3270	Hullebusch	140	5	60		4				
11	Strategic Planning for River Basins and Deltas	M3211	Evers	140	5	50		50				
11	IWRM as a tool for adaptation to climate change	M3207	de Ruyter	140	5	70			30			
11	Wetlands for livelihoods and conservation	M3214	Hes	140	5			80	20			
11	Urban water governance	M3261	Acevedo Guerrero	139	5			100				
11	Advanced water transport and distribution	M3250	Trifunovic	139	5	60		40				
11	Faecal Sludge Management	M3217	Ronteltap	116	5	85		15				
11	Decentralised Water Supply and Sanitation	M2810	Sharma	140	5	60		30	10			
11	Hydroinformatics for Decision Support	M3233	Jonoski	136	5			100				
11	Water Sensitive Cities	M3048	Pathirana	160	5		25	50	25			
11	Modelling river systems and lakes	M3277	Cattapan	142	5	40		60				
11	Flood Protection in Lowland Areas	M3251	Roelvink	140	5	60		40				
11	Remote sensing for agricultural water management	M3237	Karimi	140	5	40		60				

COASTAL ENGINEERING AND PORT DEVELOPEMENT		C1427										
Module number	Module Name	Code	Module coordinator	Workload	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
1	Introduction to Water Science and Engineering	M2131	Foppen	132	5	55		45				
2	Hydrology and hydraulics	M2208	Maskey	142	5	80		20				
3	Introduction to coastal science and engineering	M3178	Semedo	132	5	90				10		
4	Port planning and infrastructure design	M3165	Dastgheib	150	5			100				
5	Coastal systems	M3163	Ranasinghe	140	5	100						
6	Design of breakwaters	M3164	Dastgheib	134	5			100				
7	Process-based Coastal Modeling	M3162	Reyns	152	5			100				
9	Fieldtrip and Fieldwork	M3167	Duker	140	5			100				
12	Summer courses				1			100				
13	Groupwork WSE	M1284	Veerbeek	140	5				100			
14	Thesis Research Proposal Development for WSE	M3284	Foppen	196	9			100				
15	MSc research, thesis and defence	M2927	various		36			100				
	Elective modules:											
8	Integrated hydrological and river modelling	M1309	Maskey	138	5			85	15			
8	Climate change impacts and adaptation in coastal areas	M3204	Alvaro	140	5			100				
8	Dams and hydropower	M3009	Marence	149	5	90		10				
8	Planning and delivery of flood resilience	M3275	Gersonius	132	5			30	50		20	
8	River Flood Analysis and Modelling	M2709	Popescu	134	5	50		50				
8	Urban flood management and disaster risk mitigation	M1710	Vojnovic	140	5	40		60				
8	International Port Seminar	M3166	Dastgheib	140	5				100			
8	Management of irrigation and drainage systems	M3203	Duker	142	5	60		40				
10	Applied Groundwater Modelling	M2841	Zhou	142	5			100				
10	Flood Risk Management	M3243	Bhattacharya	132	5	30		70				
10	Drought Management and Reservoir Operations	M3036	Werner	138	5	60		40				
10	Geotechnical Engineering and Dredging	M2214	vd Wegen	140	5		60	40				
10	Innovative Water Systems for Agriculture	M3238	Karimi	132	5	40		60				
11	Solid waste management	M3270	Hullebusch	140	5	60		4				
11	Strategic Planning for River Basins and Deltas	M3211	Evers	140	5	50		50				
11	IWRM as a tool for adaptation to climate change	M3207	de Ruyter	140	5	70			30			
11	Wetlands for livelihoods and conservation	M3214	Hes	140	5			80	20			
11	Urban water governance	M3261	Acevedo Guerrero	139	5			100				
11	Advanced water transport and distribution	M3250	Trifunovic	139	5	60		40				
11	Faecal Sludge Management	M3217	Ronteltap	116	5	85		15				
11	Decentralised Water Supply and Sanitation	M2810	Sharma	140	5	60		30	10			
11	Hydroinformatics for Decision Support	M3233	Jonoski	136	5			100				
11	Water Sensitive Cities	M3048	Pathirana	160	5		25	50	25			
11	Modelling river systems and lakes	M3277	Cattapan	142	5	40		60				
11	Flood Protection in Lowland Areas	M3251	Roelvink	140	5	60		40				
11	Remote sensing for agricultural water management	M3237	Karimi	140	5	40		60				

LAND AND WATER DEVELOPMENT		C1505										
Module number	Module Name	Code	Module coordinator	Workload	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
1	Introduction to Water Science and Engineering	M2131	Foppen	132	5	55		45				
2	Hydrology and hydraulics	M2208	Maskey	142	5	80		20				
3	Principles and practices of land and water development	M3255	Hayde	140	5	44		56				
4	Design aspects of irrigation and drainage	M3252	Hayde	140	5	31		69				
5	Irrigation and drainage design	M3180	Suryadi	142	5	40		60				
6	Socio-economic and environmental aspects of land and water de	M3177	Duker	128	5	45		55				
7	Conveyance and irrigation structures	M3025	Suryadi	142	5	35		65				
9	Fieldtrip and Fieldwork	M3167	Duker	140	5			100				
12	Summer courses				1			100				
13	Groupwork WSE	M1284	Veerbeek	140	5				100			
14	Thesis Research Proposal Development for WSE	M3284	Foppen	196	9			100				
15	MSc research, thesis and defence	M2927	various		36			100				
	Elective modules:											
8	Integrated hydrological and river modelling	M1309	Maskey	138	5			85	15			
8	Climate change impacts and adaptation in coastal areas	M3204	Alvaro	140	5			100				
8	Dams and hydropower	M3009	Marence	149	5	90		10				
8	Planning and delivery of flood resilience	M3275	Gersonius	132	5			30	50		20	
8	River Flood Analysis and Modelling	M2709	Popescu	134	5	50		50				
8	Urban flood management and disaster risk mitigation	M1710	Vojnovic	140	5	40		60				
8	International Port Seminar	M3166	Dastgheib	140	5				100			
8	Management of irrigation and drainage systems	M3203	Duker	142	5	60		40				
10	Applied Groundwater Modelling	M2841	Zhou	142	5			100				
10	Flood Risk Management	M3243	Bhattacharya	132	5	30		70				
10	Drought Management and Reservoir Operations	M3036	Werner	138	5	60		40				
10	Geotechnical Engineering and Dredging	M2214	vd Wegen	140	5		60	40				
10	Innovative Water Systems for Agriculture	M3238	Karimi	132	5	40		60				
11	Solid waste management	M3270	Hullebusch	140	5	60		4				
11	Strategic Planning for River Basins and Deltas	M3211	Evers	140	5	50		50				
11	IWRM as a tool for adaptation to climate change	M3207	de Ruyter	140	5	70			30			
11	Wetlands for livelihoods and conservation	M3214	Hes	140	5			80	20			
11	Urban water governance	M3261	Acevedo Guerrero	139	5			100				
11	Advanced water transport and distribution	M3250	Trifunovic	139	5	60		40				
11	Faecal Sludge Management	M3217	Ronteltap	116	5	85		15				
11	Decentralised Water Supply and Sanitation	M2810	Sharma	140	5	60		30	10			
11	Hydroinformatics for Decision Support	M3233	Jonoski	136	5			100				
11	Water Sensitive Cities	M3048	Pathirana	160	5		25	50	25			
11	Modelling river systems and lakes	M3277	Cattapan	142	5	40		60				
11	Flood Protection in Lowland Areas	M3251	Roelvink	140	5	60		40				
11	Remote sensing for agricultural water management	M3237	Karimi	140	5	40		60				

LAND AND WATER DEVELOPMENT WITH NEBRASKA			C1048										
	Module number	Module Name	Code	Module coordinator	Workload	UNL credits/ ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
UNESCO-IHE	1	Introduction to Water Science and Engineering	M2131	Foppen	132	5	55		45				
	2	Hydrology and hydraulics	M2208	Maskey	142	5	80		20				
	3	Principles and practices of land and water development	M3255	Hayde	140	5	44		56				
	4	Design aspects of irrigation and drainage	M3252	Hayde	140	5	31		69				
	5	Irrigation and drainage design	M3180	Suryadi	142	5	40		60				
	6	Socio-economic and environmental aspects of land and water de	M3177	Duker	128	5	45		55				
	7	Conveyance and irrigation structures	M3025	Suryadi	142	5	35		65				
	8	Management of irrigation and drainage systems	M3203	Duker	142	5	60		40				
	9	Fieldtrip and Fieldwork	M3167	Duker	140	5			100				
University of Nebraska, Lincoln, USA		Plant-Water Relations	AGRO807			3 (5)							
		Groundwater Geology	NRES 488			3(5)							
		Advanced Irrigation and Drainage Systems Engineering	AGEN953			3 (5)							
		Advanced Irrigation Management	MSYM855			3 (5)							
		Water Law, Planning and Policy	AECN 876			3 (5)							
		Masters Water for Food Project	MSYM898			3 (5)							
		Remote Sensing	GEOG 818			4 (6)							
		Global Water and Food Seminar	BSEN 892			3(5)			100				
		Water Resources Seminar	NRES884			1(2)							

LAND AND WATER DEVELOPMENT WITH AIT			C1054										
Location	Module number	Module Name	Code	Module coordinator	Workload	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
AIT		Watershed Hydrology				7.5	30+40		30				
		Hydrodynamics				7.5	40+50		10				
		Irrigation and Drainage Engineering				7.5	30+40		30				
		Integrated Water Resources Management				7.5	20+30		50				
		MSc thesis work											
U-IHE	4	Design aspects of irrigation and drainage	M3252	Hayde	140	5	31		69				
	5	Irrigation and drainage design	M3180	Suryadi	142	5	40		60				
	6	Socio-economic and environmental aspects of land and water de	M3177	Duker	128	5	45		55				
	7	Conveyance and irrigation structures	M3025	Suryadi	142	5	35		65				
	8	Management of irrigation and drainage systems	M3203	Duker	142	5	60		40				
	9	Fieldtrip and Fieldwork	M3167	Duker	140	5			100				
		Elective modules:											
	10	Applied Groundwater Modelling	M2841	Zhou	142	5			100				
	10	Flood Risk Management	M3243	Bhattacharya	132	5	30		70				
	10	Drought Management and Reservoir Operations	M3036	Werner	138	5	60		40				
	10	Geotechnical Engineering and Dredging	M2214	vd Wegen	140	5		60	40				
	10	Innovative Water Systems for Agriculture	M3238	Karimi	132	5	40		60				

HYDROINFORMATICS		C1490										
Module number	Module Name	Code	Module coordinator	Workload	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
1	Introduction to Water Science and Engineering	M2131	Foppen	132	5	55		45				
2	Hydrology and hydraulics	M2208	Maskey	142	5	80		20				
3	Information technology and software engineering	M3184	Alfonso Segura	124	5	50		50				
4	Modelling theory and Computational Hydraulics	M3244	Popescu	138	5	55	25	20				
5	Modelling and information systems development	M2128	van Andel	136	5			100				
6	Computational Intelligence and Operational water management	M2847	Solomatine	140	5	55		45				
7	River basin modelling	M3232	Jonoski	138	5	100						
9	Fieldtrip and Fieldwork	M3167	Duker	140	5			100				
12	Summer courses				1			100				
13	Groupwork WSE	M1284	Veerbeek	140	5				100			
14	Thesis Research Proposal Development for WSE	M3284	Foppen	196	9			100				
15	MSc research, thesis and defence	M2927	various		36			100				
	Elective modules:											
8	Integrated hydrological and river modelling	M1309	Maskey	138	5			85	15			
8	Climate change impacts and adaptation in coastal areas	M3204	Alvaro	140	5			100				
8	Dams and hydropower	M3009	Marence	149	5	90		10				
8	Planning and delivery of flood resilience	M3275	Gersonius	132	5			30	50		20	
8	River Flood Analysis and Modelling	M2709	Popescu	134	5	50		50				
8	Urban flood management and disaster risk mitigation	M1710	Vojnovic	140	5	40		60				
8	International Port Seminar	M3166	Dastgheib	140	5				100			
8	Management of irrigation and drainage systems	M3203	Duker	142	5	60		40				
10	Applied Groundwater Modelling	M2841	Zhou	142	5			100				
10	Flood Risk Management	M3243	Bhattacharya	132	5	30		70				
10	Drought Management and Reservoir Operations	M3036	Werner	138	5	60		40				
10	Geotechnical Engineering and Dredging	M2214	vd Wegen	140	5		60	40				
10	Innovative Water Systems for Agriculture	M3238	Karimi	132	5	40		60				
11	Solid waste management	M3270	Hullebusch	140	5	60		4				
11	Strategic Planning for River Basins and Deltas	M3211	Evers	140	5	50		50				
11	IWRM as a tool for adaptation to climate change	M3207	de Ruyter	140	5	70			30			
11	Wetlands for livelihoods and conservation	M3214	Hes	140	5			80	20			
11	Urban water governance	M3261	Acevedo Guerrero	139	5			100				
11	Advanced water transport and distribution	M3250	Trifunovic	139	5	60		40				
11	Faecal Sludge Management	M3217	Ronteltap	116	5	85		15				
11	Decentralised Water Supply and Sanitation	M2810	Sharma	140	5	60		30	10			
11	Hydroinformatics for Decision Support	M3233	Jonoski	136	5			100				
11	Water Sensitive Cities	M3048	Pathirana	160	5		25	50	25			
11	Modelling river systems and lakes	M3277	Cattapan	142	5	40		60				
11	Flood Protection in Lowland Areas	M3251	Roelvink	140	5	60		40				
11	Remote sensing for agricultural water management	M3237	Karimi	140	5	40		60				

HYDROLOGY AND WATER RESOURCES		C1501										
Module number	Module Name	Code	Module coordinator	Workload	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
1	Introduction to Water Science and Engineering	M2131	Foppen	132	5	55		45				
2	Hydrology and hydraulics	M2208	Maskey	142	5	80		20				
3	Hydrogeology	M2166	Zhou	140	5	70		30				
4	Surface hydrology	M2367	Venneker	110	5	70		30				
5	Water quality	M2497	McClain	111	5	70		30				
6	Tracer hydrology and flow systems analysis	M1903	Foppen	142	5	100						
9	Fieldtrip and Fieldwork	M3167	Duker	140	5			100				
12	Summer courses				1			100				
13	Groupwork WSE	M1284	Veerbeek	140	5				100			
14	Thesis Research Proposal Development for WSE	M3284	Foppen	196	9			100				
15	MSc research, thesis and defence	M2927	various		36			100				
	Elective modules:											
7	Hydrological data collection and processing	M1554	Venneker	136	5	60				40		
7	Groundwater data collection and interpretation	M3160	Stigter	140	5	35		65				
8	Integrated hydrological and river modelling	M1309	Maskey	138	5			85	15			
8	Climate change impacts and adaptation in coastal areas	M3204	Alvaro	140	5			100				
8	Dams and hydropower	M3009	Marence	149	5	90		10				
8	Planning and delivery of flood resilience	M3275	Gersonius	132	5			30	50		20	
8	River Flood Analysis and Modelling	M2709	Popescu	134	5	50		50				
8	Urban flood management and disaster risk mitigation	M1710	Vojnovic	140	5	40		60				
8	International Port Seminar	M3166	Dastgheib	140	5				100			
8	Management of irrigation and drainage systems	M3203	Duker	142	5	60		40				
10	Applied Groundwater Modelling	M2841	Zhou	142	5			100				
10	Flood Risk Management	M3243	Bhattacharya	132	5	30		70				
10	Drought Management and Reservoir Operations	M3036	Werner	138	5	60		40				
10	Geotechnical Engineering and Dredging	M2214	vd Wegen	140	5		60	40				
10	Innovative Water Systems for Agriculture	M3238	Karimi	132	5	40		60				
11	Solid waste management	M3270	Hullebusch	140	5	60		4				
11	Strategic Planning for River Basins and Deltas	M3211	Evers	140	5	50		50				
11	IWRM as a tool for adaptation to climate change	M3207	de Ruyter	140	5	70			30			
11	Wetlands for livelihoods and conservation	M3214	Hes	140	5			80	20			
11	Urban water governance	M3261	Acevedo Guerrero	139	5			100				
11	Advanced water transport and distribution	M3250	Trifunovic	139	5	60		40				
11	Faecal Sludge Management	M3217	Ronteltap	116	5	85		15				
11	Decentralised Water Supply and Sanitation	M2810	Sharma	140	5	60		30	10			
11	Hydroinformatics for Decision Support	M3233	Jonoski	136	5			100				
11	Water Sensitive Cities	M3048	Pathirana	160	5		25	50	25			
11	Modelling river systems and lakes	M3277	Cattapan	142	5	40		60				
11	Flood Protection in Lowland Areas	M3251	Roelvink	140	5	60		40				
11	Remote sensing for agricultural water management	M3237	Karimi	140	5	40		60				

FLOOD RISK MANAGEMENT			C1440										
Location	Module number	Module Name	Code	Module coordinator	Workload	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
TU-Dresden		Flood Risk Management				10	50		30 +20				
		Climatology and Hydrology				5	100						
		Geodesy				5	100						
		Two courses out of the following four:											
		Hydraulic Engineering				5	100						
		Hydromechanics				5							
		Ecology				5	75			25			
		Hydrochemistry				5							
		Courses without credits:											
		GIS and Remote Sensing				0							
		Statistics				0							
		Fieldtrip				0							
				Total ECTS		**30**							
U-IHE	6	Computational Intelligence and Operational water management	M2847	Solomatine	140	5	55		45				
	7	River basin modelling	M3232	Jonoski	138	5	100						
		One course out of the following two:											
	8a	River Flood Analysis and Modelling	M2709	Popescu	134	5	50		50				
	8b	Urban flood management and disaster risk mitigation	M1710	Vojnovic	140	5	40		60				
	9	International Fieldtrip (12 days)	M3167	Duker		5						100	
	10	Flood Risk Management	M3243	Bhattacharya	132	5	30		70				
	11	Hydroinformatics for Decision Support	M3233	Jonoski	136	5			100				
				Total ECTS		**30**							
UPC		Global warming effects, Flood and Drought				3		40	60				
		Coastal flooding: impacts, conflicts and risks				3	100						
		Debris flow and flash floods: risk, vulnerability, hazard and resilience concepts				5	40		55				5
		The application of radar-based rainfall observations and forecast in Early Warning				4	100						
				Total ECTS		**30**							
UL		Spatial planning for flood protection and resilience				5	20		80				
		Socio-economic and institutional framework of floods				5							
TUD/IHE /UPC/UL		MSc thesis work		**Total ECTS**		**30**							

GROUNDWATCH			C1441										
Location	Module number	Module Name	Code	Module coordinator	Workload	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
IST Lisbon		Hydrogeology				4,5							
		Hydrology, Environment and Water Resources				6							
		Atmospheric physics and chemistry				4,5							
		Integrated River Basin Management				4,5							
		Groundwater Pollution and Protection				6							
		Environmental policies and law				4,5							
U-IHE	6	Tracer hydrology and flow systems analysis	M1903	Foppen	142	5	100						
	7	Groundwater data collection and interpretation	M3160	Stigter	140	5	35		65				
	8	Groundwater in adaptation to global change impacts	M3096	Stigter	140	5			100				
	9	Fieldtrip and Fieldwork	M3167	Duker	140	5						100	
	10	Applied Groundwater Modelling	M2841	Zhou	142	5			100				
	11	IWRM as a tool for adaptation to climate change	M3207	de Ruyter	140	5	70			30			
TU-Dresden		Climate Systems and Climate Modelling				5							
		Soil Water				5							
		Study Project IWRM				10							
		Ecology (optional)				5							
		Integrated Land Use Management in the Landscape (optional)				5							
		Water Quality adn Water Treatment				5							
		Watershed Management II				5							
		Treatment plant design				5							
IST/IHE/TUD		MSc research, thesis and defence	M2927			30							

4. Water Management programme

WATER RESOURCES MANAGEMENT		C1396										
Module number	Module Name	Code	Module coordinator	Workload	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
1	Principles of integrated water resources management	M3181	Evers	114	5	45		55				
2	The water resources system	M3182	Susnik	143	5	70		30				
3	Water governance	M3228	Kemerink	172	5		40	60				
4	Water economics	M3227	Yong	144	5	70		30				
5	Water and environmental law	M1003	Jaspers	132	5	70		30				
6	Water resources assessment	M3235	Yasir	139	5	65		35				
7	Water systems modelling	M2054	Masih	149	5	60			40			
8	Water resources planning	M3241	Cauwenberg	143	5	60		40				
9	International fieldwork	M3045	Cabrera	168	5			100				
12	Summer course				1			100				
13	Groupwork WMG	M3229	Susnik	149	5			100				
14	Thesis Research Proposal Development for WMG	M3236	Fantini	252	9		100					
15	MSc research, thesis and defence	M2927	various	1008	36		100					
	Elective modules:											
10	Partnerships for Water Supply and Sanitation	M3199	Torio	143	5		50	50				
10	Aquatic Ecosystems Processes and Applications	M3202	Gettel	140	5			90	10			
10	Institutional Analysis	M3234	Smit	189	5			80	20			
10	Drought management and reservoir operations	M3036	Werner	138	5	60		40				
10	Flood risk management	M3243	Biswa	132	5	30		70				
10	Applied groundwater modelling	M2841	Zhou	142	5			100				
10	Innovative water systems for agriculture	M3238	Karimi	140	5	40		60				
10	Environmental assessment for water related policies and develo	M3080	Mendoza		5	50		50				
11	Solid waste management	M3270	Hullebusch	140	5	60		4				
11	Strategic Planning for River Basins and Deltas	M3211	Evers	140	5	50		50				
11	IWRM as a tool for adaptation to climate change	M3207	de Ruyter	140	5	70			30			
11	Wetlands for livelihoods and conservation	M3214	Hes	140	5			80	20			
11	Urban water governance	M3261	Acevedo Guerre	139	5			100				
11	Advanced water transport and distribution	M3250	Trifunovic	139	5	60		40				
11	Faecal Sludge Management	M3217	Ronteltap	116	5	85		15				
11	Decentralised Water Supply and Sanitation	M2810	Sharma	140	5	60		30	10			
11	Hydroinformatics for Decision Support	M3233	Jonoski	136	5			100				
11	Water Sensitive Cities	M3048	Pathirana	160	5		25	50	25			
11	Modelling river systems and lakes	M3277	Cattapan	142	5	40		60				
11	Flood Protection in Lowland Areas	M3251	Roelvink	140	5	60		40				
11	Remote sensing for agricultural water management	M3237	Karimi	140	5	40		60				

WATER CONFLICT MANAGEMENT		C1370										
Module number	Module Name	Code	Module coordinator	Workload	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
1	Principles of integrated water resources management	M3181	Evers	114	5	45		55				
2	The water resources system	M3182	Susnik	143	5	70		30				
3	Water governance	M3228	Kemerink	172	5		40	60				
4	Water economics	M3227	Yong	144	5	70		30				
5	Water and environmental law	M1003	Jaspers	132	5	70		30				
6	Water conflict management 1	M3069	Shubber	91	5	50		50				
7	Water conflict management 2	M3070	Shubber	121	5	60		40				
8	Water resources planning	M3241	Cauwenberg	143	5	60		40				
9	International fieldwork	M3045	Cabrera	168	5			100				
12	Summer course				1			100				
13	Groupwork WMG	M3229	Susnik	149	5			100				
14	Thesis Research Proposal Development for WMG	M3236	Fantini	252	9		100					
15	MSc research, thesis and defence	M2927	various	1008	36		100					
	Elective modules:											
10	Partnerships for Water Supply and Sanitation	M3199	Torio	143	5		50	50				
10	Aquatic Ecosystems Processes and Applications	M3202	Gettel	140	5			90	10			
10	Institutional Analysis	M3234	Smit	189	5			80	20			
11	Solid waste management	M3270	Hullebusch	140	5	60		4				
11	Strategic Planning for River Basins and Deltas	M3211	Evers	140	5	50		50				
11	IWRM as a tool for adaptation to climate change	M3207	de Ruyter	140	5	70			30			
11	Wetlands for livelihoods and conservation	M3214	Hes	140	5			80	20			
11	Urban water governance	M3261	Acevedo Guerre	139	5			100				
11	Advanced water transport and distribution	M3250	Trifunovic	139	5	60		40				
11	Faecal Sludge Management	M3217	Ronteltap	116	5	85		15				
11	Decentralised Water Supply and Sanitation	M2810	Sharma	140	5	60		30	10			
11	Hydroinformatics for Decision Support	M3233	Jonoski	136	5			100				
11	Water Sensitive Cities	M3048	Pathirana	160	5		25	50	25			
11	Modelling river systems and lakes	M3277	Cattapan	142	5	40		60				
11	Flood Protection in Lowland Areas	M3251	Roelvink	140	5	60		40				
11	Remote sensing for agricultural water management	M3237	Karimi	140	5	40		60				

WATER MANAGEMENT		C1362										
Code	Module Name	Code	Module coordinator		ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
1	Principles of integrated water resources management	M3181	Evers	114	5	45		55				
2	The water resources system	M3182	Susnik	143	5	70		30				
3	Water governance	M3228	Kemerink	172	5		40	60				
4	Water economics	M3227	Yong	144	5	70		30				
5	Water and environmental law	M1003	Jaspers	132	5	70		30				
9	International fieldwork	M3045	Cabrera	168	5			100				
12	Summer course				1			100				
13	Groupwork WMG	M3229	Susnik	149	5			100				
14	Thesis Research Proposal Development for WMG	M3236	Fantini	252	9		100					
15	MSc research, thesis and defence	M2927	various	1008	36		100					
	Elective modules:											
6	Water quality assessment	M3169	de Ruyter	140	5	60		30		10		
6	Water resources assessment	M3235	Yasir	139	5	65		35				
6	Water conflict management 1	M3069	Shubber	91	5	50		50				
6	Managing water organisations	M3170	Tutusaus	96	5			100				
7	Environmental Engineering	M3081	Raj	140	5	75		25				
7	Water systems modelling	M2054	Masih	149	5	60			40			
7	Water conflict management 2	M3070	Shubber	121	5	60		40				
7	Environmental management and water services	M3200	Cabrera	188	5			90	10			
8	Environmental planning and implementation	M3021	Evers	140	5	50		50				
8	Water resources planning	M3241	Cauwenberg	143	5	60		40				
8	Finance in the water sector	M3044	Torio	140	5	50		50				
10	Partnerships for Water Supply and Sanitation	M3199	Torio	143	5		50	50				
10	Aquatic Ecosystems Processes and Applications	M3202	Gettel	140	5			90	10			
10	Institutional Analysis	M3234	Smit	189	5			80	20			
10	Applied Groundwater Modelling	M2841	Zhou	142	5			100				
10	Flood Risk Management	M3243	Bhattacharya	132	5	30		70				
10	Environmental assessment for water related policies and develo	M3080	Mendoza		5	50		50				
10	Drought Management and Reservoir Operations	M3036	Werner	138	5	60		40				
11	Solid waste management	M3270	Hullebusch	140	5	60		4				
11	Strategic Planning for River Basins and Deltas	M3211	Evers	140	5	50		50				
11	IWRM as a tool for adaptation to climate change	M3207	de Ruyter	140	5	70			30			
11	Wetlands for livelihoods and conservation	M3214	Hes	140	5			80	20			
11	Urban water governance	M3261	Acevedo Guerre	139	5			100				
11	Advanced water transport and distribution	M3250	Trifunovic	139	5	60		40				
11	Faecal Sludge Management	M3217	Ronteltap	116	5	85		15				
11	Decentralised Water Supply and Sanitation	M2810	Sharma	140	5	60		30	10			
11	Hydroinformatics for Decision Support	M3233	Jonoski	136	5			100				
11	Water Sensitive Cities	M3048	Pathirana	160	5		25	50	25			
11	Modelling river systems and lakes	M3277	Cattapan	142	5	40		60				
11	Flood Protection in Lowland Areas	M3251	Roelvink	140	5	60		40				
11	Remote sensing for agricultural water management	M3237	Karimi	140	5	40		60				

WATER SERVICES MANAGEMENT		C1409										
Module number	Module Name	Code	Module coordinator	Workload	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
1	Principles of integrated water resources management	M3181	Evers	114	5	45		55				
2	The water resources system	M3182	Susnik	143	5	70		30				
3	Water governance	M3228	Kemerink	172	5		40	60				
4	Water economics	M3227	Yong	144	5	70		30				
5	Water and environmental law	M1003	Jaspers	132	5	70		30				
6	Managing water organisations	M3170	Tutusaus	96	5			100				
7	Environmental management and water services	M3200	Cabrera	188	5			90	10			
8	Finance in the water sector	M3044	Torio	140	5	50		50				
9	International fieldwork	M3045	Cabrera	168	5			100				
12	Summer course				1			100				
13	Groupwork WMG	M3229	Susnik	149	5			100				
14	Thesis Research Proposal Development for WMG	M3236	Fantini	252	9		100					
15	MSc research, thesis and defence	M2927	various	1008	36		100					
	Elective modules:											
10	Partnerships for Water Supply and Sanitation	M3199	Torio	143	5		50	50				
10	Aquatic Ecosystems Processes and Applications	M3202	Gettel	140	5			90	10			
10	Institutional Analysis	M3234	Smit	189	5			80	20			
11	Solid waste management	M3270	Hullebusch	140	5	60		4				
11	Strategic Planning for River Basins and Deltas	M3211	Evers	140	5	50		50				
11	IWRM as a tool for adaptation to climate change	M3207	de Ruyter	140	5	70			30			
11	Wetlands for livelihoods and conservation	M3214	Hes	140	5			80	20			
11	Urban water governance	M3261	Acevedo Guerre	139	5			100				
11	Advanced water transport and distribution	M3250	Trifunovic	139	5	60		40				
11	Faecal Sludge Management	M3217	Ronteltap	116	5	85		15				
11	Decentralised Water Supply and Sanitation	M2810	Sharma	140	5	60		30	10			
11	Hydroinformatics for Decision Support	M3233	Jonoski	136	5			100				
11	Water Sensitive Cities	M3048	Pathirana	160	5		25	50	25			
11	Modelling river systems and lakes	M3277	Cattapan	142	5	40		60				
11	Flood Protection in Lowland Areas	M3251	Roelvink	140	5	60		40				
11	Remote sensing for agricultural water management	M3237	Karimi	140	5	40		60				

WATER QUALITY MANAGEMENT		C1383										
Module number	Module Name	Code	Module coordinator	Workload	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
1	Principles of integrated water resources management	M3181	Evers	114	5	45		55				
2	The water resources system	M3182	Susnik	143	5	70		30				
3	Water governance	M3228	Kemerink	172	5		40	60				
4	Water economics	M3227	Yong	144	5	70		30				
5	Water and environmental law	M1003	Jaspers	132	5	70		30				
6	Water quality assessment	M3169	de Ruyter	140	5	60		30		10		
7	Constructed wetlands for wastewater treatment	M2216	Vossenberg	140	5	60		40				
8	Environmental planning and implementation	M3021	Evers	140	5	50		50				
9	International fieldwork	M3045	Cabrera	168	5			100				
12	Summer course				1			100				
13	Groupwork WMG	M3229	Susnik	149	5			100				
14	Thesis Research Proposal Development for WMG	M3236	Fantini	252	9		100					
15	MSc research, thesis and defence	M2927	various	1008	36		100					
	Elective modules:											
10	Partnerships for Water Supply and Sanitation	M3199	Torio	143	5		50	50				
10	Aquatic Ecosystems Processes and Applications	M3202	Gettel	140	5			90	10			
10	Institutional Analysis	M3234	Smit	189	5			80	20			
10	Environmental assessment for water related policies and develo	M3080	Mendoza		5	50		50				
11	Solid waste management	M3270	Hullebusch	140	5	60		4				
11	Strategic Planning for River Basins and Deltas	M3211	Evers	140	5	50		50				
11	IWRM as a tool for adaptation to climate change	M3207	de Ruyter	140	5	70			30			
11	Wetlands for livelihoods and conservation	M3214	Hes	140	5			80	20			
11	Urban water governance	M3261	Acevedo Guerre	139	5			100				
11	Advanced water transport and distribution	M3250	Trifunovic	139	5	60		40				
11	Faecal Sludge Management	M3217	Ronteltap	116	5	85		15				
11	Decentralised Water Supply and Sanitation	M2810	Sharma	140	5	60		30	10			
11	Hydroinformatics for Decision Support	M3233	Jonoski	136	5			100				
11	Water Sensitive Cities	M3048	Pathirana	160	5		25	50	25			
11	Modelling river systems and lakes	M3277	Cattapan	142	5	40		60				
11	Flood Protection in Lowland Areas	M3251	Roelvink	140	5	60		40				
11	Remote sensing for agricultural water management	M3237	Karimi	140	5	40		60				

WATER COOPERATION AND PEACE			C1045										
Location	Module number	Module Name	Code	Module coordinator	Workload	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
UPEACE		UPEACE Foundation Course				3.21			100				
		General Course on the UN system				2.14			100				
		Environment, Conflicts and Sustainability				3.21			50	50			
		Water Security and Peace (concept, theories, and field course)				3.21			50	50			
		Management of Coastal Resources (concepts, theories and field course)				3.21			50	50			
U-IHE	3	Water governance	M3228	Kemerink	142	5		40	60				
	4	Water economics	M3227	Yong	144	5	70		30				
	5	Water and environmental law	M1003	Jaspers	132	5	70		30				
	6	Water conflict management I	M3069	Shubber	91	5	50		50				
	7	Water conflict management II	M3070	Shubber	121	5	60		40				
	8	Elective module				5							
	Special course	Research methodology and thesis proposal work	M3254			3							100
OSU		Natural Resources Leadership Academy				3.21	25		25				50
		Applied Hydrology				3.21	25		25		25	25	
		Applied Field Problems/Technical and Academic Writing in Water Resources				7.49			25			50	25
		Conducting Collaborative Projects/Directed research in hydrology/ Seminar/Journal club				6.42			25			50	25
		Collaborative project/Directed research in water policy/ Seminar/Journal club				6.42				25		25	50
		Collaborative project/Elective courses/Seminar/Journal Club				2.14				25		25	50
ALL		MSc thesis period											
		TOTAL				76.87							

Appendix E MSc thesis marking guidelines

Criterion 1	9.0 - 10.0	8.0 - 8.9	7.0 - 7.9	6.0 - 6.9	5.9 and below
	Excellent	**Very Good**	**Good**	**Sufficient**	**Fail**
Knowledge and understanding of the subject and answers to questions	An excellent and informative introduction , well-researched, with appropriate and key references. Evidence of critical thinking. Clear aims and objectives, within an overall context, which identifies knowledge gaps. Sets the scene for the research succinctly and elegantly.	Good project background, with reference to key literature. A logical framework that identifies the research objectives, but may lack some thoroughness, or comprise a limited series of research questions. It might be competent but a little mundane. .	Covers the main areas, but has minor flaws in logic or omissions of important detail, or minor flaws in structure. Aims and objectives comprehensible, but maybe slightly over or under ambitious, and/or lacking in clarity or precision. Objectives may be unrealisitc.	Generally lacks some coherence; may be poorly referenced, but includes at least some points relevant to the research. Aims and objectives no more than adequate.	Poorly structured, with significant omissions of key background literature. No logical progression. Fails to set the context of the project. Research question not developed into appropriate or testable hypotheses

Criterion 2		9.0 - 10.0	8.0 - 8.9	7.0 - 7.9	6.0 - 6.9	5.9 and below
		Excellent	**Very Good**	**Good**	**Sufficient**	**Fail**
Originality, analysis and interpretation	Methods	Well-chosen and entirely appropriate and often novel methods identified clearly. Clear and easy to follow procedures and techniques. Where appropriate, good site description, with informative maps, diagrams etc.	Appropriate actions and methods identified and detailed. Where appropriate, setting of research well described with relevant maps etc	Methodology generally sound but with some lapses in detail of methods, and/or proposed analysis. Maps or diagrams may be poorly produced, or not clear in the context of the research	Significant gaps in methods, or methods not always appropriate to the research questions, or very difficult to comprehend. Lapses in detail in parts of methodology. Maps may be absent or poorly produced.	Methodology vague and poorly detailed. No obvious understanding of methodology relevant to research theme. Maps etc may be poorly produced or absent.
	Results	These are well analysed and presented with clarity, with clear and comprehensive relationship to the the research questions.	Results reported well and with clarity . Some minor lapses in summary of findings. Shows ability to address methodological short-comings	Results comprehensible, generally linking with the research questions. Figures and tables convey adequate meaning, providing a summary of at least some of the key findings.	Some obvious flaws in analysis, but the general essence of the key findings conveyed.	Difficult to follow the results and, analysis. Presentation careless and poor summary of the key findings
	Discussion	Elegant and well structured, placing the results in the context of the international literature and demonstrating a clear understanding of their significance, and/or shortcomings. Show some new ideas and novel interpretation.	Identifies the key finding and relevance of these to some key literature. A well ordered sequence to the chapter to produce a logical framework.	Recognises some interesting findings, but may be limited in placing these into a wider context. At lease some use of key literature. There will likely to be some repetition with the results section.	Largely a repetition of the results section, with minimal context to wider understanding and relevant literature.	Fails to identify key findings and/or their wider significance . Little logical framework and lacking any individual ideas or intepretation.

Criterion 3	9.0 - 10.0	8.0 - 8.9	7.0 - 7.9	6.0 - 6.9	5.9 and below
	Excellent	**Very Good**	**Good**	**Sufficient**	**Fail**
Organisation, style, presentation and communication	Writing elegant and succinct. Uses precise language and correct terminology throughout. Figs and tables well laid out to a publishable quality with accurate and succinct legends.	A clear and well-written report that is technically proficient.	A generally well-written report that is understandable. Uses appropriate terminology. Occasional spelling or grammatical errors. Presentation generally neat	Language generally clear and uses correct terminology, but with some misunderstandings and lapses in grammar or spelling. Presentation and use of tables and figures may be sloppy.	Sentences and/or paragraphs poorly constructed. Language inexact or ambiguous. Contains numerous grammatical and spelling mistakes.

Criterion 4	9.0 - 10.0	8.0 - 8.9	7.0 - 7.9	6.0 - 6.9	5.9 and below
	Excellent	**Very Good**	**Good**	**Sufficient**	**Fail**
Creativity, independence, work planning and critical attitude	Student self-motivated and independent. Engages in intelligent discussion and responds well to suggestions.	Significant help may be given, but students show ability to learn from suggestions and develop ideas and research approaches accordingly.	Needs clear guidance and support, but gradually develops the required competencies.	A need to repeat instructions a number of times. Generally finds taking initiative difficult, and limited self-reliance.	Lacks motivation, or much ability to develop competencies. Shows little self reliance or interest in the topic.

Appendix F Appeal procedure

(annex to the Examination Regulations 2015-17)
draft d.d. 28 April 2016

A student has the right to lodge an appeal against:

- decisions by examiners, the MSc Examination Committee, or the Examination Board;
- termination of registrations by the Academic Registrar.

NB: An appeal against the decision of an Examiner or an MSc Examination Committee is lodged with the Examination Board. The Examination Board's decision is final and binding, and can therefore not be appealed against with the Academic Appeals Board.

Before starting an appeal procedure, the student has the obligation to attempt to solve the case amicably with the body or person who took the disputed decision.

Appeal against the decision of an Examiner or an MSc Examination Committee:

1. The appeal shall be submitted in hard copy to the Examination Board (via its secretary) within 3 weeks following the date on which the decision was made known.
2. The appeal must be signed by the student (= appellant) and contain at least the following:
    a. name and address, degree programme and student number of the appellant;
    b. details of the Examiner or MSc Examination Committee concerned;
    c. a clear description of the decision against which the appeal has been lodged, on submission of a copy of the decision, if possible, or, if the appeal has been lodged against a refusal to decide, a clear description of the decision which should have been taken in the appellant's opinion;
    d. the grounds of the appeal;
    e. an account of the initiatives taken by the appellant to come to an amicable agreement with the decision maker.
3. The chair of the Board will inform the appellant of any omissions on the appellant's part and will invite him to rectify these within a period of time to be set by the chair. In the event that the appellant fails to rectify the omissions on his/her part, the appeal may be declared inadmissible.
4. The Examination Board may decide to hear the concerned parties.
5. The Examination Board will take a decision within three (3) weeks of receipt of the letter of appeal and inform the parties concerned accordingly in writing, stating whether the initial decision is to be upheld or a new decision taken.
6. The decision of the Examination Board is final and binding.

Appeal against the decision of the Examination Board or the Academic Registrar:

1. The appeal shall be submitted in hard copy to the Academic Appeals Board (via its secretary) within 3 weeks following the date on which the decision was made known.

2. The appeal must be signed by the student (= appellant) and contain at least the following:
    a. name and address, degree programme and student number of the appellant;
    b. details of the body or person who has taken the contested decision;
    c. a clear description of the decision against which the appeal has been lodged, on submission of a copy of the decision, if possible, or, if the appeal has been lodged against a refusal to decide, a clear description of the decision which should have been taken in the appellant's opinion;
    d. the grounds of the appeal;
    e. an account of the initiatives taken by the appellant to come to an amicable agreement with the decision maker.
3. The chair of the Board will inform the appellant of any omissions on the appellant's part and will invite him to rectify these within a period of time to be set by the chair. In the event that the appellant fails to rectify the omissions on his part, the appeal may be declared inadmissible.
4. The Academic Appeals Board may decide to hear the concerned parties.
5. The Academic Appeals Board will take a decision within four (4) weeks of receipt of the letter of appeal and inform the parties concerned accordingly in writing, stating whether the initial decision is to be upheld or a new decision taken.
6. The decision of the Academic Appeals Board is final and binding.

Appendix G Procedures when using eCampusXL for assessments

GENERAL RULES

Students taking part in an examination are expected to have taken notice of these procedures and are expected to understand the implied meaning of these procedures.

Electronic examinations take place in lecture rooms A4, A5 and B6
In the examination room

1. The student brings his/her own laptop to the examination room.
2. When the examination takes place in rooms A4 and A5, students for safety reasons have to connect their laptops with the available network cables in that room instead of using the less stable Wi-Fi.
3. The student brings his/her student card and displays it on the table.
4. A check of attendance is required to proof that the student has taken part in the examination. The invigilator (examination supervisors) verifies the student card and confirms attendance by the student by ticking the box of the student on the attendance list.
5. The invigilators ensure a proper conduct of the examination and maintain order in the examination room. They will announce the beginning and the duration of the examination, and will warn the students 10 minutes before the ending of the examination.
6. The invigilators will instruct the students to log in to the safe browser environment for the examination.
7. At the start of the examination the invigilator announces the password to the students to get access to the examination.
8. The programme will automatically save all answers during an examination every 5 minutes. However during the examination students are strongly advised to save his/her current answers as well various times before the final submission to prevent loss of work in case the server goes down. Students remain responsible for the final submission of their work.
9. For a situation where the time of an examination expires without the final submission, for example when the server is not available on that specific moment, a grace period has been set where attempts can be submitted even after the deadline, but questions cannot be answered/changed.
10. When the laptop of the student stops working correctly, the student can restart the computer and will arrive at the same place in the examination. (this will also work when restart/login is made on a different machine).
11. At the end of the examination the invigilators return the attendance list to the Planning Office.

Other issues:
Bags: Bags and carrying cases, including penholders, are to be placed along the side of the room before the start of the examination.

Dictionary: The use of a printed language dictionary without any additional written annotations is allowed (all languages are allowed). Invigilators are allowed to check the dictionaries for hand-written annotations during the exam (spot checks while they are walking around).
Electronic dictionaries are not allowed.

Calculators:. Use of calculators is not allowed and must be switched off. A scientific calculator inside the save browser environment is available.

Cell phones: Use of cell phones is not allowed and must be switched off

Communication: During the examination, students are not allowed to exchange materials or to communicate with other students. If something is unclear, students have to inform the invigilator, who will contact the

programme coordinator, the examiner or planning officer if necessary.

Other materials: The use of materials other than listed above, including blank paper, texts, of any kind, is not allowed.
Examiners may nevertheless allow students to use specified text matter or other effects in a so-called 'open book' examination. These materials shall not include previous or example examinations and solutions.

Toilet visit: Only one student at a time will be allowed by the invigilator to leave the examination room for a short visit to the lavatory, except during the first 15 and the last 15 minutes of the examination. Examination materials and requirements may not be taken outside the examination room. Before leaving the examination room, students have to hand over their cell phone to the invigilator.

IHE DELFT - Academic Calendar 2017/2019 .....

YEAR 1	2017										
	October		November				December				
Week	42	43	44	45	46	47	48	49	50	51	52
Mon	16	23	30	06	13	20	27	04	11	18	25
Tue	17	24	31	07	14	21	28	05	12	19	26
Wed	18	25	01	08	15	22	29	06	13	20	27
Thu	19	26	02	09	16	23	30	07	14	21	28
Fri	20	27	03	10	17	24	01	08	15	22	29
Sat	21	28	04	11	18	25	02	09	16	23	30
Sun	22	29	05	12	19	26	03	10	17	24	31
		(2x5 ECTS)							(2x5 ECTS)		
		Module 1			Module 2				Module 3		

YEAR 1	2018											
	January				February				March			
Week	01	02	03	04	05	06	07	08	09	10	11	12
Mon	01	08	15	22	29	05	12	19	26	05	12	19
Tue	02	09	16	23	30	06	13	20	27	06	13	20
Wed	03	10	17	24	31	07	14	21	28	07	14	21
Thu	04	11	18	25	01	08	15	22	01	08	15	22
Fri	05	12	19	26	02	09	16	23	02	09	16	23
Sat	06	13	20	27	03	10	17	24	03	10	17	24
Sun	07	14	21	28	04	11	18	25	04	11	18	25
									(2x5 ECTS)			
				Module 4				Module 5			Module 6	

YEAR 1	2018								fieldtrip		2018	
	April					May				June		
Week	13	14	15	16	17	18	19	20	21	22	23	24
Mon	26	02	09	16	23	30	07	14	21	28	04	11
Tue	27	03	10	17	24	01	08	15	22	29	05	12
Wed	28	04	11	18	25	02	09	16	23	30	06	13
Thu	29	05	12	19	26	03	10	17	24	31	07	14
Fri	30	06	13	20	27	04	11	18	25	01	08	15
Sat	31	07	14	21	28	05	12	19	26	02	09	16
Sun	01	08	15	22	29	06	13	20	27	03	10	17
		(2x5 ECTS)							(5 ECTS)		(2x5 ECTS)	
		Module 7			Module 8				Module 9		Module 10	

YEAR 1	2018							Groupwork			2018	
	June	July					August				Sept	
Week	25	26	27	28	29	30	31	32	33	34	35	36
Mon	18	25	02	09	16	23	30	06	13	20	27	03
Tue	19	26	03	10	17	24	31	07	14	21	28	04
Wed	20	27	04	11	18	25	01	08	15	22	29	05
Thu	21	28	05	12	19	26	02	09	16	23	30	06
Fri	22	29	06	13	20	27	03	10	17	24	31	07
Sat	23	30	07	14	21	28	04	11	18	25	01	08
Sun	24	01	08	15	22	29	05	12	19	26	02	09
							1	(5 ECTS)				
		Module 11					M12	Module 13				

YEAR 2	2018															
	September			October				November				December				
Week	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
Mon	10	17	24	01	08	15	22	29	05	12	19	26	03	10	17	24
Tue	11	18	25	02	09	16	23	30	06	13	20	27	04	11	18	25
Wed	12	19	26	03	10	17	24	31	07	14	21	28	05	12	19	26
Thu	13	20	27	04	11	18	25	01	08	15	22	29	06	13	20	27
Fri	14	21	28	05	12	19	26	02	09	16	23	30	07	14	21	28
Sat	15	22	29	06	13	20	27	03	10	17	24	01	08	15	22	29
Sun	16	23	30	07	14	21	28	04	11	18	25	02	09	16	23	30
	(9 ECTS)						(36 ECTS)									
	Module 14						Module 15									

YEAR 2	2019																
	January				February				March					April			
Week	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17
Mon	31	07	14	21	28	04	11	18	25	04	11	18	25	01	08	15	22
Tue	01	08	15	22	29	05	12	19	26	05	12	19	26	02	09	16	23
Wed	02	09	16	23	30	06	13	20	27	06	13	20	27	03	10	17	24
Thu	03	10	17	24	31	07	14	21	28	07	14	21	28	04	11	18	25
Fri	04	11	18	25	01	08	15	22	01	08	15	22	29	05	12	19	26
Sat	05	12	19	26	02	09	16	23	02	09	16	23	30	06	13	20	27
Sun	06	13	20	27	03	10	17	24	03	10	17	24	31	07	14	21	28
	(36 ECTS)																
	Module 15																

Legend

- = Opening academic year
- = Week one
- = Freetime / Holiday =
- = Fieldtrip
- = Summer course week
- = MSc diploma awarding
- = Lecture period
- = Msc thesis writing
- = Examination week
- = MSc diploma awarding *(prev year)*

Christmas: Dec 25-26 2017
Good Friday: March 30, 2018
Easter: April 1-2, 2018
Kingsday: April 27, 2018
Liberationday: May 5, 2018
Ascencion: May 10, 2018
Pentecost: May 20-21, 2018
Christmas: Dec 25-26, 2018
Good Friday: April 19, 2019
Easter: April 21-22, 2019
Kingsday: April 27, 2019

Environmental Science programme overview 2017-2019

INFO ES programme		EST Environmental Science and Technology C1140	EPM Environmental Planning and Management C1127	WQM Water Quality Management C1166	LWM Limnology and Wetland Management C1155
1	.....-20/10 23/10-27/10	Week ONE introduction (ALL)			Programme at BOKU, Vienna
	30/10-03/11 06/11-10/11	Introduction to environmental science 1 (ES01) M3172			
2	13/11-17/11 20/11-24/11 28/11-01/12	Introduction to environmental science 2 (ES02) M3173			
..	04/12-08/12	Examination Week			
3	11/12-15/12 18/12-22/12	Introduction to environmental science 3 (ES03) M3194			
..	25/12-29/12 01/01-05/01	Free Period			
3	08/01-12/01	Introduction to environmental science 3 (ES03) M3194			
4	15/01-19/01 22/01-26/01 29/01-02/02	Integrated project environmental science (ES04) M3031			
..	05/02-09/02	Examination Week			
5	12/02-16/02 19/02-23/02 26/02-02/03	Industrial resource management and cleaner production (ES05T) M3179	Water and environmental law (=> WM05) M1003	Water and environmental law (=> WM05) M1003	Travel to Kenia (..) Programme in Egerton Lake ecology (ES05L) LIWM713
6	05/03-09/03 12/03-16/03 19/03-23/03	Environmental systems analysis (ES06TM) M3171	Environmental systems analysis (ES06TM) M3171	Water quality assessment (ES06W) M3169	Ecology of streams & rivers (ES06L) LIWM714
..	26/03-30/03	Examination Week			
7	02/04-06/04 09/04-13/04 16/04-20/04	Environmental engineering (ES07T) M3081	Water and environmental policy analysis (ES07M) M3212	Constructed wetlands for wastewater treatment (ES07W) M2216	Wetlands for water quality (ES07L) LIWM721
8	23/04-27/04 30/04-04/05 07/05-11/05	Environmental monitoring and modelling (ES08T) M3187	Environmental planning and implementation (ES08MW) M3021	Environmental planning and implementation (ES08MW) M3021	Fisheries and aquaculture (ES08L) LIWM722
..	14/05-18/05	Examination Week			Travel to Delft (..)
9	21/05-25/05 28/05-01/06 04/06-08/06	Foreign fieldtrip and fieldwork ES (ES09TMW) M1766			Data analysis and modelling for aquatic ecosystems (ES09L) M3273
10	11/06-15/06 18/06-22/06 25/06-29/06	Aquatic ecosystems: processes and applications (ES10TWL) M3202 OR Environmental assessment for water-related policies and developments (ES10M) M3080			Aquatic ecosystems processes and applications (ES10TWL) M3202
Click HERE TO CHOOSE YOUR MODULE 10 and 11 (2017-2019)					Click HERE TO CHOOSE YOUR MODULE 10 and 11 (2017-2019)
11	02/07-06/07 09/07-13/07 16/07-20/07	Solid waste management (ES11T) M3270 or Strategic planning for river basins and deltas (ES11MW) M3211 or IWRM as a tool for adaptation to climate change (ES11X) M3207 or Wetlands for livelihoods and conservation (ES11LM) M3214 or a module from another programme(WSE UWS WM)			Wetlands for livelihoods and conservation (ES11LM) M3214 or
..	23/07-27/07	Examination Week			
12	30/07-03/08	Click here to choose your summer course (ES12)			
13	06/08-10/08 13/08-17/08 20/08-24/08	Groupwork ES (ES13TMW) M3197			
..	27/08-31/08	Examination Week			Examination Week
..	03/09-07/09	Free			Free
14	10/09-14/09 17/09-21/09 24/09-28/09 01/10-05/10 08/10-12/10	MSc research proposal development for ES (ES14) M3283			MSc research proposal development for ES (ES14) M3283
..	15/10-19/10	Examination Week			Examination Week
15	22/10/18 .... 05/04/19	MSc research, thesis and defence (6 months) (ES15) M2927			MSc research, thesis and defence (6 months) (ES15) M2927
..	10/04-12/04 15/04-17/04	Final Examination Week - Diploma awarding 25/04/2019			Final Examination Week - Diploma awarding 25/04/2019

Environmental Science

Certificate course

2017/2018

Industrial Resource Management and Cleaner Production

M3179

Industrial Resource Management and Cleaner Production

Term	201718
Coordinator	E.R. Raj
Credit points	5.000000000
Specialization	

Target Group

The module on Industrial Resource Management and Cleaner Production (IRMCP) is directed at engineers and scientists working in the urban or industrial field and wanting to have a better knowledge on efficiently managing various industrial resources (example: water, energy, precious metals, etc). The module is of great interest to practicing engineers and scientists in the fields of urban, municipal and industrial management, water-related chemistry and biology, water resources, environmental management, process design and implementation.

Prerequisites

Participants should possess a BSc degree in an area related to environmental engineering and science, chemical engineering, industrial engineering, chemistry, biotechnology, public health, etc. Professional experience in the water or waste management field helps to fully understand the concepts of cleaner production, sustainable consumption and the case-studies presented in the module. Active communication and a good command of the English language is required.

Learning Objectives

1	Suggest options for preventing pollution within urban and industrial water management settings
2	Analyze the responsibilities of companies for their impact on environmental resources and assess the environmental impact of products and processes
3	Suggest treatment/disposal methods for industrial wastewater from which the value has been taken out
4	Understand the importance of environmental management systems in the industrial context
5	Indicate how the sustainable use of resources can be beneficial for reducing environmental burden(s)
6	Analyze the different system tools that support industrial ecology and make basic calculations related to life cycle analysis
7	How can products designed for sustainability contribute towards circular economy of a country

Assessments

%	Type	Name
60	Written examination (open book)	Examination is on-line using MOODLE

35	Assignment	Group work (case-study), final presentation and final report submission
5	Presentation	Part of the 5% from presentation includes contribution in class, presence, intiative

Topics

1 Introduction to the field of Cleaner Production (CP)

What is Cleaner Production (CP)? How did it develop, in what context? How can CP be applied to industrial, domestic, institutional and rural management? How does CP relate to water management, industrial resource management and sustainable consumption? What are the benefits of adopting CP?

2 Life Cycle Analysis (LCA), Eco-design

What is Life Cycle Analysis (LCA)? What does it aim at? How does it work in practice and what is the practical significance of LCA? What are the economical and environmental benefits of eco-design?

3 Environmental Management Systems

What is Environmental Management and what are Environmental Management Systems (EMS)? What are the major components of EMS? How does ESM relate to environmental issues? What is the industrial perspective of EMS? Can EMS be applied to existing industrial systems?

4 Corporate social responsibility (CSR)

What is a company?, What is the role of business in society ? What is the difference between CSR active and CSR proactive business models ?

5 Material Flow Analysis (MFA)

- To be able to describe conversion and mass transfer in selected industrial processes (paper manufacturing, iron and steep production, leather production, horiculture, meat production, dairy industry, wastewater treatment, electricity production)
- To indicate apropriate waste prevention strategies for each industry
- To know adeaquate data sources and data collection strategies to conduct a regional mass flow analysis (MFA)
- To suggest policy measures for resource efficiency at different policy levels

6 Eco-industrial parks and Industrial ecology (EIP and IE)

What are the key concepts of industrial ecology, What are the consequences of not-effectively managing the resources, How the sustainable use of resources can be beneficial for reducing environmental burden(s), What are the different system tools that support industrial ecology and the creation of a sustainable eco-industrial park?

7 Industrial Water Management - Processes and case studies

- Understanding the impact of industry on water resources
- Implementing cleaner production practices and concepts in heavily polluting process industries

Topics

8 Simulation game - fun factory

- Learning to apply mass balance principles in process industries
- Understanding the different reasons of waste generation during a production process
- Getting a feeling for waste prevention measures and where to implement them

9 Technologies for the recovery of metals from e-waste

This topic deals with the different commercially available technologies used for the recovery of precious and base metals from electronic waste (e-waste). Both physico-chemical and biological recovery techniques will be covered.

10 Group work

Recovery of valuable resources and products from industrial wastes

11 Field trip

Field trip to SIMS

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Introduction to the field of Cleaner Production (CP)	6	0	1	0	0	0	7	19	D. Huisingh
2	Life Cycle Analysis (LCA), Eco-design	4	0	0	0	0	0	4	12	L.F. Dijk
3	Environmental Management Systems	4	0	0	0	0	0	4	12	M. Grashof
4	Corporate social responsibility (CSR)	4	0	0	0	0	0	4	12	E. van Galen
5	Material Flow Analysis (MFA)	5	0	7	0	0	0	12	22	V.S. Rotter
6	Eco-industrial parks and Industrial ecology (EIP and IE)	4	0	0	0	0	0	4	12	E.R. Raj
7	Industrial Water Management - Processes and case studies	2	0	0	0	0	0	2	6	H.A. Garcia Hernandez
8	Simulation game - fun factory	0	0	4	0	0	0	4	4	E.D. van Hullebusch, E.R. R
9	Technologies for the recovery of metals from e-waste	2	0	0	0	0	0	2	6	M. Sethurajan
10	Group work	3	6	12	0	0	0	15	27	E.D. van Hullebusch, E.R. R
11	Field trip	0	0	0	0	8	0	8	8	E.R. Raj
	Total	34	6	24	0	8	0	66	140	

Education Material

Lecture notes	Lecture notes in electronic form

Scientific Software

M3206

Online Course on Constructed Wetlands for Wastewater Treatment

Term	201718
Coordinator	J.L.C.M. van de Vossenberg
Credit points	5.000000000
Specialization	

Target Group

The course is designed for professionals actively involved in wetland management and/or wastewater treatment. They may be working in organisations responsible for water treatment or responsible for wetland conservation/sustainable use of wetlands. Targeted are also those who have an interest in onsite wastewater treatment for small communities.

Prerequisites

Learning Objectives

1 Understand the basic principles of wastewater treatment
2 Distinguish the functions of the different compartments in the constructed wetland
3 Apply the concept of constructed wetlands to wastewater treatment
4 Evaluate the importance of operation and maintenance
5 Design a constructed wetland treatment system

Assessments

%	Type	Name
5	Assignment	Design aspects
40	Written examination (open book)	Exam questions based on final assignment
40	Assignment	Final assignment
5	Assignment	History of constructed wetlands
5	Assignment	Quiz
5	Assignment	Wetland design

Topics

1 Introduction to wetlands

- Introduction to UNESCO-IHE
- Introduction to the course
- History and philosophy of constructed wetlands
- Introduction to wetlands
- Wetlands and climate

2 Basic principles

- Introduction to wetlands
- Basic principles of the treatment
- Case study Nakivubo Swamp in Uganda
- Types of constructed wetlands
- Use of constructed wetlands for various types of wastewater
- Optional movie switching views
- Lecture on value of natural wetlands

3 Design

- Design manual
- Model framework
- Constructed wetland sizing
- Practical design aspects
- IWA conference papers

4 Operation and maintenance

- Operation and maintenance
- Economics and reuse

5 Case studies

- Case study Texel
- Case study Brazil
- Case study arid climate
- Case study Belgium

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Introduction to wetlands	5	0	0	0	0	0	5	15	
2	Basic principles	10	0	0	0	0	0	10	30	
3	Design	10	20	0	0	0	0	10	50	
4	Operation and maintenance	10	0	0	0	0	0	10	30	
5	Case studies	5	0	0	0	0	0	5	15	
	Total	40	20	0	0	0	0	40	140	

Education Material

Scientific Software

M3262

Online Course on Environmental Flows

Term	201718
Coordinator	A. Mendoza - Sammet
Credit points	0.000000000
Specialization	

Target Group

Professionals, students and other people interested in learning the theory and application of environmental flows to guide management decisons on water use in fiver basins.

Prerequisites

General knowledge of the water cyce and ecological concepts.

Learning Objectives

1	To be able to define environmental flows and explain their role in water resources management
2	To acquire knowledge of the key physical, chemical and biological processes of river systems relevant to environmental flows.
3	3. To be able to describe the social dimensions of environmental flows, including stakeholder involvement and social benefits of ecosystem services.
4	4. To be able to list and compare legislation and policies for environmental flows of different countries
5	5. To be able to list and compare the main environmental flow assessment methodologies
6	6. To be able to explain different options, the factors of success and impediments for implementation of environmental flows
7	To be able to synthesise and apply the material of the course in a real world case.

Assessments

%	Type	Name
99	Assignment	case study report
1	Attendance	forum discussions

Topics

0 Introduction

Intro

Instructions to use eCampusXL and to successfully complete the online course.

1 Concepts and concepts of environmental flows

Important scientific as well as resource management concepts underpinning eflows and key context elements.

Context elements include relevant socioeconomic and biophysical characteristics of the river basin in which eflows are to be assessed.

Unit 1,

- Ecological flows (eflows) and why they are needed
- The history of eflows

Unit 2

- Core ecological and management concepts
- Fundamental eco-hydrological and management concepts

Unit 3

- Situation Analysis and river basin plans related to eflow assessment

2 Legal, Insitutional and Social Aspects

Legal, institutional, and social aspects essential for successfully applying eflows in natural resource management. Examples of fifferent governance systems. The range of flow-related ecosystem services that people use and depend upon in the basin

Unit 4.

- Governance and environmental flows in policy and legislation:

1. What are the legal and institutional arrangements that affect water resource management and enable the eflow process?
2. Who are the key stakeholders and how are they involved?

Unit 5.

- Ecosystem Services

1. Ecosystem services provided by the river basin. Vision and objectives for eflows implementation
2. Ecosystem Services Assessment for integrating environmental flows in decisionmaking at project and/or basin levels.

Topics

3 Underlying Science

Interlinked aspects of hydrology, hydraulics, ecology, and social processes.

Relations between bio-physical and social attributes with flow regime and its alterations.

Unit 6

- Hydrology: Ecologically relevant components of the river flow regime.

Unit 7

- Hydraulics and morphology: How hydraulics affects riverine habitats.

Unit 8

- Ecology: Key flow‐ecology relationships and how flow alteration affects them.

4 Methods & Models

Key characteristics of the methods methods used in eflow assessments, their strengths and weaknesses, and the criteria to be applied in choosing the right method for the situation at hand.

Methods and models available to assess eflows and evaluate the impacts on the water uses and users in a river basin.

Unit 9

- Hydrological methods

Unit 10

- Habitat suitability methods

Unit 11

- Holistic and Regional methods

Topics

5 Implementation

The main mechanisms available to embed eflow recommendations into ongoing management processes. Impediments and obstacles to implemetn eflows, and approaches to increase the likelihood and success of implementation. The importance of monitoring and taking an adaptive approach to elfows assessment and implementation.

Unit 12

- Implementation at project level. EIA and other mechanisms for eflow implementation at project level.

Unit 13

- Implementation at basin level. Water allocation planning, caps, Australian approaches. Steps in the planning cycle for eflows.

Unit 14

- Eflows monitoring and adaptive management.

6 Lessons learnt & case studies

Unit 15

Lessons learnt in environmental flow projects around the world.

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
0 Intro	Introduction	1	2	1	0	0	0	2	6	M.E. McClain
1	Concepts and concepts of environmental flows	6	2	2	0	0	0	8	22	K.M.F. Fouchy, M.E. McClai
2	Legal, Insitutional and Social Aspects	4	6	0	0	0	0	4	18	A. Mendoza - Sammet, K.M.F. Fouchy
3	Underlying Science	6	1	3	0	0	0	9	22	M.E. McClain
4	Methods & Models	6	9	3	0	0	0	9	30	M.E. McClain
5	Implementation	6	12	2	0	0	0	8	32	A. Mendoza - Sammet, M.E. McClain
6	Lessons learnt & case studies	1	7	0	0	0	0	1	10	M.E. McClain
	Total	30	39	11	0	0	0	41	140	

Education Material

Scientific Software

M3213

Online Course on Industrial Resource Management and Cleaner Production

Term	201718
Coordinator	E.R. Raj
Credit points	5.000000000
Specialization	

Target Group

The online course on Industrial Resource Management and Cleaner Production is directed at engineers and scientists working in the urban or industrial sectors and for those wanting to have a better grasp of the concepts of industrial resource management, resource recovery and the various preventative approaches. This course will be interesting for graduates working in the fiels of urban, municipal, chemical and industrial engineering, water related chemists, biologists, water resources engineers, process engineers and plant managers.

Prerequisites

Participants should possess a BSc degree in an area related to environmental engineering and science, chemical engineering, industrial engineering, chemistry, biotechnology, public health, etc. Professional experience in the water or waste management field helps to fully understand the concepts of cleaner production, sustainable consumption and the case-studies presented in the online course. Active communication and a good command of the English language is required.

Learning Objectives

1	Suggest options for preventing pollution in the urban and industrial settings
2	Analyze the responsibilities of companies for their impact on environmental resources and assess the environmental impact of products and processes
3	Suggest treatment/disposal methods for industrial wastewater from which the value has been taken out
4	Understand the importance of environmental management systems in the industrial context
5	Indicate how the sustainable use of resources can be beneficial for reducing environmental burden(s)
6	Analyze the different system tools that support industrial ecology and make basic calculations related to life cycle analysis
7	How can products designed for sustainability contribute towards the circular economy of a country

Assessments

%	Type	Name

60	Written examination (open book)	Examination is on-line using MOODLE
35	Assignment	Individual assignment, final presentation by skype
5	Presentation	Part of the 5% from presentation includes contribution in forum discussions

Topics

1 Cleaner production - concepts

Cleaner Production is the concept of improving the quality of 'doing things' from a sustainability point of view. Cleaner Production came about when industries started to realize that by producing tons of (liquid, solid, gaseous) waste they did not only pollute the/-ir environment (which gradually became more expensive for clean-up reasons), they also wasted resources which could have been used for the generation of products and, thus, for the making of profit. Cleaner Production then started looking at better - less wasteful - industrial production processes, the use of less toxic raw materials, more effective reuse, recycling and recovery processes, etc. Over the decades the scope of Cleaner Production has expanded beyond just industrial processes and now include many sustainability-based theories and concepts.

2 Cleaner production - methodology and finances

In this unit, the participants will learn the following aspects:

1. The implementation in the various points of the process leading from raw materials to final products;
2. Indicate where environmental gains most significant when comparing options for improvement;
3. How economic improvements can go in parallel with environmental improvements.

3 Cleaner production - case studies

In this unit, the participants will learn the following case studies related to the application of cleaner production (CP) concepts:
1- Examples in which cleaner production has been applied to full-scale (process) industries in developing and developed countries,
2- Applying the methodology of CP and the way in which CP can been applied to different process modules within a certain industrial facility (both small and large-scale process industries).

4 Urban water management

This unit on urban water management deals with the following aspects:
1. Definitions and terminologies involved in Urban Water Management (UWM),
2. Improvement in the management of urban water, and
3. Provide ideas for further improvement of water management in existing situations.

5 Industrial water management - introduction

The unit on industrial water management (IWM) - introduction deals with the following aspects:

1. Provides definitions and terminologies involved in Industrial Water Management (IWM),
2. How water and waste water resources can be effectively managed in industries, and
3. Ideas for further improvement of water and wastewater resources in existing industries.

Topics

6 Industrial water management - prevention and minimization

This IWM unit on Prevention and Minimization deals with waste measurement principles and minimization, implementation, and water management. The following aspects are covered in this unit.

1. Mass balance principles involved in water audit and the methodologies to reduce-reuse-and-recycle water.

2. Different legal aspects, as well as environmental policies, education and economics pertaining to IWM, and

3. Illustrated example from a Coffee industry - the water consumption pattern, waste water source, and treatment practices in that industry.

7 Industrial water management - monitoring and control

This unit deals with the selection of an appropriate technology for wastewater, the different treatment options available, and some specific case-studies. The following aspects are covered in this unit:

1. Different wastewater characteristics, quality considerations and socio-political aspects of selecting and appropriate technology.

2. Different treatment processes, such as physical, chemical, biological and advanced oxidation processes for wastewater treatment, and

3.Illustrated examples of a cooling system, ethylene cracker and laundry wastewater.

8 Life cycle analysis - introduction

This unit on Life Cycle Analysis or Assessment (LCA) - Introduction discusses the definition(s) of LCA, some examples of sectors where LCA is used, the concept of eco-design and the different steps of eco-design. The following aspects of LCA are covered in this unit:

1. LCA in product design and development,
2. LCA as a product-oriented method for sustainability analysis,
3. LCA framework for continuous product development, and
4. The principles of eco-design.

Topics

9 Life cycle analysis - methodology

This unit on Life Cycle Analysis or Assessment (LCA) - Methodology deals with the basic information on why should we make an LCA, how much effort should we invest, who are the interested parties, and what methodology (steps) will we use? The following aspects of LCA are discussed in this unit:
a) Inventory: Data collection, determine total emissions and resource use,
b) Impact assessment: Transform (long) list of LCI results in environmental impacts, like climate change, acidification, eco-toxic impacts, among others;
c) Interpretation: What conclusions can we draw, how (un)certain are we about these conclusions.

10 Life cycle analysis - application and case studies

In this unit, a broad range of literature based case studies is provided. These case studies deal with the application of LCA to assess/evaluate specific problems. These include the following:

1 - Case-study on refined palm oil production from United Plantations, Malaysia,

2 - LCA of specific chemicals,

3 - LCA of specific food products (industrial, dairy and meat, and agricultural),

4 - LCA for different renewable energy sources (wind, solar, geo-thermal, solar thermal, and biogas),

5 - LCA for the evaluation of wastewater treatment plant (secondary and tertiary treatment processses), and

6 - LCA for evaluating solid waste management systems in different countries (Indonesia, Brazil, Italy, Sweden, China, Thailand, etc, among

11 Environmental management system - introduction

An environmental management system (EMS) provides long-term guidance to gradually improve environmental management in any industrial setting or factory. EMS will reduce environmental impacts of processes, products or services. This unit deals with the following aspects:
1. Key elements of EMS and their relationship to each other,
2. Environmental aspects of an organization's operation,
3. Framework that helps an organization achieve its environmental goal through consistent control of its operation,
4. Legal requirements and determine their applicability to the organization,
5. Corrective actions required to achieve complance, and
6. EMS requirements andbasic concepts of ISO-14001.

Topics

12 Environmental management systems - case studies

The following aspects will be addressed in this unit:

1 - Design and implementation of an EMS in any organisation,

2 - EMS implementation strategy for specific industries (Eg. water, food, petroleum and shipping sectors),

3 - Benefits of EMS, in terms of return on investment(s),

4 - Link between Environmental Impact Assessment (EIA) and EMS, and

5 - Implementation process of ISO-14001 through the specific case-studies provided from Spain, Japan and Sweden, respectively.

13 Corporate social responsibility

In this unit, the following aspects of corporate social responsibility will be covered:

After this unit, you will be able -

- Companies responsibility for social and environmental compliance in their supply chain operations,

- How companies bear responsibility for their impact on water resources, in particular areas with freshwater scarcity, and

- Specific case-studies - how leading multinationals voluntarily prepare sustainability reports based on the Global Reporting Initiative (GRI) guidelines.

14 Eco-industrial parks and Industrial ecology (EIP and IE)

What are the key concepts of industrial ecology, What are the consequences of not-effectively managing the resources, How the sustainable use of resources can be beneficial for reducing environmental burden(s), What are the different system tools that support industrial ecology and the creation of a sustainable eco-industrial park?

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Cleaner production - concepts	0	4	10	0	0	0	10	14	D. Huisingh
2	Cleaner production - methodology and finances	0	2	8	0	0	0	8	10	D. Huisingh
3	Cleaner production - case studies	0	0	10	0	0	0	10	10	E.R. Raj
4	Urban water management	0	2	8	0	0	0	8	10	E.R. Raj, M.A. Siebel
5	Industrial water management - introduction	0	2	8	0	0	0	8	10	R.W. Hill
6	Industrial water management - prevention and minimization	0	4	6	0	0	0	6	10	R.W. Hill
7	Industrial water management - monitoring and control	0	2	8	0	0	0	8	10	R.W. Hill
8	Life cycle analysis - introduction	0	2	10	0	0	0	10	12	L.F. Dijk
9	Life cycle analysis - methodology	0	0	8	0	0	0	8	8	L.F. Dijk
10	Life cycle analysis - application and case studies	0	0	8	0	0	0	8	8	L.F. Dijk
11	Environmental management system - introduction	0	2	8	0	0	0	8	10	M. Grashof
12	Environmental management systems - case studies	0	0	8	0	0	0	8	8	M. Grashof
13	Corporate social responsibility	0	2	8	0	0	0	8	10	E. van Galen
14	Eco-industrial parks and Industrial ecology (EIP and IE)	0	0	10	0	0	0	10	10	E.R. Raj
	Total	0	22	118	0	0	0	118	140	

Education Material

Scientific Software

M3169

Water Quality Assessment

Term	201718
Coordinator	A.L. Zuijdgeest
Credit points	5.000000000
Specialization	

Target Group

Young and mid-career professionals (scientists, consultants, decision makers) with a background in Water management or Environmental science.

Prerequisites

Basic background in chemistry and statistics. Basic knowledge in computer operations (MS-Windows, Office). Good command of English.

Basic background in GIS and R statistical software is recommended but not required (ES programme modules 1-3).

Learning Objectives

1	Explain the impacts of major pollutants on the quality of natural waters.
2	Apply appropriate methods to assess the chemical, biological, and microbial quality in natural waters in relation to their anticipated use.
3	Explain the possibilities and limitations of water quality models.
4	Design and evaluate water quality monitoring networks for different types of surface water and groundwater in relation to set objectives.
5	Report the results of water quality assessment and monitoring programmes using appropriate statistical tools for interpretation and presentation of large data sets.

Assessments

%	Type	Name
15	Assignment	Group assignment on monitoring networks
30	Assignment	Individual assignment on data analysis and presentation
15	Assignment	Individual assignment on modelling
40	Written examination (closed book)	Topics: water quality assessment and monitoring, water quality modelling, groundwater quality monitoring)

Topics

1 Water Quality Assessment

Chemical and (micro-)biological water quality assessment, pollution, ecotoxicology.

2 Water Quality Monitoring

Monitoring cycle, physico-chemical and (micro-)biological water quality monitoring, recent trends and techniques, optimization. Excursion(s).

3 Water Quality Modelling

Introduction to modelling, types of models, model components, examples, and in-class exercise.

4 Groundwater quality monitoring

Basics of hydrogeology, pollutant transport in groundwater, monitoring.

5 Data analysis and presentation

Use of statistics in water quality monitoring, presentation of data.

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Water Quality Assessment	8	0	6	0	0	0	14	30	A.L. Zuijdgeest, C.A.M. van Gestel, E.D. de Ruijter van Steveninck, J.L.C.M. van de Vossenberg
2	Water Quality Monitoring	4	10	0	0	6	0	10	28	A.L. Zuijdgeest
3	Water Quality Modelling	6	0	6	0	0	0	12	24	J. van der Kwast
4	Groundwater quality monitoring	8	0	4	0	0	0	12	28	J.W.A. Foppen
5	Data analysis and presentation	4	10	8	0	0	0	12	30	A.A. van Dam
	Total	30	20	24	0	6	0	60	140	

Education Material

Handout	Compiled power point slides on all above topics, exercise materials, additional materials, and othe relevant information will be supplied

Scientific Software

PCRaster

R_statistics

M1380

Dutch Language Course for Foreigners

Term	201718T01
Coordinator	J.L.C.M. van de Vossenberg
Credit points	2.000000000
Specialization	Environmental Technology and Engineering

Target Group

Erasmus Mundus students

Prerequisites

Learning Objectives

Assessments

%	Type	Name
50	Oral examination	
50	Written examination (open book)	

Topics

Study load

Nr	Topic		Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
		Total	0	0	0	0	0	0	0	0	

Education Material

Scientific Software

M3172

Introduction to Environmental Science 1

Term	201718T01
Coordinator	E.D. de Ruijter van Steveninck
Credit points	5.000000000
Specialization	Core Program

Target Group

Students and professionals with an interest in environmental sciences and in maintaining environmental integrity to support human development.

Prerequisites

BSc or MSc in natural sciences, chemistry, environmental science, agriculture, geography, environmental economics, planning and management or engineering. Good conversational, reading and writing capabilities in the English language. Computer literacy. Professional experience in a relevant area is desirable.

Learning Objectives

1	Identify and describe global, regional and local environmental problems
2	Identify and describe fundamental natural, chemical, hydrological and socio-economic processes in relation to the environment
3	Carry out fundamental hydrological, chemical and ecological field sampling
4	Carry out fundamental chemical and (micro)biological laboratory analyses
5	Apply fundamental principles of data analysis, statistics, environmental modelling and GIS
6	Apply the principles of the scientific method to design, develop and present a research project

Assessments

%	Type	Name
100	Written examination (closed book)	Introduction environmental science: hydrology, chemistry, ecology, GIS and data analysis and statistics

Topics

0 Integration modules 1 and 2

Modules 1 and 2 form an integral part and their learning objectives are alligned. Except for the institutional week 1, all activities are integrated around the case study. During module 1 the focus will be on introducing concepts and theories as well as on practical sampling and data collection. The assessment consists of a written examination. In module 2 the focus will be on data analysis and presentation and the development of research skills. Assessments will be based on different assignments.

1 Water, environment and sustainable development

Week 1 will provide an introduction to the global agendas and policies for water and environment. Participants will be introduced to key documents in these fields (World Water Vision, Vision21, Earth Summit on Sustainable Development, WWF-3). The concept of IWRM will be explained and illustrated by examples.

2 Introduction Environmental Science

Introduction to the module objectives and procedures. The river basin as the context to study environmental science.

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3 Hydrology

Hydrological cycle, precipitation and collection of meteorological data, evaporation, discharge, soil moisture, groundwater hydrology. The lectures will be supported by exercises and application in the case study.

4 Chemistry

Elemental cycles of C, N and P, redox, BOD/COD, charge balance, pH, alkalinity, buffering, (heavy) metals (cycling, speciation, adsorption/desorption, dissolution/precipitation), ecotoxicology (metals and pesticides). The lectures will be supported by laboratory sessions and application in the case study.

5 GIS

Introduction to GIS, vector data, projections, raster data, file types, raster analysis, map design. Introduction to remote sensing. Application in the case study.

6 Ecology

Food webs, trophic levels, flow of energy, cycling of nutrients, biological communities and species interactions, population dynamics, case study eutrophication. The lectures will be supported by laboratory sessions and application in the case study

Topics

7 Case study-inquiry

Integrated hydrological, chemical and ecological fieldwork in a river catchment, mapping using GIS, data analysis and presentation.

8 Data analysis and statistics

Organizing data, creating graphs, statistical analysis and experimental design using MS Excel and the R software for statistical computing and graphics. Application in the case study.

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
0	Integration modules 1 and 2	0	0	0	0	0	0	0	0	
1	Water, environment and sustainable development	0	0	20	0	0	0	20	20	
2	Introduction Environmental Science	0	0	4	0	0	0	4	4	E.D. de Ruijter van Steveninck, E.M.A. Hes
3	Hydrology	6	0	2	0	0	0	8	20	J.W. Wenninger, T.Y. Stigter
4	Chemistry	4	0	0	0	0	0	4	12	A.L. Zuijdgeest
5	GIS	4	0	8	0	0	0	12	20	J. van der Kwast
6	Ecology	6	0	0	0	0	0	6	18	E.D. de Ruijter van Steveninck
7	Case study-inquiry	4	0	0	0	18	0	22	30	A.A. van Dam, A.L. Zuijdgeest, E.D. de Ruijter van Steveninck, G.M. Gettel J. van der Kwast, J.W. Wenninger
8	Data analysis and statistics	4	4	0	0	0	0	4	16	A.A. van Dam
	Total	28	4	34	0	18	0	80	140	

Education Material

Book	Cunningham & Cunningham, Environmental Science, a global concern. 13th ed.
Lecture notes	Power point presentations
Handout	Various topics

Scientific Software
QGis
R_statistics

M3173

Introduction to Environmental Science 2

Term	201718T02
Coordinator	E.D. de Ruijter van Steveninck
Credit points	5.000000000
Specialization	Core Program

Target Group

Students and professionals with an interest in environmental sciences and in maintaining environmental integrity to support human development..

Prerequisites

BSc or MSc in natural sciences, chemistry, environmental science, agriculture, geography, environmental economics, planning and management or engineering. Good conversational, reading and writing capabilities in the English language. Computer literacy. Professional experience in a relevant area is desirable.

Learning Objectives

1	Identify and describe global, regional and local environmental problems
2	Identify and describe fundamental natural, chemical, hydrological and socio-economic processes in relation to the environment
3	Carry out fundamental hydrological, chemical and ecological field sampling
4	Carry out fundamental chemical and (micro)biological laboratory analyses
5	Apply fundamental principles of data analysis, statistics, environmental modelling and GIS
6	Apply the principles of the scientific method to design, develop and present a research project

Assessments

%	Type	Name
35	Assignment	Group assignment case study: written report and oral presentation
30	Assignment	Individual assignment Data analysis and statistics
15	Assignment	Individual assignment Integration topics: evidence-based policy making
10	Assignment	Individual assignment Integration topics: information research and retrieval
10	Assignment	Individual assignment Integration topics: reading and retrieving scientific literature

Topics

0 Integration modules 1 and 2

Modules 1 and 2 form an integral part and their learning objectives are alligned. Except for the institutional week 1, all activities are integrated around the case study. During module 1 the focus will be on introducing concepts and theories as well as on practical sampling and data collection. The assessment consists of a written examination. In module 2 the focus will be on data analysis and presentation and the development of research skills. Assessments will be based on different assignments.

1 Hydrology

Hydrological cycle, precipitation and collection of meteorological data, evaporation, discharge, soil moisture, groundwater hydrology. The lectures will be supported by exercises and application in the case study.

2 Chemistry

Elemental cycles of C, N and P, redox, BOD/COD, charge balance, pH, alkalinity, buffering, (heavy) metals (cycling, speciation, adsorption/desorption, dissolution/precipitation), ecotoxicology (metals and pesticides). The lectures will be supported by laboratory sessions and application in the case study.

3 GIS

Introduction to GIS, vector data, projections, raster data, file types, raster analysis, map design. Introduction to remote sensing. Application in the case study.

4 Ecology

Food webs, trophic levels, flow of energy, cycling of nutrients, biological communities and species interactions, population dynamics, case study eutrophication. The lectures will be supported by laboratory sessions and application in the case study

5 Case study-inquiry

Integrated hydrological, chemical and ecological fieldwork in a river catchment, mapping using GIS, data analysis and presentation.

6 Data analysis and statistics

Organizing data, creating graphs, statistical analysis and experimental design using MS Excel and the R software for statistical computing and graphics. Application in the case study.

7 Integration topics

Evidence-based policy making, information research and retrieval and reading and reviewing scientific literature. Developing critical thinking, academic writing and communication/presentation skills.

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
0	Integration modules 1 and 2	0	0	0	0	0	0	0	0	
1	Hydrology	2	0	2	0	0	0	4	8	J.W. Wenninger, T.Y. Stigter
2	Chemistry	10	0	8	0	0	0	18	38	A.L. Zuijdgeest, C.A.M. van Gestel, E.D. van Hullebusch
3	GIS	2	2	0	0	0	0	2	8	J. van der Kwast
4	Ecology	2	0	8	0	0	0	10	14	E.D. de Ruijter van Steveninck
5	Case study-inquiry	0	2	0	0	0	0	0	2	A.A. van Dam, A.L. Zuijdgeest, E.D. de Ruijter van Steveninck, G.M. Gettel J. van der Kwast, J.W. Wenninger
6	Data analysis and statistics	6	0	20	0	0	0	26	38	A.A. van Dam
7	Integration topics	8	0	8	0	0	0	16	32	G.M. Gettel, K.A. Irvine, L.P. Darvis
	Total	30	4	46	0	0	0	76	140	

Education Material

Lecture notes	Copies of power point presentations
Book	Cunningham & Cunningham, Environmental Science, a global concern. 13th ed.
Handout	Various topics

Scientific Software

QGis
R_statistics
stella

M3194

Introduction to Environmental Science 3

Term	201718T03
Coordinator	E.D. de Ruijter van Steveninck
Credit points	5.000000000
Specialization	Core Program

Target Group

Students and professionals with an interest in environmental sciences and in maintaining environmental integrity to support human development.

Prerequisites

BSc or MSc in natural sciences, chemistry, environmental science, agriculture, geography, environmental economics, planning and management or engineering. Good conversational, reading and writing capabilities in the English language. Computer literacy. Professional experience in a relevant area is desirable.

Learning Objectives

1	Identify and describe the fundamental natural, chemical, hydrological and socio-economic processes in relation to the environment
2	Carry out fundamental chemical and (micro)biological laboratory analyses
3	Apply fundamental principles of data analysis, statistics and environmental modelling
4	Apply the principles of the scientific method to design, develop and present a research project
5	Describe the current practice of wastewater treatment and resource recovery in the Netherlands, in terms of its governance, economics and technological aspects
6	Indicate interactions and relations between aspects of governance, economy, technology and microbiology, in relation to infrastructure for wastewater treatment

Assessments

%	Type	Name
25	Written examination (closed book)	Environmental modelling
40	Assignment	Individual assignment case study: written report on the economic aspects and an oral presentation
35	Written examination (closed book)	Microbiology

Topics

1 Microbiology

Basics of microbial physiology and metabolism. Microbiological detection and analysis to assess e.g. water safety or water quality. Microbiological actors in the cyclic processes of the most important elements (C, N, P, S). The lectures in microbiology are supported by laboratory sessions.

2 Environmental economics

Basic knowledge of economic principles, concepts and methods for understanding, analysing and addressing environmental and resource issues.

3 Case study Wastewater Treatment and Resource Recovery

Case study Wastewater Treatment and Resource Recovery: technologies, planning and management and economic aspects.

4 Environmental modelling

Principles and techniques, basics of dynamic simulation modelling using Stella.

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Microbiology	10	0	16	0	0	0	26	46	J.J.A. van Bruggen, J.L.C.M van de Vossenberg
2	Environmental economics	6	0	4	0	0	0	10	22	Y. Jiang
3	Case study Wastewater Treatment and Resource Recovery	6	0	12	0	6	0	24	36	E.M.A. Hes, J.G. Evers, N.P van der Steen, Y. Jiang
4	Environmental modelling	10	0	6	0	0	0	16	36	E.M.A. Hes
	Total	32	0	38	0	6	0	76	140	

Education Material

Lecture notes	Copies of power point presentations
Book	Cunningham & Cunningham, Environmental Science, a global concern. 13th ed.
Handout	Various topics

Scientific Software
R_statistics
stella

M3031

Integrated Project Environmental Science

Term	201718T04
Coordinator	N.P. van der Steen
Credit points	5.000000000
Specialization	Core Program

Target Group

Programme target group

Prerequisites

ES Modules 1-3 or ETSUD programme AIT.

Learning Objectives

1 Describe the environmental policy process and the role and sources of data and information that play a role in formulating policy

2 Gather information on an environmental problem from various sources and critically assess its quality and role in the debate about the problem

3 Formulate a scientific research question, compare and contrast scientific information relevant to the research question from a variety of sources and present the findings in a concise report

4 Make an oral presentation of scientific information

5 Analyze, evaluate and present scientific data

6 Perform a basic multi-criteria analysis in the context of decision making for an environmental problem

Assessments

%	Type	Name
30	Presentation	Consisting of technical report, policy brief and poster presented by group
70	Assignment	Consisting of three assignments submitted by each individual participant

Topics

1 Introductory and closing session

In the introductory session the environmental problem will be introduced by watching a documentary and by group discussions. The closing session has the presentation of the final products (group reports, posters) by the various groups.

Each year one of the following environmental problems will be studied:

1. Dams for water storage and hydropower generation

2. Hydraulic fracking for gas exploration

3. Water quality management in the North Sea

2 Policy

Introduction into policy making and developing a policy brief.

3 Documentary

The environmental problem that is studied in this module is introduced by means of watching a relevant selected documentary.

4 Research questions

The individual literature study is aimed at developing a research question. Lecturers will give a short introduction on how to develop research questions and what are characteristics of a good research question.

6 Multi-criteria analysis

In the policy brief, several policy options will be presented. MCA will be introduced in order for the participants to make a systematic analysis and selection of the preferred alternative.

7 Group sessions

The entire group of participants will be dividedin three sub-groups. Each sub-group receives assignments; both individual assignments and a group assignment. Product included: a individual literature study, a group report, a policy brief and a poster.

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Introductory and closing session	8	52	0	0	0	0	8	76	N.P. van der Steen
2	Policy	4	0	8	0	0	0	12	20	A. Mendoza - Sammet, J.G. Evers
3	Documentary	0	0	8	0	0	0	8	8	N.P. van der Steen
4	Research questions	4	0	4	0	0	0	8	16	A. Mendoza - Sammet, G.M Gettel, N.P. van der Steen
6	Multi-criteria analysis	2	0	6	0	0	0	8	12	E.M.A. Hes
7	Group sessions	0	0	8	0	0	0	8	8	A. Mendoza - Sammet, A.L. Zuijdgeest, G.M. Gettel, J.G Evers, N.P. van der Steen
	Total	18	52	34	0	0	0	52	140	

Education Material

Scientific Software

M3179

Industrial Resource Management and Cleaner Production

Term	201718T05
Coordinator	E.R. Raj
Credit points	5.000000000
Specialization	

Target Group

The module on Industrial Resource Management and Cleaner Production (IRMCP) is directed at engineers and scientists working in the urban or industrial field and wanting to have a better knowledge on efficiently managing various industrial resources (example: water, energy, precious metals, etc). The module is of great interest to practicing engineers and scientists in the fields of urban, municipal and industrial management, water-related chemistry and biology, water resources, environmental management, process design and implementation.

Prerequisites

Participants should possess a BSc degree in an area related to environmental engineering and science, chemical engineering, industrial engineering, chemistry, biotechnology, public health, etc. Professional experience in the water or waste management field helps to fully understand the concepts of cleaner production, sustainable consumption and the case-studies presented in the module. Active communication and a good command of the English language is required.

Learning Objectives

1	Suggest options for preventing pollution within urban and industrial water management settings
2	Analyze the responsibilities of companies for their impact on environmental resources and assess the environmental impact of products and processes
3	Suggest treatment/disposal methods for industrial wastewater from which the value has been taken out
4	Understand the importance of environmental management systems in the industrial context
5	Indicate how the sustainable use of resources can be beneficial for reducing environmental burden(s)
6	Analyze the different system tools that support industrial ecology and make basic calculations related to life cycle analysis
7	How can products designed for sustainability contribute towards circular economy of a country

Assessments

%	Type	Name
60	Written examination (open book)	Examination is on-line using MOODLE

35	Assignment	Group work (case-study), final presentation and final report submission
5	Presentation	Part of the 5% from presentation includes contribution in class, presence, intiative

Topics

1 Introduction to the field of Cleaner Production (CP)

What is Cleaner Production (CP)? How did it develop, in what context? How can CP be applied to industrial, domestic, institutional and rural management? How does CP relate to water management, industrial resource management and sustainable consumption? What are the benefits of adopting CP?

2 Life Cycle Analysis (LCA), Eco-design

What is Life Cycle Analysis (LCA)? What does it aim at? How does it work in practice and what is the practical significance of LCA? What are the economical and environmental benefits of eco-design?

3 Environmental Management Systems

What is Environmental Management and what are Environmental Management Systems (EMS)? What are the major components of EMS? How does ESM relate to environmental issues? What is the industrial perspective of EMS? Can EMS be applied to existing industrial systems?

4 Corporate social responsibility (CSR)

What is a company?, What is the role of business in society ? What is the difference between CSR active and CSR proactive business models ?

5 Material Flow Analysis (MFA)

- To be able to describe conversion and mass transfer in selected industrial processes (paper manufacturing, iron and steep production, leather production, horiculture, meat production, dairy industry, wastewater treatment, electricity production)
- To indicate apropriate waste prevention strategies for each industry
- To know adeaquate data sources and data collection strategies to conduct a regional mass flow analysis (MFA)
- To suggest policy measures for resource efficiency at different policy levels

6 Eco-industrial parks and Industrial ecology (EIP and IE)

What are the key concepts of industrial ecology, What are the consequences of not-effectively managing the resources, How the sustainable use of resources can be beneficial for reducing environmental burden(s), What are the different system tools that support industrial ecology and the creation of a sustainable eco-industrial park?

7 Industrial Water Management - Processes and case studies

- Understanding the impact of industry on water resources
- Implementing cleaner production practices and concepts in heavily polluting process industries

Topics

8 Simulation game - fun factory

- Learning to apply mass balance principles in process industries
- Understanding the different reasons of waste generation during a production process
- Getting a feeling for waste prevention measures and where to implement them

9 Technologies for the recovery of metals from e-waste

This topic deals with the different commercially available technologies used for the recovery of precious and base metals from electronic waste (e-waste). Both physico-chemical and biological recovery techniques will be covered.

10 Group work

Recovery of valuable resources and products from industrial wastes

11 Field trip

Field trip to SIMS

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Introduction to the field of Cleaner Production (CP)	6	0	1	0	0	0	7	19	D. Huisingh
2	Life Cycle Analysis (LCA), Eco-design	4	0	0	0	0	0	4	12	L.F. Dijk
3	Environmental Management Systems	4	0	0	0	0	0	4	12	M. Grashof
4	Corporate social responsibility (CSR)	4	0	0	0	0	0	4	12	E. van Galen
5	Material Flow Analysis (MFA)	5	0	7	0	0	0	12	22	V.S. Rotter
6	Eco-industrial parks and Industrial ecology (EIP and IE)	4	0	0	0	0	0	4	12	E.R. Raj
7	Industrial Water Management - Processes and case studies	2	0	0	0	0	0	2	6	H.A. Garcia Hernandez
8	Simulation game - fun factory	0	0	4	0	0	0	4	4	E.D. van Hullebusch, E.R. R
9	Technologies for the recovery of metals from e-waste	2	0	0	0	0	0	2	6	M. Sethurajan
10	Group work	3	6	12	0	0	0	15	27	E.D. van Hullebusch, E.R. R
11	Field trip	0	0	0	0	8	0	8	8	E.R. Raj
	Total	34	6	24	0	8	0	66	140	

Education Material

Lecture notes	Lecture notes in electronic form

Scientific Software

M1003

Water and Environmental Law

Term	201718T05
Coordinator	F.G.W. Jaspers
Credit points	5.000000000
Specialization	Core Program

Target Group

Students of the Masters of Science Programmes of Water Management and Environmental Science and Technology . Practitioners with a relevant Bachelor's degree in a water related discipline

Prerequisites

Preferably a relevant water science and engineering related bachelor's degree or equivalent; affinity with water management; good command of English.

Learning Objectives

1 Critically investigate and grasp different dimensions of water and environmental law (including principles, rights, instruments, organizations) from local to global level.

2 Obtain proficiency in the review of contrasting legal arguments.

3 Practise treaty writing and contract writing skills.

4 Integrate legal knowledge within their existing water and environmental knowledge that try to address key issues o water sharing under the equity articles of the UN Watercourses Convention.

Assessments

%	Type	Name
30	Assignment	Water and environmental law
70	Written examination (closed book)	

Topics

1 International Water Law

1.1 Introduction International Water Law

International water and environmental law and law making bodies (the UN)

Topics

1.2 International Water Law

1. What is international law? Where does water and environment fit in?
    1. Sources of international law with a focus on water/environmental law
    2. How is international law made – how were the water conventions and climate law negotiated/ being negotiated?
    3. Elements of a treaty, introduction to key concepts
    4. How effective is international (water and environmental) law
    5. How are disputes addressed?
2. International water law
    1. Water and the Sustainable Development Goals
    2. Sovereignty versus hydro-solidarity
    3. Principles of water law
    4. Evolution of water law
    5. The Watercourses Convention and the organizations it recommends
    6. The UNECE Water Law
    7. The RAMSAR Convention on Wetlands
    8. The UN Draft Articles on Trans-boundary AQUIFERS
    9. The Human Right to Water and Sanitation

1.3 International Environmental Law

1. International environmental law
    1. Principles of environmental law
    2. The Climate Change Convention and the Conference of the Parties
    3. Mitigation and a focus on forests/energy
    4. Adaptation and a focus on water related adaptation

1.4 Case studies

Case studies on forestery and groundwater law

1.5 Other international law

Investment treaties and implications for water and environmental contracts

Trade agreements and implications for water and environmental contracts

1.6 Trans-boundary water and environmental law and related basin organizations

Legal issues in trans-boundary water governance

The Nile Water Agreements and organization

The Convention of Protection of the Rhine

2 National Water Law

Topics

2.1 Intro National Water Law

Legal instruments, principles and conepts

2.2 Legal Instruments

2.3 River Basin Organizations (Intro)

National and international river basin organizations; organizations. Decentralization

2.4 Water Rights

Comparative water rights and water allocation systems and statutory water rights

2.5 Case: Customary Water Rights

Customary water and environmental rights, including rights of indigenous peoples

2.6 Water Quality Management Regulations

Legal instruments for water quality management, EU Water Framework Directive

3 Contract Management

3.1 Contract law

3.2 Case study contract management on water related issues

3.3 Case study contract management for the Clean Development Mechanism or Reducing Emissions from Deforestation and Forestation Degradation

3.4 Group work contract law

3.1 Contract Law

Private law, contract law

3.2 Contract Management Workshop

Groupwork designing contracts and agreements

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	International Water Law	0	0	0	0	0	0	0	0	
1.1	Introduction International Water Law	2	0	0	0	0	0	2	6	J. Gupta
1.2	International Water Law	4	0	2	0	0	0	6	14	J. Gupta
1.3	International Environmental Law	4	0	2	0	0	0	6	14	J. Gupta
1.4	Case studies	0	0	4	0	0	0	4	4	J. Gupta
1.5	Other international law	4	0	0	0	0	0	4	12	Z.S. Shubber
1.6	Trans-boundary water and environmental law and related basin organizations	2	0	0	0	0	0	2	6	F.G.W. Jaspers, Z.S. Shubber
2	National Water Law	0	0	0	0	0	0	0	0	
2.1	Intro National Water Law	2	0	0	0	0	0	2	6	F.G.W. Jaspers
2.2	Legal Instruments	2	0	0	0	0	0	2	6	F.G.W. Jaspers
2.3	River Basin Organizations (Intro)	4	0	2	0	0	0	6	14	F.G.W. Jaspers
2.4	Water Rights	4	0	2	0	0	0	6	14	F.G.W. Jaspers
2.5	Case: Customary Water Rights	2	0	2	0	0	0	4	8	P. van der Zaag
2.6	Water Quality Management Regulations	3	0	3	0	0	0	6	12	
3	Contract Management	0	0	0	0	0	0	0	0	
3.1	Contract Law	2	0	2	0	0	0	4	8	F.G.W. Jaspers
3.2	Contract Management Workshop	0	0	8	0	0	0	8	8	F.G.W. Jaspers
	Total	35	0	27	0	0	0	62	132	

Education Material

Lecture notes	F.G.W. Jaspers - Chapters in Water and Environmental Resources Law, UNESCO-IHE Lecture Notes.

Scientific Software

M3171

Environmental Systems Analysis

Term	201718T06
Coordinator	K.A. Irvine
Credit points	5.000000000
Specialization	Core Program

Target Group

Participants in the Environmental Science MSc-programme at IHE

Prerequisites

Modules 1-4 of Environmental Science programme.

Learning Objectives

1 List and describe environmental systems analysis (ESA) concepts and methods, and in particular the Ecosystem Services framework

2 Perform a problem analysis and stakeholder analysis for a given environmental system

3 Perform an analysis of ecosystem functions and services and their drivers of change for a given environmental system

4 Construct a simple dynamic simulation model of an environmental system

5 Discuss critically the strengths, weaknesses, missing information, advantages and disadvantages of the analyses

6 Communicate effectively the methods, results and conclusions of a case study (presentation and written report)

Assessments

%	Type	Name
40	Written examination (closed book)	Ecosystem Services and Systems Analysis
50	Assignment	Individual report on the case study
10	Presentation	Stella model developed during the group work

Topics

1 Connecting ecosystem character with ecosystem services. Concept and application

An introduction to ecosystem character and type, including global biomes, prevailing pressures affecting structure and function, and how this relates to the concept of ecosystem services.

Topics

2 Drivers of change in ecosystems, and using the DPSIR framework to guide management

Exploration of the proximate and underlying drivers of ecosystem change and how this relates to emergent properties. Introduction to the Drivers, Pressures, State, Impact, Response framework for describing ecosystems and how these relate to each other. Evaluating options for management using DPSIR using examples from policy and the scientific literature

3 Modelling Biodiversity within an ESA framework

Introduction and interactive sessions for global biodiversity assessment and modelling lake ecosystems

4 Stakeholder analysis

Identifying key stakeholders, and their roles within the DPSIR framework will lead to an exercise in assigning what impact they have on the ecosystem and influences in management.

5 Case study: modelling ecosystem functions and services

Working in groups participants will create a system model of each of a number of ecosystem case studies with defined pressures. This will apply knowledge acquired in the first part of the module.

6 Awareness of professional use of modelling frameworks

An excusion to DELTARES in Delft will provide an introduction to a variety of modelling platforms and approaches that are used to help solve real world problems

7 Group presentations

Each Group will present and describe the results of their modelling, identifying main challenges and overall summary of outputs

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Connecting ecosystem character with ecosystem services. Concept and application	8	0	0	0	0	0	8	24	A.A. van Dam, K.A. Irvine
2	Drivers of change in ecosystems, and using the DPSIR framework to guide management	8	0	2	0	0	0	10	26	A. Mendoza - Sammet, K.A. Irvine
3	Modelling Biodiversity within an ESA framework	6	0	2	0	0	0	8	20	A.A. van Dam, J.H. Janse
4	Stakeholder analysis	2	16	0	0	0	0	2	22	A. Mendoza - Sammet
5	Case study: modelling ecosystem functions and services	4	0	28	0	0	0	32	40	A. Mendoza - Sammet, E.M.A. Hes, K.A. Irvine
6	Awareness of professional use of modelling frameworks	0	0	0	0	4	0	4	4	A.L. Zuijdgeest, K.A. Irvine
7	Group presentations	0	0	4	0	0	0	4	4	A. Mendoza - Sammet, E.M.A. Hes, K.A. Irvine
	Total	28	16	36	0	4	0	68	140	

Education Material

Scientific Software

stella

M3169

Water Quality Assessment

Term	201718T06
Coordinator	A.L. Zuijdgeest
Credit points	5.000000000
Specialization	

Target Group

Young and mid-career professionals (scientists, consultants, decision makers) with a background in Water management or Environmental science.

Prerequisites

Basic background in chemistry and statistics. Basic knowledge in computer operations (MS-Windows, Office). Good command of English.

Basic background in GIS and R statistical software is recommended but not required (ES programme modules 1-3).

Learning Objectives

1	Explain the impacts of major pollutants on the quality of natural waters.
2	Apply appropriate methods to assess the chemical, biological, and microbial quality in natural waters in relation to their anticipated use.
3	Explain the possibilities and limitations of water quality models.
4	Design and evaluate water quality monitoring networks for different types of surface water and groundwater in relation to set objectives.
5	Report the results of water quality assessment and monitoring programmes using appropriate statistical tools for interpretation and presentation of large data sets.

Assessments

%	Type	Name
15	Assignment	Group assignment on monitoring networks
30	Assignment	Individual assignment on data analysis and presentation
15	Assignment	Individual assignment on modelling
40	Written examination (closed book)	Topics: water quality assessment and monitoring, water quality modelling, groundwater quality monitoring)

Topics

1 Water Quality Assessment

Chemical and (micro-)biological water quality assessment, pollution, ecotoxicology.

2 Water Quality Monitoring

Monitoring cycle, physico-chemical and (micro-)biological water quality monitoring, recent trends and techniques, optimization. Excursion(s).

3 Water Quality Modelling

Introduction to modelling, types of models, model components, examples, and in-class exercise.

4 Groundwater quality monitoring

Basics of hydrogeology, pollutant transport in groundwater, monitoring.

5 Data analysis and presentation

Use of statistics in water quality monitoring, presentation of data.

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Water Quality Assessment	8	0	6	0	0	0	14	30	A.L. Zuijdgeest, C.A.M. van Gestel, E.D. de Ruijter van Steveninck, J.L.C.M. van de Vossenberg
2	Water Quality Monitoring	4	10	0	0	6	0	10	28	A.L. Zuijdgeest
3	Water Quality Modelling	6	0	6	0	0	0	12	24	J. van der Kwast
4	Groundwater quality monitoring	8	0	4	0	0	0	12	28	J.W.A. Foppen
5	Data analysis and presentation	4	10	8	0	0	0	12	30	A.A. van Dam
	Total	30	20	24	0	6	0	60	140	

Education Material

Handout	Compiled power point slides on all above topics, exercise materials, additional materials, and othe relevant information will be supplied

Scientific Software

PCRaster

R_statistics

M3315

Constructed Wetlands for Wastewater Treatment

Term	201718T07
Coordinator	J.L.C.M. van de Vossenberg
Credit points	5.000000000
Specialization	

Target Group

Programme target group

Prerequisites

Programme prerequisites

Learning Objectives

1 assess the value of wetlands and explain the use of natural and constructed wetlands for the treatment of wastewater;

2 describe the concept of wastewater treatment by wetlands;

3 design and operate a wetland treatment system.

Assessments

%	Type	Name
80	Assignment	
20	Presentation	

Topics

1 Introduction into the module

Explanation of the contents of the module, the objectives, logistics etc.

2 Introduction Natural Wetlands

Definition, characteristics, types, relevance, human well being

3 Basics Wastewater Treatment

Wastewater: composition, prinicples.

Natural wetlands or constructed wetlands, limitations

Topics

4 Wetlands and Climate

Climate change, Greenhouse effect, Solar energy, evaporation, condensation, airconditioning, case studies, solutions, waterparadigm

5 Natural wetlands for water treatment

the basic principles, the advantages and disadvantages, the risks. Examples in a temperate climate and examples in the tropics.

6 Types of Constructed Wetlands and Application

Different types. Advantages and disadvantages. Constructed wetlands in The Netherlands, the tropics and the rest of the world.

Application for different types of wastewater.

7 Integrated production systems

theory, examples, advantages, disadvantages, economics, nutrient flows. Modelling of integrated production systems. Field visits.

8 Design Constructed Wetlands

Design of constructed wetlands

9 Operation and Maintenance

Operation and Maintenance Constructed Wetlands

10 Economics

Economics of constructed wetlands

11 Case study

Case study constructed wetland on Texel

12 Fieldtrip 1

Fieldtrip to constructed wetland at ZIN in Vught, and the forested wetland in Hapert

13 Assignment

Explanation of the assignment

14 Presentations

Final presentations on own design of a constructed wetland

15 Exam

Exam about the content of the module

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Introduction into the module	1	0	0	0	0	0	1	3	J.J.A. van Bruggen
2	Introduction Natural Wetlands	6	3	0	0	0	0	6	21	E.M.A. Hes
3	Basics Wastewater Treatment	2	0	0	0	0	0	2	6	J.J.A. van Bruggen
4	Wetlands and Climate	2	0	0	0	0	0	2	6	J. Pokorny
5	Natural wetlands for water treatment	4	0	0	0	0	0	4	12	
6	Types of Constructed Wetlands and Application	4	0	0	0	0	0	4	12	J.J.A. van Bruggen
7	Integrated production systems	4	0	0	0	0	0	4	12	A.A. van Dam
8	Design Constructed Wetlands	8	0	0	0	0	0	8	24	D.P.L. Rousseau
9	Operation and Maintenance	2	0	0	0	0	0	2	6	D.P.L. Rousseau
10	Economics	2	0	0	0	0	0	2	6	D.P.L. Rousseau
11	Case study	0	0	4	0	0	0	4	4	S. Toet
12	Fieldtrip 1	0	0	0	0	8	0	8	8	J.J.A. van Bruggen
13	Assignment	1	10	0	0	0	0	1	13	J.J.A. van Bruggen
14	Presentations	0	0	4	0	0	0	4	4	J.J.A. van Bruggen
15	Exam	0	3	0	0	0	0	0	3	
	Total	36	16	8	0	8	0	52	140	

Education Material

Lecture notes Lecture notes and case studies

Scientific Software

M3081

Environmental Engineering

Term	201718T07
Coordinator	E.R. Raj
Credit points	5.000000000
Specialization	Core Program

Target Group

Programme target groups (MSc and short course participants) having background in Environmental Sciences, Chemical or Civil Engineering

Prerequisites

Basic knowledge in mathematics, including calculus, linear algebra and differential equations - Strong fundamentals in chemistry and biology - Fundamental understanding of different physical, chemical and biological processes of environmental significance - Confidence to solve problems involving chemical kinetics and design of bioprocesses - Ability to work in a group and contribute to specific assignments of this course

Learning Objectives

1	Describe different biological processes and their engineering applications for wastewater treatment;
2	Categorize different air pollutants and distinguish the different physico-chemical and biological air pollution control techniques for particulate and gaseous contaminants;
3	Apply basic thermodynamic principles to determine reaction rates of environmental processes under a given set o operating conditions
4	Describe the different water treatment methods and with the help of simple examples, evaluate the performance o water treatment plants;
5	Solve problems pertaining to the design and operation of different environmental systems

Assessments

%	Type	Name
25	Written examination (closed book)	Environmental process technology
50	Written examination (closed book)	Wastewater treatment and air pollution control
25	Assignment	Water treatment

Topics

1 Water treatment

Water is playing an essential role in relation with the environment and in this module it is shown, how man can actively intervene in its pollution. Man is using several simple and advanced techniques to produce reliable drinking water from groundwater and surface water. The participant will be able to learn the following aspects: (i) Water treatment methods, and (ii) water treatment processes and plants.

2 Wastewater treatment

To limit environmental pollution, wastewater has to be treated. An overview of basic processes available for the treatment of domestic and industrial wastewater, with special emphasis on natural processes and systems that can be applied, is taught under the topic wastewater treatment. The following topics will be covered; (i) Anaerobic reactors, (ii) Waste stabilization ponds, (iii) Activated sludge process, (iv) UASB reactor, (v) Photo-bioreactors, (vi) Design and problem solving tutorials, and (vii) Application of biochar in environmental engineering.

3 Environmental process technology

For a better understanding of water and wastewater treatment the principles of mass balances, reaction kinetics and reactor design are discussed in environmental process technology (EPT). During this lecture, the following topics will be covered; (i) Mass balance analysis, (ii) Ideal batch reactors, (iii) Plug flow reactor, (iv) Stirred tank reactor, (v) Continuous flow reactors with recycle, and (vi) Problem solving tutorials.

4 Air pollution control

Air pollution and atmospheric air quality in developing countries is a topic of major concern. The nature of damages caused to human health and the environment due to air pollutants is worsening every year. For instance, acid rain results when sulfur dioxide and nitrogen oxides are emitted into the atmosphere and transported by wind and air currents. Therefore, it is important to develop effective technologies for the management and control of air pollution. The following topics will be covered; (i) Classification of air pollutants, (ii) Air pollution control systems: odour control from wastewater treatment plants, control of particulate matter & gaseous contaminants, and (iii) Biological odour control systems.

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Water treatment	3	0	0	16	0	0	19	41	J.P. Buiteman
2	Wastewater treatment	9	0	0	15	8	0	32	65	E.D. van Hullebusch, E.R. Raj, J.J.A. van Bruggen, J.L.C.M. van de Vossenberg
3	Environmental process technology	8	0	0	0	0	0	8	24	N.P. van der Steen
4	Air pollution control	3	1	0	0	0	0	3	10	E.R. Raj
	Total	23	1	0	31	8	0	62	140	

Education Material

Lecture notes	Lecture notes Wastewater Treatment + Tutorials
Lecture notes	Lecture notes on Air Pollution Control and powerpoint presentations
Lecture notes	Lecture notes on EPT, Problem solving in class
Lecture notes	Lecture notes on Water Treatment and assignments topics

Scientific Software

M2541

Nanotechnology for Water and Wastewater Treatment

Term	201718T07
Coordinator	P.N.L. Lens
Credit points	0.000000000
Specialization	

Target Group

Young and mid-career professionals with a relevant wo bachelor (academic bachelor)

Prerequisites

BSc degree or equivalent qualification in a relevant field from a recognised university Several years of relevant working experience

Learning Objectives

1 Apply innovative applications of nanotechnology in drinking water production and wastewater treatment.

2 Be familiar with the state-of-the-art, impact and cost-benefit analysis of nanotechnology processes for water and wastewater treatment.

3 Communicate successfully on nanoscience and nanotechnology interfacing with environmental chemistry, environmental engineering and bioprocess.

Assessments

%	Type	Name
1	Attendance	

Topics

Study load

Nr	Topic		Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
		Total	0	0	0	0	0	0	0	0	

Education Material

Scientific Software

M3212

Water and Environmental Policy Analysis

Term	201718T07
Coordinator	A. Mendoza - Sammet
Credit points	5.000000000
Specialization	

Target Group

This module is intended for professionals with an interest learning the tools and methods used for the analysis and improvement of environmental policy, especially in water management and related areas.

Prerequisites

A basic understanding of policy and planning concepts is helpful, but not required.

Learning Objectives

1 Structure complex policy problems.

2 Apply meaningfully and coherently three types of methods for rational-analytical problem exploration: System analysis (including analysis of objectives and initial problem demarcation), Actor analysis, and Future Scenarios.

3 Reflect on the possible roles of a policy analyst and discuss which role(s) a policy analyst can effectively fulfil in different situations to support individuals or organisations facing a complex policy problem.

4 Set up an agenda, based on previous problem exploration, for relevant, subsequent research activities to inform policy decisions.

5 Write an issue paper containing the results of a broad, exploratory problem analysis, including the proposal for meaningful, subsequent policy research.

Assessments

%	Type	Name
50	Assignment	Team (2 person) policy analysis report
50	Written examination (closed book)	Theory exam

Topics

1 Introduction: policy analysis, systems analysis

Understand the difference between policy analysis and policy making.

Learn and apply tools for formulating and delimiting a policy problem:

- system diagram,
- analysis of objectives,
- means-ends diagrams, and
- causal analysis.

2 Actor and network analysis

Use actor and network analysis to reflect on the multi-actor setting of complex problems, inform the analysis of socio-political systems, and help improve policy.

3 Future exploration and scenario development

Analyze driving forces and use scenario development tools to create and compare plausible future contexts that show how different factors may influence the achievement of policy objectives or the solution of policy problems.

Assess how the way in which policy problems are formulated influences thedefintion and selction of possible alternatives to solve those problems.

4 Synthesis and knowledge gaps, and issue paper

Inegrate the insights from the previous analytical steps to develop a rich definition of the policy problem. Based on this, identify knowledge gaps that must be filled to help problem owners decide on future courses of action and develop strategies to solve policy problems.

Create a specify and relevant research agenda for follow-up, inluding addressing knowledge gaps for policy research.

The insights gained from the analytical steps covered to this point, including a synthesis, need to be reported in the form of an issue paper directed to a specific problem owner.

5 Policy analysis in practice

The practice of policy analysis for developing or improving environmental policy is much more complex than the practice of policy analysis for research purposes. An experienced policy maker will discuss his/her experiences with the group.

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Introduction: policy analysis, systems analysis	4	6	6	0	0	0	10	24	A. Mendoza - Sammet, J.G. Evers, W.A.H. Thissen, W.J.A.M. Douven
2	Actor and network analysis	4	10	10	0	0	0	14	32	A. Mendoza - Sammet, J.G. Evers, W.A.H. Thissen, W.J.A.M. Douven
3	Future exploration and scenario development	8	10	10	0	0	0	18	44	A. Mendoza - Sammet, J.G. Evers, W.A.H. Thissen, W.J.A.M. Douven
4	Synthesis and knowledge gaps, and issue paper	4	6	10	0	0	0	14	28	A. Mendoza - Sammet, J.G. Evers, W.A.H. Thissen, W.J.A.M. Douven
5	Policy analysis in practice	4	0	0	0	0	0	4	12	A. Mendoza - Sammet, J. Leentvaar, J.G. Evers, W.A.H. Thissen, W.J.A.M. Douven
	Total	24	32	36	0	0	0	60	140	

Education Material

Book	Bert Enserink, Leon Hermans, Jan Kwakkel, Wil Thissen, Joop Koppenjan, Pieter Bots (2010) Policy Analysis of Multi-Actor Systems. Publisher: Lemma/Boom, The Hague. ISBN 978-90-5931-538-9. On-line videos.
Digital files	Copies of Lecturer's presentations
Lecture notes	Course and assignment guide

Scientific Software

M3187

Environmental Monitoring and Modelling

Term	201718T08
Coordinator	A.L. Zuijdgeest
Credit points	5.000000000
Specialization	

Target Group

Young and mid-career professionals (scientists, consultants, decision makers) with a background in Water management or Environmental science

Prerequisites

Basic background in chemistry, physics, and mathematics. Basic knowledge in computer operations (MS-Windows, Office). Good command of English.

Basic background in GIS is recommended but not required (ES programme modules 1-3).

Learning Objectives

1	Explain the impacts of major pollutants on the quality of natural waters and the air.
2	Select and apply appropriate methods to assess the chemical, biological, and microbial quality in air and in natura waters in relation to their anticipated use.
3	Design and evaluate water quality monitoring networks for different types of surface water, groundwater, and the air in relation to set objectives.
4	Explain the possibilities and limitations of water quality models.

Assessments

%	Type	Name
15	Assignment	Group assignment on air quality
15	Assignment	Group assignment on monitoring networks
15	Assignment	Individual assignment on modelling
55	Written examination (closed book)	Written exam (water quality assessment and monitoring, water quality modelling, groundwater quality monitoring, air quality)

Topics

1 Water Quality Assessment

Chemical and (micro-)biological water quality assessment, pollution.

2 Water Quality Monitoring

Monitoring cycle, physico-chemical and (micro-) biological water quality monitoring, recent trends and techniques, optimizations, excursion (liable to change).

Link between monitoring and Environmental Impact Assessment

3 Water Quality Modelling

Introduction to modelling, types of models, model components, examples, and in-class exercise

4 Groundwater Quality Monitoring

Basics of hydrogeology, pollutant transport in groundwater, monitoring.

5 Air Quality Monitoring

Basics of atmospheric sciences, atmospheric pollution, volatile organic and inorganic pollutants, monitoring equipment, dispersion modelling, excursion (liable to change).

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	**Lecturers**
1	Water Quality Assessment	6	0	4	0	0	0	10	22	A.L. Zuijdgeest, E.D. de Ruijter van Steveninck, J.L.C.M. van de Vossenberg
2	Water Quality Monitoring	4	10	4	0	4	0	12	30	A.L. Zuijdgeest, K.A. Irvine
3	Water Quality Modelling	6	0	6	0	0	0	12	24	J. van der Kwast
4	Groundwater Quality Monitoring	8	0	4	0	0	0	12	28	J.W.A. Foppen
5	Air Quality Monitoring	8	6	2	0	4	0	14	36	E.R. Raj
	Total	32	16	20	0	8	0	60	140	

Education Material

Digital files	Compiled power point slides on all above topics, exercise materials, additional materials, and othe relevant information will be supplied.

Scientific Software

PCRaster

M3021

Environmental Planning and Implementation

Term	201718T08
Coordinator	J.G. Evers
Credit points	5.000000000
Specialization	Core Program

Target Group

Young and mid-career professionals (scientists, decision-makers) with a background in environmental management, water management and / or watershed management.

Prerequisites

Affinity with environmental policy plannign, implementation and enforcement, development economics, and preferably experience in water management arena. Good command of English.

Learning Objectives

1 Understand (partly) the complexities of the individual within the complex policy system
2 Develop (adaptive) strategies for network (stakeholder) and process management of water and environmental policy planning and implementation
3 Explain and critically reflect on the role of policy implementers (people) in the policy process
4 Reflect and further develop personal skills for policy planning and implementation
5 Apply and critically assess tools/approaches/strategies for (participatory) policy planning and implementation
6 Understand and apply economic valuation methods for environmental policy planning

Assessments

%	Type	Name
25		Environmental Economics
50	Written examination (closed book)	Environmental Planning and Implementation
25		Policy Plan Analysis

Topics

1 Environmental planning and implementation

Introduction to the module, theories on policy (process) analysis, case studies and experiences on Environmental planning and implementation

1.1 Introduction to EPI

Introducing the module, learning objectives, learning activities, and assessment.

Topics

1.2 Environmental Planning

Introducing key concepts of environmental planning

1.3 Policy Implementation

Introducing concepts of Contextual Interaction Theory, Street-level buraucracy, policy theory analysis

1.4 Assignment Policy plan analysis

In the assignment student groups will analyze a policy plan of action using the Policy Theory concept of Hoogerwerff.

2 Personal skills and experiences in planning and implementation

Team roles in policy planning and implementation, Emotional Intelligence, roundtable discussion with professionals in planning and implementation, field trip

2.1 Personal Experiences in Water and Environmental policy implemetation

Guests are invited from to discuss with the participants their experiences and personal lessons learned from many years of being involved in environmental policy planning and implementation

2.2 Roundtable discussion

A politician, civil servant, and NGO director will discuss with the participants their role around dealing with a specific environmental issue.

2.3 Personal skills in planning and implementation

We organize 2 workshops to develop personal skills: Teamroles; and Emotional Intelligence

3 Environmental Economics

Economic valuation methods, and economic tools for the management of natural (water) resources.

4 Decision support tools for EPI

What is the role of DSS/planning tools in Environmental Planning

4.1 MOTA analysis

In this session we use the MOTA framework to assess the implementation feasibilty of proposed measures in de River Basin Game.

4.2 Tools for planning

In this lecture we discuss the variety of tools which are used in planning processes, its role, and what tools do.

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Environmental planning and implementation	0	0	0	0	0	0	0	0	
1.1	Introduction to EPI	2	0	0	0	0	0	2	6	J.G. Evers
1.2	Environmental Planning	4	0	0	0	0	0	4	12	J.G. Evers, W.J.A.M. Douve
1.3	Policy Implementation	4	0	0	0	0	0	4	12	J.G. Evers
1.4	Assignment Policy plan analysis	0	32	0	0	0	0	0	32	J.G. Evers, W.A.H. Thissen
2	Personal skills and experiences in planning and implementation	0	0	0	0	0	0	0	0	
2.1	Personal Experiences in Water and Environmental policy implemetation	0	0	4	0	0	0	4	4	J.G. Evers
2.2	Roundtable discussion	0	0	2	0	0	0	2	2	J.G. Evers
2.3	Personal skills in planning and implementation	0	0	12	0	0	0	12	12	J.G. Evers
3	Environmental Economics	14	8	0	0	0	0	14	50	Y. Jiang
4	Decision support tools for EPI	0	0	0	0	0	0	0	0	
4.1	MOTA analysis	0	0	4	0	0	0	4	4	J.G. Evers
4.2	Tools for planning	2	0	0	0	0	0	2	6	J.G. Evers, S. Hasan
	Total	26	40	22	0	0	0	48	140	

Education Material

Handout	Additional Reading Materials
Lecture notes	Lecture Notes

Scientific Software

M1212

Data Analysis and Modelling for Aquatic Ecosystems

Term	201718T09
Coordinator	A.A. van Dam
Credit points	5.000000000
Specialization	

Target Group

Participants in the Limnology and Wetland Management specialisation of the IHE Environmental Science MSc-programme; Other IHE participants who select this module as an elective; Participants who take this module as a short course.

Prerequisites

Programme prerequisites; Basic course in statistics.

Learning Objectives

1	Store and manipulate experimental data efficiently in a simple database and perform exploratory data analysis using time series plots, scatter plots and descriptive statistics in MS Excel and R.
2	Perform basic statistical procedures and analyses using R (distribution tests and transfor-mations, t-tests, ANOVAs, non-parametric tests, simple and multiple regression, etc.)
3	Do multivariate statistical analyses, such as multiple regression analysis and factor analysis, using R; and understand the principles of some other advanced modelling applications for ecological data.
4	Construct a simple dynamic simulation model of an aquatic ecosystem using Stella.
5	Discuss critically the strengths, weaknesses, missing information, advantages and disadvantages of the analyses.
6	Communicate effectively the methods, results and conclusions of a case study (presentation and written report).

Assessments

%	Type	Name
40	Assignment	This consists of an individual report on the case study. The participants use
40	Written examination (closed book)	This is an exam covering all the material presented in the module. It con
20	Presentation	Presentation This is a presentation made by each group about the Stella model developed during the g

Topics

1 Module intro

Explain learning objectives, learning activities in the module, assessment methods for different learning objectives. Agree on way of working during the module, expectations. Installation of software (Stella, R, R-Studio).

2 Ecosystem modelling lectures

Participants learn about the rationale for modelling as a scientific approach and different types of models as used for achieving different objectives. They are introduced to dynamic simulation models and to Stella software to implement simple models.

3 Data analysis lectures

Participants learn how to store a dataset in an Excel file and save the data in text format (as .csv file). How to read data into R and perform data manipulations for producing graphs (bar graphs, scatter plots, line plots, and others) and basic statistical analysis.

4 Ecosystem modelling exercises

Participants learn to use the Stella software for ecosystem modelling.

5 Data analysis exercises

Participants learn to use the R-software for data analysis.

6 Case study ecosystem modelling

Participants study an ecosystem by reading scientific articles and then create a simple model of this ecosystem with which they explore different management options.

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Module intro	2	0	0	0	0	0	2	6	A.A. van Dam
2	Ecosystem modelling lectures	10	0	0	0	0	0	10	30	E.M.A. Hes
3	Data analysis lectures	10	0	0	0	0	0	10	30	A.A. van Dam
4	Ecosystem modelling exercises	0	0	25	0	0	0	25	25	A.A. van Dam, E.M.A. Hes
5	Data analysis exercises	0	0	29	0	0	0	29	29	A.A. van Dam
6	Case study ecosystem modelling	0	0	20	0	0	0	20	20	A.A. van Dam, E.M.A. Hes
	Total	22	0	74	0	0	0	96	140	

Education Material

Scientific Software

stella

M3320

Data Analysis and Modelling for Aquatic Ecosystems

Term	201718T09
Coordinator	A.A. van Dam
Credit points	5.000000000
Specialization	

Target Group

Participants in the Limnology and Wetland Management specialisation of the IHE Environmental Science MSc-programme; Other IHE participants who select this module as an elective; Participants who take this module as a short course.

Prerequisites

Programme prerequisites; Basic course in statistics.

Learning Objectives

1	Store and manipulate experimental data efficiently in a simple database and perform exploratory data analysis using time series plots, scatter plots and descriptive statistics in MS Excel and R.
2	Perform basic statistical procedures and analyses using R (distribution tests and transfor-mations, t-tests, ANOVAs, non-parametric tests, simple and multiple regression, etc.)
3	Do multivariate statistical analyses, such as multiple regression analysis and factor analysis, using R; and understand the principles of some other advanced modelling applications for ecological data.
4	Construct a simple dynamic simulation model of an aquatic ecosystem using Stella.
5	Discuss critically the strengths, weaknesses, missing information, advantages and disadvantages of the analyses.
6	Communicate effectively the methods, results and conclusions of a case study (presentation and written report).

Assessments

%	Type	Name
40	Assignment	This consists of an individual report on the case study.
20	Presentation	This is a presentation made by each group about the Stella model developed during the groupwork
40	Written examination (closed book)	This is an exam covering all the material presented in the module. It consists of closed questions (yes/no)

Topics

1 Module intro

Explain learning objectives, learning activities in the module, assessment methods for different learning objectives. Agree on way of working during the module, expectations. Installation of software (Stella, R, R-Studio).

2 Ecosystem modelling lectures

Participants learn about the rationale for modelling as a scientific approach and different types of models as used for achieving different objectives. They are introduced to dynamic simulation models and to Stella software to implement simple models.

3 Data analysis lectures

Participants learn how to store a dataset in an Excel file and save the data in text format (as .csv file). How to read data into R and perform data manipulations for producing graphs (bar graphs, scatter plots, line plots, and others) and basic statistical analysis.

4 Ecosystem modelling exercises

Participants learn to use the Stella software for ecosystem modelling.

5 Data analysis exercises

Participants learn to use the R-software for data analysis.

6 Case study ecosystem modelling

Participants study an ecosystem by reading scientific articles and then create a simple model of this ecosystem with which they explore different management options.

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Module intro	2	0	0	0	0	0	2	6	A.A. van Dam
2	Ecosystem modelling lectures	10	0	0	0	0	0	10	30	E.M.A. Hes
3	Data analysis lectures	10	0	0	0	0	0	10	30	A.A. van Dam
4	Ecosystem modelling exercises	0	0	25	0	0	0	25	25	A.A. van Dam, E.M.A. Hes
5	Data analysis exercises	0	0	29	0	0	0	29	29	A.A. van Dam
6	Case study ecosystem modelling	0	0	20	0	0	0	20	20	A.A. van Dam, E.M.A. Hes
	Total	22	0	74	0	0	0	96	140	

Education Material

Scientific Software

stella

M3273

Data Analysis and Modelling for Aquatic Ecosystems for LWM

Term	201718T09
Coordinator	A.A. van Dam
Credit points	5.600000000
Specialization	

Target Group

Participants in the Limnology and Wetland Management specialisation of the IHE Environmental Science MSc-programme; Other IHE participants who select this module as an elective; Participants who take this module as a short course.

Prerequisites

Programme prerequisites; Basic course in statistics.

Learning Objectives

1 Store and manipulate experimental data efficiently in a simple database and perform exploratory data analysis using time series plots, scatter plots and descriptive statistics in MS Excel and R.

2 Perform basic statistical procedures and analyses using R (distribution tests and transfor-mations, t-tests, ANOVAs, non-parametric tests, simple and multiple regression, etc.)

3 Do multivariate statistical analyses, such as multiple regression analysis and factor analysis, using R; and understand the principles of some other advanced modelling applications for ecological data.

4 Construct a simple dynamic simulation model of an aquatic ecosystem using Stella.

5 Discuss critically the strengths, weaknesses, missing information, advantages and disadvantages of the analyses.

6 Communicate effectively the methods, results and conclusions of a case study (presentation and written report).

Assessments

%	Type	Name
40	Assignment	This consists of an individual report on the case study.
20	Presentation	This is a presentation made by each group about the Stella model developed during the groupwork
40	Written examination (closed book)	This is an exam covering all the material presented in the module. It consists of closed questions (yes/no)

Topics

1 Module intro

Explain learning objectives, learning activities in the module, assessment methods for different learning objectives. Agree on way of working during the module, expectations. Installation of software (Stella, R, R-Studio).

2 Ecosystem modelling lectures

Participants learn about the rationale for modelling as a scientific approach and different types of models as used for achieving different objectives. They are introduced to dynamic simulation models and to Stella software to implement simple models.

3 Data analysis lectures

Participants learn how to store a dataset in an Excel file and save the data in text format (as .csv file). How to read data into R and perform data manipulations for producing graphs (bar graphs, scatter plots, line plots, and others) and basic statistical analysis.

4 Ecosystem modelling exercises

Participants learn to use the Stella software for ecosystem modelling.

5 Data analysis exercises

Participants learn to use the R-software for data analysis.

6 Case study ecosystem modelling

Participants study an ecosystem by reading scientific articles and then create a simple model of this ecosystem with which they explore different management options.

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Module intro	2	0	0	0	0	0	2	6	A.A. van Dam
2	Ecosystem modelling lectures	10	0	0	0	0	0	10	30	E.M.A. Hes
3	Data analysis lectures	10	0	0	0	0	0	10	30	A.A. van Dam
4	Ecosystem modelling exercises	0	0	25	0	0	0	25	25	A.A. van Dam, E.M.A. Hes
5	Data analysis exercises	0	0	29	0	0	0	29	29	A.A. van Dam
6	Case study ecosystem modelling	0	0	20	0	0	0	20	20	A.A. van Dam, E.M.A. Hes
	Total	22	0	74	0	0	0	96	140	

Education Material

Scientific Software

stella

M1766

Foreign Fieldtrip and Fieldwork ES

Term	201718T09
Coordinator	E.D. de Ruijter van Steveninck
Credit points	5.000000000
Specialization	Core Program

Target Group

Students and professionals with an interest in environmental sciences and in maintaining environmental integrity to support human development.

Prerequisites

BSc or MSc in natural sciences, chemistry, environmental science, agriculture, geography, environmental economics, planning and management or engineering. Good conversational, reading and writing capabilities in the English language. Computer literacy. Professional experience in a relevant area is desirable.

Learning Objectives

1 delineate streams and catchments using GIS and to prepare field maps with GPS locations
2 carry out basic eco-hydrological measurements and analyse and interpret the collected data
3 describe how natural processes and anthropogenic activities interact in shaping river catchments
4 explain the value of ecosystem protection and rehabilitation for society
5 relate their findings to the situation in their home countries and recognize the possibilities and limitations for application

Assessments

%	Type	Name
100	Assignment	Fieldwork

Topics

1 GIS and mapping

2 Fieldwork

In the integrated fieldwork, hydrological, chemical and biological measurements will be integrated into an overall evaluation of the water quality in a river basin in relation to land use.

Topics

3 International visits

Excursions to environment-related organisations and companies in Western Europe. Visits will also be made to different ecosystems (more or less disturbed by anthropogenic activities, restoration projects).

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	GIS and mapping	0	20	0	0	0	0	0	20	J. van der Kwast
2	Fieldwork	0	0	0	0	60	0	60	60	A. Mendoza - Sammet, A.L. Zuijdgeest, E.D. de Ruijter van Steveninck, G.M. Gettel J.W. Wenninger
3	International visits	0	0	0	0	60	0	60	60	A. Mendoza - Sammet, A.L. Zuijdgeest, E.D. de Ruijter van Steveninck, J.L.C.M. va de Vossenberg
	Total	0	20	0	0	120	0	120	140	

Education Material

Handout	Practical and field guides

Scientific Software

M3202

Aquatic Ecosystems Processes and Applications

Term	201718T10
Coordinator	G.M. Gettel
Credit points	5.000000000
Specialization	Core Program

Target Group

Programme target group (Participants in the programmes at IHE) and qualified short course participants

Prerequisites

Programme prerequisites (BSc in a topic appropriate to IHE-Delft programmes) and basic knowledge of aquatic ecology, chemistry, and statistics.

Learning Objectives

1 Conduct laboratory techniques used for basic limnological studies. Specifically, you will be able to measure physical-chemical properties, chlorophyll a concentration in seston and periphyton and calculate primary production and respiration.

2 Critically analyze scientific literature, including interpretation of data in graphs and tables, and evaluation of methodology and conclusions.

3 Develop your own research question and specific objectives designed to answer it.

4 Analyze data using either statistical or modeling techniques to answer your research question.

5 Develop writing skills in the format of a scientific article that presents your research question, the data supporting it, and a discussion of your results, including a review of relevant literature.

6 Communicate in verbal scientific discourse: articulate problems, data interpretation, and conclusions in presentations and informal discussions.

Assessments

%	Type	Name
10	Assignment	The peer review will comprise 10% of the grade for this course.
80	Assignment	The scientific report serves as the exam and the bulk of the grade for this course.
10	Presentation	Presentation Students will be asked to present conclusions from in-class discussions and exercises.

Topics

1 Eutrophication in shallow-lake ecosystems

A mesocosm experiment will be used to analyse the effects of eutrophication in shallow lakes and to familiarise participants with techniques that are common in ecological research. Ample attention will be paid to the development of a critical scientific approach, including study design, statistical analysis and data presentation. Lectures on ecological processes and human impacts on aquatic ecosystems will provide the necessary theoretical background, including introductory limnology, principles of primary production and bottom-up and top-down control, and benthic and pelagic primary production.

2 Fundamental Limnological Laboratory Skills

Laboratory analysis of physical-chemical and ecological characteristics including nutrients, phtyoplankton, zooplankton, and primary production will be performed.

3 Data analysis

Students will analyse data using the necessary statistical approaches, including ANOVA and post-hoc tests (e.g. Tukey), regression, and non-parametric tests as required.

4 Report Writing

Skills in writing a scientific report, including developing a research question, the structure of Introduction, Methods and Materials, Results, and Discussion sections of a scientific resport are described.

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Eutrophication in shallow-lake ecosystems	14	0	22	0	0	0	36	64	G.M. Gettel, J. Schoelynck
2	Fundamental Limnological Laboratory Skills	0	0	22	0	0	0	22	22	E.R. Raj, G.M. Gettel
3	Data analysis	0	20	0	0	0	0	0	20	A.A. van Dam, G.M. Gettel
4	Report Writing	0	34	0	0	0	0	0	34	E.R. Raj, G.M. Gettel
	Total	14	54	44	0	0	0	58	140	

Education Material

Scientific Software

R_statistics

stella

M3316

Aquatic Ecosystems Processes and Applications for LWM

Term	201718T10
Coordinator	G.M. Gettel
Credit points	5.600000000
Specialization	

Target Group

Programme target group (Participants in the programmes at IHE) and qualified short course participants

Prerequisites

Programme prerequisites (BSc in a topic appropriate to IHE-Delft programmes) and basic knowledge of aquatic ecology, chemistry, and statistics.

Learning Objectives

1	Conduct laboratory techniques used for basic limnological studies. Specifically, you will be able to measure physical-chemical properties, chlorophyll a concentration in seston and periphyton and calculate primary production and respiration.
2	Critically analyze scientific literature, including interpretation of data in graphs and tables, and evaluation of methodology and conclusions.
3	Develop your own research question and specific objectives designed to answer it.
4	Analyze data using either statistical or modeling techniques to answer your research question.
5	Develop writing skills in the format of a scientific article that presents your research question, the data supporting it, and a discussion of your results, including a review of relevant literature.
6	Communicate in verbal scientific discourse: articulate problems, data interpretation, and conclusions in presentations and informal discussions.

Assessments

%	Type	Name
10	Assignment	The peer review will comprise 10% of the grade for this course.
80	Assignment	The scientific report serves as the exam and the bulk of the grade for this course.
10	Presentation	Presentation Students will be asked to present conclusions from in-class discussions and exercises.

Topics

1 Eutrophication in shallow-lake ecosystems

A mesocosm experiment will be used to analyse the effects of eutrophication in shallow lakes and to familiarise participants with techniques that are common in ecological research. Ample attention will be paid to the development of a critical scientific approach, including study design, statistical analysis and data presentation. Lectures on ecological processes and human impacts on aquatic ecosystems will provide the necessary theoretical background, including introductory limnology, principles of primary production and bottom-up and top-down control, and benthic and pelagic primary production.

2 Fundamental Limnological Laboratory Skills

Laboratory analysis of physical-chemical and ecological characteristics including nutrients, phtyoplankton, zooplankton, and primary production will be performed.

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Students will analyse data using the necessary statistical approaches, including ANOVA and post-hoc tests (e.g. Tukey), regression, and non-parametric tests as required.

4 Report Writing

Skills in writing a scientific report, including developing a research question, the structure of Introduction, Methods and Materials, Results, and Discussion sections of a scientific resport are described.

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Eutrophication in shallow-lake ecosystems	14	0	22	0	0	0	36	64	G.M. Gettel
2	Fundamental Limnological Laboratory Skills	0	0	22	0	0	0	22	22	E.R. Raj, G.M. Gettel
3	Data analysis	0	20	0	0	0	0	0	20	A.A. van Dam, G.M. Gettel
4	Report Writing	0	34	0	0	0	0	0	34	E.R. Raj, G.M. Gettel
	Total	14	54	44	0	0	0	58	140	

Education Material

Scientific Software

R_statistics

stella

M3080

Environmental Assessment for Water-related Policies and Development

Term	201718T10
Coordinator	A. Mendoza - Sammet
Credit points	5.000000000
Specialization	Core Program

Target Group

Professionals from the academic, public or private sectors, with a background in environmental or social sciences, engineering, or management of natural resources (e.g. environmental, water and / or watershed management).

Prerequisites

Interest on environmental, social and strategic impact assessment; improvement and implementation of policies, plans, and programs; and/or sustainability.

Good command of English (written and spoken).

Learning Objectives

1 Understand the role of impact assessment (Environmental Impact Assessment [EIA] and Strategic Environmental Assessment [SEA]) in achieving sustainable development and critically reflect on their function as a decision-making tool.

2 Describe the methods and tools used in EIA & SEA and apply them to conduct a desk-top assessment for a water related development project.

3 Describe the importance of public participation in ESIA & SEA and how the roles of stakeholders, experts, regulators and proponents- vary between the two processes.

4 Analyse the barriers and drivers that influence the effective integration of EIA & SEA into the planning/project approval process in different contexts, including developing and transition countries.

5 Explain the similarities and differences between the EIA & SEA principles and processes, and their application in river basin and natural resource planning and management.

Assessments

%	Type	Name
40	Assignment	EIA individual assingment
50	Written examination (closed book)	Exam
0	Attendance	Minimum 80% of attendance
10	Assignment	SEA group assignment

Topics

1 Impact assessment (EIA and SEA): Introduction and principles

The concepts and principles that guide the practice of EIA and SEA. The influence of environmental legislation and international guidance on EIA scope and degree of public participation.

2 EIA and SEA: Process, methods and tools

Overview of the basic steps of the impact assessment processes are covered: screening, scoping, impact analysis, mitigation, reporting, reviewing and follow-up.

Revision of the methods used to identify the impacts and benefits of resource development projects: including matrices, cause-effect diagrams, sakeholder analysis, cumulative effects assessment.

Overview and application of methodologies to integrate into EIA and SEA climate change, human rights, gender, biodiversity, and ecosystem services, to analyse the social and environmental impacts of projects and strategic interventions.

3 Public participation in impact assessment

The differences among the modalities of public participation (information, consultation, collaboration and empowerment) and their different outcomes in impact assessment.

Examples from developed and developing countries.

Use of stakeholder's analysis to determine consultation needs and challenges.

4 The role of EIA & SEA in decision-making

Learn to use criteria to determine the signifficance of impacts and inform the public and decision-makers.

Analyse the factors that determine the quality and usefulness of impact assessment, especially in transition and developing countries.

Critically reflect on the complementarity of EIA and SEA to improve regional and river basin planning, and management of water and natural resources.

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Impact assessment (EIA and SEA): Introduction and principles	1	1	2	0	0	0	3	6	A. Mendoza - Sammet
2	EIA and SEA: Process, methods and tools	8	0	56	0	0	0	64	80	A. Mendoza - Sammet, A.J. Kolhoff, R. Slootweg, T. Vellinga
3	Public participation in impact assessment	2	2	6	0	0	0	8	14	A. Mendoza - Sammet, A.J. Kolhoff
4	The role of EIA & SEA in decision-making	4	4	16	0	8	0	28	40	A. Mendoza - Sammet, K.A. Irvine
	Total	15	7	80	0	8	0	103	140	

Education Material

Lecture notes	Copies of Powerpoint presentations, lecture notes
Digital files	Course and assignment guide
Digital files	Report template and spreadsheets for analysis in Excel

Scientific Software

M3048

Water Sensitive Cities

Term	201718T10
Coordinator	P.D.A. Pathirana
Credit points	5.000000000
Specialization	Core Program

Target Group

All participants and external professionals dealing with urban water and flood risk management working for municipalities, water management organisation, consulting firms, educational institutions and NGOs.

Prerequisites

BSc degree in Engineering or Social Sciences background; basic knowledge of urban water and flood risk management; good command of English.

Learning Objectives

1 Describe the historical transition of cities from the viewpoint of water management. List salient features of that transition (both positive and negative). (ILO1:History)

2 Argue that the three main components of the urban water cycle (UWC) management are interdependent. Describe the interactions with other important aspects of UWC like groundwater, urban atmosphere, etc., and how they affect each. (ILO2:Integration)

3 Identify interactions between water system components, while following 'thematic' topics (e.g. urban hydrology, water transport and distribution). Describe how to exploit such interactions to enhance livability, sustainability and resilience of cities.

4 Argue that considering multiple aspects of the water systems could provide opportunities to add extra value and create substantial additional benefits related to water management projects. Estimate such benefits using toolkits. (ILO4:MultipleValues)

5 Illustrate the importance of 'mainstreaming' water sensitive elements to general urban development process. Describe concrete examples (real-world and hypothetical) of such mainstreaming. (ILO5: Mainstreaming)

6 Analyse the stakeholder involvement in the management of water in city. Argue that for effective embedding of water-sensitive features to urban development, stakeholders should also include traditionally 'non-water' domains. (ILO6:Stakeholders)

7 Reflect on the relationship of WSC principals and practice to existing cities and their sub-components (e.g. neighbourhoods). Propose (conceptual) next steps in moving towards a more water-sensitive state for a given concrete case-study. (ILO7:Vision)

Assessments

%	Type	Name
50	Assignment	Case study reflection reports
25	Oral examination	
25	Presentation	

Topics

T1 Introduction to water sensitive cities

This module's structure is quite different from the 'traditional model' of teaching modules here at IHE. The Learning objectives are realized via a series of 'Cast Studies' (between 10 and 14) each taking a half a day or full day. Each case study has a hands-on, workshop type part as well.

This section which precedes those case studies describe:

1. What is a water sensitive city? Why it is important? How cities can strive to arrive at more water sensitive states?

2. The components of the urban water cycle (Water supply, Surface/storm water system, Wastewater system + groundwater), each as a brief inroduction and how they interact with each other and the borader urban processes that are outside the domain of water.

T2 Case studies (change every year)

List of case studies. Each case study has

1. Lecture/discussion part

2. Workshp - hands-on part.

Since the number and content of the case studies change every year this section represents the 'collection' of the case studies.

T3 Field trip

In most years, the module has a one day field trip.

T4 Final presentations

Here students present their own impressions about the concept of WSC, its implementation, challenges, suitability, etc. They do peer-assessment.

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
T1	Introduction to water sensitive cities	8	0	0	0	0	0	8	24	P.D.A. Pathirana
T2	Case studies (change every year)	28	12	28	0	0	0	56	124	
T3	Field trip	0	0	0	0	8	0	8	8	P.D.A. Pathirana, W. Veerbeek
T4	Final presentations	0	0	4	0	0	0	4	4	M. Radhakrishnan, P.D.A. Pathirana
	Total	36	12	32	0	8	0	76	160	

Education Material

Lecture notes	Every year a set of scientific papers, reports and book chapters will be provided in addition to the slides used in the class.

Scientific Software

M2602

Advanced Water Transport and Distribution

Term	201718T11
Coordinator	N. Trifunovic
Credit points	5.000000000
Specialization	Environmental Science and Technology

Target Group

Engineers and scientists with keen interest in modern methods, technologies and tools used in design, operation and maintenance of water transport & distribution networks.

Prerequisites

BSc degree in Civil Engineering or similar; a few years of relevant experience; knowledge of steady-state hydraulics of pressurised flows; basic use of network models; good English command. Students without any WTD experience should first complete the module Water Transport and Distribution.

Learning Objectives

1 distinguish between various sources of water quality problems in distribution networks;understand the basic corrosion mechanisms and suggest the list of preventive and reactive measures;

2 understand the theory of advanced hydraulic and water quality modelling; apply state-of-the-art network software for assessment of irregular operational scenarios and develop a reliability-based and cost effective design using computer model.

3 recognise the GIS and remote sensing technologies, and familiarise with the GIS-based techniques for sustainabl planning and management of WTD systems;

4 understand the theory of transient flows, and plan the measures to prevent/control water hammer;

5 select modern tools for monitoring of operation, and planning of maintenance of WTD systems.

Assessments

%	Type	Name
12	Assignment	GIS assignment on the exercise using ArcGIS
60	Written examination (closed book)	Multiple choice test covering theoretical aspects of (1) advanced water distribution modelling, (2) water quality and corrosion in distribution networks and (3)water hammer (20% each)
28	Assignment	Report on four short assignments regarding advanced water distribution modelling done in WaterGEMS software: (1) Network design using GA optimiser, (2) Network criticality analysis, (3) Water quality analysis,

Topics

1 Water Quality in Distribution Networks

Corrosion of pipe materials, indices of measure, corrossion assessment, prevention and control, optial water composition, principles of water quality modelling of distribution networks, modelling of chlorine residuals.

2 Advanced Water Distribution Modelling

Principles of genetic algorithm; pressure-driven demand calculations; network calibration; failure analysis and calculation of demand losses; economic aspects of capital investments and network operation.

3 GIS in Water Distribution

The aim of this course is to provide both a solid theoretical understanding and a comprehensive practical introduction of how to use geographic information systems and remote sensing technologies for the analysis and solution of water distribution related problems. The course focuses on the analysis of digital spatial data, preparation for numerical modelling, presentation of modelling results and support to the decision making process. The topics covered in the course include the following: introduction to geographic information systems and remote sensing technologies, active and passive remote sensing,data structures, map projections and coordinate systems, processing of digital geographic information, creation of digital elevation models, visualisation, mapping of water related features features, delineation of pressure zone areas, digitisation, soil and land use mapping,map algebra, export of GIS layers into a modelling package, incorporation of modelling results in GIS.

4 Introduction to Water Hammer

Basic equations and applications; computer modelling: model building, simulations of simple cases (full pump trip, emergency shut down; protection devices: practical methods of surge suppression, direct action, diversionary tactics, choice of protection strategy.

5 Advanced O&M Practices in Water Distribution

Monitoring of network condition and operation; data collection and management; organisation of maintenance, emergency water supply, asset management plans, water company organisation.

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Water Quality in Distribution Networks	6	0	0	0	0	4	10	30	N. Trifunovic, S. Velickov, S.K. Sharma
2	Advanced Water Distribution Modelling	6	0	12	0	0	6	24	48	N. Trifunovic, S. Velickov
3	GIS in Water Distribution	4	0	0	0	0	4	8	24	A. Sanchez Torres, Z. Vojinovic
4	Introduction to Water Hammer	6	0	4	0	4	0	14	26	N. Trifunovic, S. Velickov
5	Advanced O&M Practices in Water Distribution	0	4	0	0	8	0	8	12	
	Total	22	4	16	0	12	14	64	140	

Education Material

Lecture notes	S.Sharma - Corrosion of Pipe Materials, lecture notes UNESCO-IHE 2009 (LN/0310/09/1)

Scientific Software
WaterGEMS

M3250

Advanced Water Transport and Distribution

Term	201718T11
Coordinator	N. Trifunovic
Credit points	5.000000000
Specialization	Core Program

Target Group

Engineers and scientists with keen interest in modern methods, technologies and tools used in design, operation and maintenance of water transport & distribution networks.

Prerequisites

BSc degree in Civil Engineering or similar; a few years of relevant experience; knowledge of steady-state hydraulics of pressurised flows; basic use of network models; good English command. Students without any WTD experience should first complete the module Water Transport and Distribution.

Learning Objectives

1 distinguish between various sources of water quality problems in distribution networks;understand the basic mechanisms and suggest the list of preventive and reactive measures;

2 understand the theory of advanced hydraulic and water quality modelling; apply state-of-the-art network software for assessment of irregular operational scenarios and develop a reliability-based and cost effective design using computer model.

3 recognise the GIS and remote sensing technologies, and familiarise with the GIS-based techniques for sustainabl planning and management of WTD systems;

4 understand the theory of transient flows, and plan the measures to prevent/control water hammer;

5 select modern tools for monitoring of operation, and planning of maintenance of WTD systems.

Assessments

%	Type	Name
12	Assignment	GIS assignment on the exercise using ArcGIS
60	Written examination (closed book)	Multiple choice test covering theoretical aspects of (1) advanced water distribution modelling, (2) water quality in distribution networks and (3)water hammer (20%each)
28	Assignment	Report on four short assignments regarding advanced water distribution modelling done in WaterGEMS software: (1) Network design using GA optimiser, (2) Network criticality analysis, (3) Water quality analysis,

Topics

1 Water Quality in Distribution Networks

Corrosion of pipe materials, indices of measure, corrossion assessment, prevention and control, optial water composition, principles of water quality modelling of distribution networks, modelling of chlorine residuals.

2 Advanced Water Distribution Modelling

Principles of genetic algorithm; pressure-driven demand calculations; network calibration; failure analysis and calculation of demand losses; economic aspects of capital investments and network operation.

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The aim of this course is to provide both a solid theoretical understanding and a comprehensive practical introduction of how to use geographic information systems and remote sensing technologies for the analysis and solution of water distribution related problems. The course focuses on the analysis of digital spatial data, preparation for numerical modelling, presentation of modelling results and support to the decision making process. The topics covered in the course include the following: introduction to geographic information systems and remote sensing technologies, active and passive remote sensing,data structures, map projections and coordinate systems, processing of digital geographic information, creation of digital elevation models, visualisation, mapping of water related features features, delineation of pressure zone areas, digitisation, soil and land use mapping,map algebra, export of GIS layers into a modelling package, incorporation of modelling results in GIS.

4 Introduction to Water Hammer

Basic equations and applications; computer modelling: model building, simulations of simple cases (full pump trip, emergency shut down; protection devices: practical methods of surge suppression, direct action, diversionary tactics, choice of protection strategy.

5 Advanced O&M Practices in Water Distribution

Monitoring of network condition and operation; data collection and management; organisation of maintenance, emergency water supply, asset management plans, water company organisation.

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Water Quality in Distribution Networks	6	0	0	0	0	4	10	30	D. Ferras, N. Trifunovic, S. Velickov
2	Advanced Water Distribution Modelling	9	0	10	0	0	8	27	61	D. Ferras, N. Trifunovic, S. Velickov, Z. Kapelan
3	GIS in Water Distribution	0	0	8	0	0	0	8	8	A. Sanchez Torres
4	Introduction to Water Hammer	4	0	4	0	0	4	12	28	D. Ferras, S. Velickov
5	Advanced O&M Practices in Water Distribution	0	0	4	0	8	0	12	12	C.G. van der Drift, D. Ferras N. Trifunovic
	Total	19	0	26	0	8	16	69	139	

Education Material

Scientific Software
ArcGIS
WaterGEMS

M2810

Decentralised Water Supply and Sanitation

Term	201718T11
Coordinator	S.K. Sharma
Credit points	5.000000000
Specialization	Core Program

Target Group

Mid-career professionals, involved in planning and management aspects of decentralised, small-scale or low-cost water supply or sanitation systems, working for municipalities, universities, research institutes, government ministries, water supply agencies, NGOs and consultancies

Prerequisites

MSc. programme entry requirements

Learning Objectives

1 know different technologies/methods for small-scale water abstraction and water treatment that can be used at household or small community level

2 understand the basics of sustainable sanitation technologies including nutrient reuse in agriculture, soild waste management and fecal sludge management and their implementation in small towns, peri-urban and urban poor areas of developing countries

3 prepare concept design for small-scale water supply treatment and ecosan technology

4 facilitate planning, financing, implementation and operation and maintenance of decentralised water supply and sanitation infrastructures based on stakeholder participation and community management

Assessments

%	Type	Name
30	Assignment	
10	Presentation	
60	Written examination (closed book)	

Topics

1 Introduction

Introduction to the module; Water Supply and Sanitation situations in small towns, peri-urban areas and urban poor areas. Rationale for decentralised water supply system

1.1 Module introduction

1.2 Introduction to decentralised water supply and sanitation

Topics

2 Decentralised Water Supply and Treatment Systems

Water Supply Systems (water sources,source selection,service levels, suitability of types of water supply systems under different conditions); Rainwater Harvesting (introduction, collection systems, advantages and limitations, design considerations). Small-scale Water Treatment Methods (design water treatment systems for small community or household. Roughing filtration, slow sand filters, small-scale disinfection)

2.1 Water supply systems

2.2 Rain water harvesting

2.3 Small-scale water treatment

3 Decentralised Sanitation Systems

Ecological sanitation (introduction to ecosan approach; characteristics of urine, faeces and greywater; overview of technologies for ecosan; treatment aspects for urine, faeces and greywater; conventional on-site sanitation; storage and transport logistics; introduction to anaerobic treatment, composting and constructed wetlands; safe reuse of ecosan products in agriculture with WHO guidelines; financial institutional, social and policy aspects of ecosan). Faecal Sludge Management (treatment goals and standards, treatment options, faecal sludge management (planning, financial, economic, agronomic, institutional and legal aspects), transmission of excreta-related infections and risk management). Solid waste management in developing countries (technical and practical aspects of collection, transport, segregation, disposal and reuse)

3.1 Ecological sanitation

3.2 Soild waste management in small towns and urban poor areas

3.3 Sanitation planning and strategic tools

3.4 Fecal sludge management

4 Management Aspects of DWSS

Participatory planning and evaluation of DWSS systems, demand responsive approach; Institutional arrangements (community based management; small-scale independent providers), Financial and Operational aspects (financing, cost recovery, operation and maintenance of DWSS systems)

4.1 Participatory planning and evaluation

4.2 Institutional arrangements

4.3 Financing and cost recovery aspects

4.4 Operation and maintenance aspects

5 Presentation of the Participants

All participants make a presentation of 10 minutes in the field of decentralised water supply and sanitation in order to share experiences or problems they are facing now and learn from each others experience.

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Introduction	0	0	0	0	0	0	0	0	S.K. Sharma
1.1	Module introduction	0	0	1	0	0	0	1	1	
1.2	Introduction to decentralised water supply and sanitation	2	0	0	0	0	0	2	6	
2	Decentralised Water Supply and Treatment Systems	0	0	0	0	0	0	0	0	S.K. Sharma
2.1	Water supply systems	3	0	0	0	0	0	3	9	
2.2	Rain water harvesting	2	0	2	0	0	0	4	8	
2.3	Small-scale water treatment	6	6	0	0	0	0	6	24	
3	Decentralised Sanitation Systems	0	0	0	0	0	0	0	0	
3.1	Ecological sanitation	6	0	2	0	4	0	12	24	M. Ronteltap
3.2	Soild waste management in small towns and urban poor areas	4	0	0	0	0	0	4	12	M.A. Siebel
3.3	Sanitation planning and strategic tools	2	0	2	0	0	0	4	8	
3.4	Fecal sludge management	2	0	4	0	0	0	6	10	M. Ronteltap
4	Management Aspects of DWSS	0	0	0	0	0	0	0	0	
4.1	Participatory planning and evaluation	2	2	0	0	0	0	2	8	M. Mulenga
4.2	Institutional arrangements	2	0	2	0	0	0	4	8	K.H. Schwartz
4.3	Financing and cost recovery aspects	2	0	2	0	0	0	4	8	
4.4	Operation and maintenance aspects	2	0	2	0	0	0	4	8	S.K. Sharma
5	Presentation of the Participants	0	0	6	0	0	0	6	6	S.K. Sharma
	Total	35	8	23	0	4	0	62	140	

Education Material

Handout	Schwartz, K. (2015) Institutional Arranagements (Handouts)
Handout	Siebel, M (2015) Solid Waste Management in Urban Poor Areas (Handouts)

Scientific Software

M2873

Faecal Sludge Management

Term	201718T11
Coordinator	M. Ronteltap
Credit points	5.000000000
Specialization	Environmental Science and Technology

Target Group

This course is a specialist course fitting within Sanitary Engineering. It is designed for sanitary, civil / wastewater and environmental engineers who are facing challenges with faecal sludge. As on-site sanitation is by far the most applied sanitation technology, faecal sludge management is of paramount importance globally.

Prerequisites

Preceding modules in Sanitary Engineering; an interest in and working knowledge of the business of faecal sludge management help to bring this module to a good end.

Learning Objectives

1 Describe the way how excreta and faecal sludge are characterised.
2 Know which technologies can be applied for which type of faecal sludge (settling tanks, planted and unplanted drying beds, etc)
3 Name the key stakeholders in FSM.
4 Describe the relationship between sanitation and health.
5 Name the challenges in emergency sanitation and know how emergency sanitation can be addressed.
6 Be familiar with the latest developments in sustainable (on-site) sanitation solutions that can be applied in high density low income areas.

Assessments

%	Type	Name
15	Assignment	
85	Written examination (closed book)	

Topics

1 Faecal sludge management

Faecal sludge management (FSM) is incredibly important in sanitation. While the focus has been on the provision of toilets mainly in the light of the MDGs, the adequate collection and treatment of the remaining faecal sludge was not always a priority, to say the least. As so many factors play a role in faecal sludge management / climate, hardware, a vast number of stakeholders, willingness to pay, space to store and treat, groundwater pollution, different toilet types / a proper and well-functioning faecal sludge management system is hard to achieve. In this module we will address a holistic approach on FSM. There will be a focus on technology; however, technology cannot be seen separately from planning and management aspects; therefore, non-technical aspects will also be addressed in this module.

2 Public Health

3 Institutional Aspects

4 Collection and Transport

5 Emergency Sanitation

6 Co treatment

7 Sludge characterisation

8 Treatment Mechanisms

9 Operation and Maintenance

10 Financial Aspects

11 Slum sanitation

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Faecal sludge management	0	0	0	0	0	0	0	0	
2	Public Health	6	0	0	0	0	0	6	18	
3	Institutional Aspects	4	0	4	0	0	0	8	16	
4	Collection and Transport	6	0	0	0	0	0	6	18	
5	Emergency Sanitation	4	0	0	0	0	0	4	12	C.M. Hooijmans
6	Co treatment	2	0	0	0	0	0	2	6	C.M. Lopez Vazquez
7	Sludge characterisation	2	0	0	0	0	0	2	6	M. Ronteltap
8	Treatment Mechanisms	6	6	0	0	0	0	6	24	M. Ronteltap
9	Operation and Maintenance	4	0	0	0	0	0	4	12	M. Mulenga
10	Financial Aspects	6	0	0	0	0	0	6	18	
11	Slum sanitation	2	0	0	0	0	0	2	6	M. Ronteltap
	Total	42	6	4	0	0	0	46	136	

Education Material

Book	Faecal Sludge Management Book (IWA; Editors Linda Strande, Mariska Ronteltap, Damir Brdjanovic)
Handout	Handouts.

Scientific Software

SWMM

sobek-RUR

M3217

Faecal Sludge Management

Term	201718T11
Coordinator	S. Singh
Credit points	5.000000000
Specialization	Core Program

Target Group

This course is a specialist course fitting within Sanitary Engineering. It is designed for sanitary, civil / wastewater and environmental engineers who are facing challenges with faecal sludge. As on-site sanitation is by far the most applied sanitation technology, faecal sludge management is of paramount importance globally.

Prerequisites

Preceding modules in Sanitary Engineering; an interest in and working knowledge of the business of faecal sludge management help to bring this module to a good end.

Learning Objectives

1	Describe the way how excreta and faecal sludge are characterised.
2	Know which technologies can be applied for which type of faecal sludge (settling tanks, planted and unplanted drying beds, etc)
3	Name the key stakeholders in FSM.
5	Name the challenges in emergency sanitation and know how emergency sanitation can be addressed.
6	Be familiar with the latest developments in sustainable (on-site) sanitation solutions that can be applied in high density low income areas.

Assessments

%	Type	Name
100	Written examination (closed book)	

Topics

1 Faecal sludge management

Faecal sludge management (FSM) is incredibly important in sanitation. While the focus has been on the provision of toilets mainly in the light of the MDGs, the adequate collection and treatment of the remaining faecal sludge was not always a priority, to say the least. As so many factors play a role in faecal sludge management / climate, hardware, a vast number of stakeholders, willingness to pay, space to store and treat, groundwater pollution, different toilet types / a proper and well-functioning faecal sludge management system is hard to achieve. In this module we will address a holistic approach on FSM. There will be a focus on technology; however, technology cannot be seen separately from planning and management aspects; therefore, non-technical aspects will also be addressed in this module.

Topics

2 Quantification and characterisation

3 Collection, Transport, Onsite Sanitation systems

4 Treatment Mechanisms

5 FS co-treatment with wastewater

6 Emergency Sanitation

7 Sanitation Planning

8 Financial Aspects

9 Operation, Maintenance and Monitoring

10 Resource Recovery

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Faecal sludge management	0	0	0	0	0	0	0	0	
2	Quantification and characterisation	2	0	0	0	0	0	2	6	M. Ronteltap
3	Collection, Transport, Onsite Sanitation systems	6	0	2	0	0	0	8	20	D.M. Robbins
4	Treatment Mechanisms	4	0	0	0	0	0	4	12	M. Ronteltap
5	FS co-treatment with wastewater	2	0	0	0	0	0	2	6	C.M. Lopez Vazquez
6	Emergency Sanitation	4	0	2	0	0	0	6	14	C.M. Hooijmans
7	Sanitation Planning	4	0	4	0	0	0	8	16	C.E. Luethi
8	Financial Aspects	6	0	0	0	0	0	6	18	V.C.K.A.M. Post
9	Operation, Maintenance and Monitoring	4	0	0	0	0	0	4	12	M. Mulenga
10	Resource Recovery	3	0	3	0	0	0	6	12	C. Furlong
	Total	35	0	11	0	0	0	46	116	

Education Material

Book	Faecal Sludge Management Book (IWA; Editors Linda Strande, Mariska Ronteltap, Damir Brdjanovic)
Handout	Handouts.

Scientific Software

SWMM

sobek-RUR

M3251

Flood Protection in Lowland Areas

Term	201718T11
Coordinator	J.A. Roelvink
Credit points	5.000000000
Specialization	Core Program

Target Group

Prerequisites

Basic knowledge of hydraulics, basic knowledge of soil mechanics

Learning Objectives

1 carry out a basic design of dikes, revetments and closure dams

2 understand concepts and advances of flood risk management with due consideration of societal aspects, including flooding issues in the floodplain and coastal zone, management of flood risk, planning aspects and a variety of no structural measures

3 understand and apply concepts and advances in tools used for coastal flood modelling and flood forecasting

4 understand and apply the principles of flood frequency analysis and risk based approaches to design of hydraulic works

5 understand (the practical application of) probabilistic design theory

Assessments

%	Type	Name
0,4	Written examination (closed book)	Dikes and Revetments
0,2	Written examination (closed book)	Probabilistic Design
0,4	Assignment	Storm Impact Modelling

Topics

1 Dikes and Revetments

Seadikes in The Netherlands, philosophy of dike design, definition of frequency of failure, risk analysis, design methodology for dikes, hydraulic boundary conditions, wave run-up and overtopping, geometrical design of dikes and revetments, stability for rock, artificial units, design criteria for placed block revetment, other types (bituminous, asphalt.. etc), other design considerations, geotechnical aspects related to dikes, overall stability, design of granular filter, geotextiles, geosystems, improvement and maintenance of dikes and revetments, design of bottom protection, design methodology for closures; sand closures, stone closures, caisson closures.

2 Dikes and Revetments

Topics

3 Probabilistic design

Theoretical background of probability functions, practical application of probabilistic design, various levels of probability, examples of application of probabilistic design, the use of fault trees, exercise in the application of probabilistic design in coastal engineering problems.

4 Storm Impact modelling

This course focuses on prediction of flooding from the sea, due to tsunamis and storms. Subjects that are treated are causes, models, effects and warning systems related to tsunamis; storm types and characteristics in different areas in the world; storm surge and extreme wave modeling; storm erosion, overtopping and inundation modeling; predictive modeling vs. (probabilistic) modeling for design purposes. Case studies based on Katrina, Ivan, Sidr and the Indian Ocean tsunami. Hands-on exercises using Delft3D and XBeach.

5 Storm Impact modelling

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Dikes and Revetments	8	0	4	0	0	0	12	28	C. Dorst
2	Dikes and Revetments	12	0	0	0	0	0	12	36	J.H. van Dalen
3	Probabilistic design	6	0	6	0	0	0	12	24	M. Kok
4	Storm Impact modelling	6	0	5	0	0	0	11	23	J.A. Roelvink
5	Storm Impact modelling	8	0	5	0	0	0	13	29	M. van Ormondt
	Total	40	0	20	0	0	0	60	140	

Education Material

Handout	Groot, M.: Handouts, Geotechnical Aspects for Dikes, 2003
Handout	Handout: collection of tutorials and papers related to OpenEarth, Delft3D and XBeach applications
Handout	Hassan, R.M.: handouts, Dikes and Revetments, 2002
Lecture notes	Verhagen, H.J. : Design of closure of dams- Lecture notes ln0052/02
Lecture notes	Verhagen, H.J.: Revetments, Sea Dikes and River Levees-Lecture notes hh292/99/1
Lecture notes	Vrijling, J.K.: Probabilistic Design, Lecture notes ln0217/04/

Scientific Software

Delft3D

Matlab

Xbeach

M3233

Hydroinformatics for Decision Support

Term	201718T11
Coordinator	A. Jonoski
Credit points	5.000000000
Specialization	Core Program

Target Group

Participants from all Master Programmes of IHE Delft.

Prerequisites

Hydrological and hydraulic modelling concepts; Basic programming skills

Learning Objectives

1 Identify the role of system analysis in water resources planning and management
2 Formulate and solve water resources problems as optimisation problems
3 Distinguish and properly use different types of decision support methods for water problems
4 Build simple software applications that integrate data and models across Internet
5 Discuss challenges in integrating weather prediction and water models

Assessments

%	Type	Name
0,3	Assignment	Exercise report on Decision support systems
0,3	Assignment	Exercise report on Software technologies for integration
0,4	Assignment	Exercise report on Systems analysis in water resources

Topics

1 Systems analysis in water resources

Definition and role of systems analysis in engineering planning. Basic concepts. Linear and Dynamic programming for water resources problems. Development and use of static and dynamic stochastic simulation models of river systems. Introduction to decision support systems and their use. Exercises in multipurpose integrated river basin (or regional) water resources management modelling.

2 Decision support systems

Introduction to decision making process; objectives and alternatives. Optimisation in decision support (single and multi-objective0. Multi-attribute decision methods and tools: formulation of decision matrix, generating and using weights, compensatory and non-compensatory decision methods. Introduction to mDSS4 decision support software; exercises and assignments with case studies implemented in mDSS4.

Topics

3 Software technologies for integration

Introduction to methods and tools for software integration of models and data: Object-oriented integration approaches. Software integration across networks: Client-server programming, Web protocols, Web services.Technologies for integrating distributed resources: web-interfaces technologies; creating web-based and mobile phone applications with assignment exercise.

4 Integration of weather prediction and water models

Approaches and methods for integration of weather prediction with hydrological models. Challenges of temporal resolution, spatial scale, and accounting for uncertainty. Exercise in ensamble hydro-meteorological forecasts.

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Systems analysis in water resources	12	0	4	4	0	0	20	48	D.P. Loucks
2	Decision support systems	6	0	4	4	0	0	14	30	A. Jonoski, I.I. Popescu
3	Software technologies for integration	4	0	10	10	0	0	24	42	A. Jonoski, G.E. Espinoza Davalos, J.L. Alfonso Segura
4	Integration of weather prediction and water models	4	0	4	0	0	0	8	16	J.L. Alfonso Segura, S.J. van Andel
	Total	26	0	22	18	0	0	66	136	

Education Material

Digital files	A. Jonoski, L. Alfonso, G.E. Davalos, J. Craven: Handouts - Software technologies for Integration exercises
Digital files	A. Jonoski: Introduction to Decision Making and Decision Support Systems (PowerPoint Slides)
Digital files	A. Jonoski: Software Technologies for Integration (PowerPoint Slides)
Lecture notes	D.P. Loucks: Lecture Notes on Water Resource Systems Modelling: Its Role in Planning and Management (chapters 2, 3, 4, 10 and 11)
Handout	I.Popescu: Handout DSS exercises with mDSS4
Digital files	S.J van Andel: Integration of weather prediction and water models (PowerPoint Slides)
Digital files	Software for the subject Software technologies for integration: PMWin, Notepad++ text editor, Apache web server with PHP, Openlayers API, Phonegap

Scientific Software
Lingo
mDSS

M3207

IWRM as a Tool for Adaptation to Climate Change

Term	201718T11
Coordinator	E.D. de Ruijter van Steveninck
Credit points	5.000000000
Specialization	Core Program

Target Group

Students and professionals with an interest in the impacts of climate change on water sectors and how to adapt to uncertain future conditions.

Prerequisites

BSc or MSc in natural sciences, chemistry, environmental science, agriculture, geography, environmental economics, planning and management or engineering. Good conversational, reading and writing capabilities in the English language. Computer literacy. Professional experience in a relevant area is desirable.

Learning Objectives

1 describe the expected impacts of climate change on water resources and water use sectors in relation to (other) human activities

2 identify the consequences of the predicted impacts of climate change and climate variability for integrated water resources management

3 integrate climatic change conditions at different time and spatial scales into (risk) management in the water sector

4 justify decisions on adaption to the impacts of climate change under uncertainty

Assessments

%	Type	Name
70	Written examination (closed book)	Adaptation to climate change
0	Assignment	Data search
0	Attendance	Fieldtrip
30	Presentation	Water allocation in Climateland-Group presentation

Topics

1 IWRM, climate change and the hydrological cycle

Introduction into the concept of IWRM. The climate system and the causes of climate change and variability. Impacts of climate change on the hydrological cycle. Integrating IWRM and climate change.

2 Climate change: impacts and adaptation

Impacts of climate change on the environment and on water use sectors. Adaptation measures and economic aspects.

3 Vulnerability and adaptation under uncertainty

What determines vulnerability to climate change. Adaptation strategies how to adapt under a high level of uncertainty.

4 Institutional aspects and stakeholder participation

The importance of involving stakeholders in water management and climate change adaptation and strategies on involving stakeholders.

5 Multi sector/multicriteria decision making

Modelling effects of climate change on water resources using Climateland as a case study.

6 Country presentations

Presentations by participants covering impacts of climate change and adaptation measures in their countries/ regions.

7 Field trip

Field trip to Dordrecht and the Biesbosch. Adaptation to climate change in an urban setting and in a polder area.

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	IWRM, climate change and the hydrological cycle	6	0	3	0	0	0	9	21	E.D. de Ruijter van Steveninck, R. van Dorland, S. Maskey
2	Climate change: impacts and adaptation	17	0	7	0	0	0	24	58	C.M.S. de Fraiture, E.D. de Ruijter van Steveninck, F. van der Meulen, I.I. Popescu P.D.A. Pathirana, T.Y. Stigter, Y. Jiang
3	Vulnerability and adaptation under uncertainty	4	0	2	0	0	0	6	14	A.H.M. Bresser, E.D. de Ruijter van Steveninck
4	Institutional aspects and stakeholder participation	0	0	6	0	0	0	6	6	J.S. Kemerink - Seyoum
5	Multi sector/multicriteria decision making	0	0	28	0	0	0	28	28	J.W. Wenninger, R.G.W. Venneker
6	Country presentations	1	0	4	0	0	0	5	7	E.D. de Ruijter van Steveninck
7	Field trip	0	0	0	0	6	0	6	6	B. Gersonius, M.F. van Staveren
	Total	28	0	50	0	6	0	84	140	

Education Material

Digital files	Background reading
Handout	Climateland
Digital files	Copies of power point presentations

Scientific Software

WEAP

M3277

Modelling River Systems and Lakes

Term	201718T11
Coordinator	A. Cattapan
Credit points	5.000000000
Specialization	Core Program

Target Group

All participants in the WSE programme

Prerequisites

Hydrology and Hydraulics & Basic mathematics

Learning Objectives

1	Familiarize participants with structure of equations used to represent water phenomenas, numerical solution techniques and their representation in modelling systems and practical use of these.
2	Provide participants practical experience with standard models and develop an understanding of modelling in river and lake systems
3	Understanding rainfall run-off processes that will contribute to river flow and applying them to determine flow hydrographs as upstream conditions to a river
4	Develop critical assessment in assessing quality of model calibration and validation, verification and uncertainty

Assessments

%	Type	Name
0,2	Assignment	Assignment on hydrological modelling. (20% of the final mark)
0,2	Assignment	Assignment on modelling lakes. (20% of the final mark)
0,2	Assignment	Assignment on modelling rivers. (20% of the final mark)
0,4	Written examination (closed book)	Written exam on Computational Hydraulics. (40% of the final mark)

Topics

1 Computational Hydraulics

The course aims to introduce numerical aspects of modelling, so that students become aware of the limitations and characteristics of hydrodynamic numerical models. The course starts with a short overview of the differential equations used in hydraulics, principles of discretisation of shallow water equations in 1D and 2D. Further the concept of Courant number, stability and accuracy, will be introduced for both implicit and explicit schemes. Emphasis will be on river and lake applications and short wave propagation.

2 Modelling lakes

The objective of this component is for the students to acquire the ability to apply a numerical 3D hydrodynamic model to simulate water flow in lakes.

The software used in this part is MOHID.

"MOHID is a three-dimensional water modelling system, developed by MARETEC (Marine and Environmental Technology Research Center) at Instituto Superior Técnico (IST) which belongs to the Universidade de Lisboa in Portugal. **MOHID** has been applied to different study cases, as coastal and estuarine areas, as well as oceanic processes and reservoirs, and it has showed its ability to simulate complex features of the flows." [www.mohid.com]

3 Hydrological modelling

Students will gain practical experience in working with a hydrological model (HEC HMS) which simulates processes at basin scale and will allow them to integrate the outputs of their simulations with the software they are going to use for modelling rivers (HEC RAS), so to provide them with a complete modelling framework to solve practical problems they might encounter in their professional life.

"The Hydrologic Modeling System (HEC-HMS) is designed to simulate the complete hydrologic processes of dendritic watershed systems. The software includes many traditional hydrologic analysis procedures such as event infiltration, unit hydrographs, and hydrologic routing. HEC-HMS also includes procedures necessary for continuous simulation including evapo-transpiration, snowmelt, and soil moisture accounting." [http://www.hec.usace.army.mil/software/hec-hms/]

Topics

4 Modelling rivers

Students will gain practical experience in working with an hydrodynamic model (HEC RAS). Students will learn how to set up a model using georeferenced data for the definition of the geometry of the system (HEC GeoRAS) and how to model the presence of different types of structures (bridges, in-line and lateral structures, culverts, gates etc.). Depending on time availability they will also learn how to simulate the propagation of floods on floodplains using a combined 1D/2D approach. An introduction to model calibration and validation will also be provided.

"The HEC-RAS system contains several river analysis components for: (1) steady flow water surface profile computations; (2) one- and two-dimensional unsteady flow simulation; (3) movable boundary sediment transport computations; and (4) water quality analysis. A key element is, that all four components use a common geometric data representation and common geometric and hydraulic computation routines. In addition to these river analysis components, the system contains several hydraulic design features that can be invoked once the basic water surface profiles are computed." [http://www.hec.usace.army.mil/software/hec-ras/features.aspx]

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Computational Hydraulics	14	0	0	2	0	0	16	46	I.I. Popescu
2	Modelling lakes	2	0	0	16	0	0	18	38	F.A. Bastos da Cruz Martins
3	Hydrological modelling	2	0	0	10	0	0	12	26	B. Bhattacharya
4	Modelling rivers	0	0	0	16	0	0	16	32	A. Cattapan, I.I. Popescu
	Total	18	0	0	44	0	0	62	142	

Education Material

Handout	Handouts
Book	MOHID - Hydrodynamics user manual, 2009
Lecture notes	Martins, F., 2011: Modelling river and lakes using MOHID. UNESCO-IHE. Lecture notes
Lecture notes	Popescu, I., 2004: Differential Equations and Numerical Methods.UNESCO-IHE Lecture notes.

Scientific Software

ArcGIS
HEC-HMS
HEC-RAS
Mohid

M3237

Remote Sensing for Agricultural Water Management

Term	201718T11
Coordinator	P. Karimi
Credit points	5.000000000
Specialization	Core Program

Target Group

All WSE participants and from other programmes with specific interest.

Prerequisites

General knowledge about remote sensing and GIS.

Learning Objectives

1	The students will be able to explain RS theory, technology, typical applications, and be able to identify and download relevant RS data and products
2	The students will be able to pre-process, extract and analyse common indices, design and collect groundtruth points, and conduct land cover classification
3	The students will be able to extract biophysical, infrastructure and management features of agricultural system
4	The students will be able to explain the theory and implement pySEBAL model to estimate ET, yield, and WP
5	The students will be able to assess the irrigation performance using remote sensing, Interpret them to identify gaps, diagnose water management problems, and attribute to relevant factors for improvements
6	The students will be able to produce water accounts for an irrigation system using remote sensing information

Assessments

%	Type	Name
0,6	Assignment	Irrigation and remote sensing
0,4	Written examination (open book)	RS theory and applications

Topics

1 Introduction to Remote sensing

The subject will cover basics of RS, common data portals, satellites, and RS products.

Topics

2 Remote Sensing data analysis, groundtruthing, and land cover classification

Overview of RS data processing flow, common indices, and classification theory; Ground Truthing methods; Hands-on exercises (1) GT collection, (2) Landsat data pre-processing, extracting common indices, categorize them, and (3) Land cover classification and accuracy assessment

3 Mapping agricultural systems

Extracting biophysical, infrstructure and management features of an agricultural system

4 Remote sensing for Evapotransipration, yield and WP assessment (SEBAL)

Theory and implementation of pySEBAL model to estimate ET, yield, and WP

5 Remote sensing for enhancing performance of irrigation systems

Assessment of the irrigation performance using remote sensing, Interpret WP and other performance indicators results to identify gaps, diagnose water management problems, and attribute to relevant factors for improvements

6 Remote Sensing for Irrigation water Accounting

Producing water accounts for an irrigation system using remote sensing information

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Introduction to Remote sensing	6	0	2	0	0	0	8	20	P. Karimi, S. Pareeth, T.M. Hessels
2	Remote Sensing data analysis, groundtruthing, and land cover classification	6	0	4	0	0	0	10	22	S. Pareeth, X Cai
3	Mapping agricultural systems	4	0	2	0	0	0	6	14	X Cai
4	Remote sensing for Evapotransipration, yield and WP assessment (SEBAL)	6	0	8	0	0	0	14	26	J.D. van Opstal, M.L. Blatchford, S. Pareeth
5	Remote sensing for enhancing performance of irrigation systems	10	0	6	0	0	0	16	36	
6	Remote Sensing for Irrigation water Accounting	6	0	4	0	0	0	10	22	P. Karimi
	Total	38	0	26	0	0	0	64	140	

Education Material

Scientific journal	A remote sensing surface energy balance algorithm for land (SEBAL). 1. Formulation
Scientific journal	Diagnosing irrigation performance and water productivity through satellite remote sensing and secondary data in a large irrigation system of Pakistan
Scientific journal	Irrigation performance indicators based on remotely sensed data: a review of literature
Book	Tutorial: Fundamentals of Remote Sensing, http://www.nrcan.gc.ca/node/9309 (Open)
Book	Wegmann, M., B. Leutner, and S. Dech. Remote Sensing and GIS for Ecologists: Using Open Source Software. Data in the Wild. Pelagic Publishing, 2016

Scientific Software

QGis

M3270

Solid Waste Management

Term	201718T11
Coordinator	E.D. van Hullebusch
Credit points	5.000000000
Specialization	Core Program

Target Group

Engineers, scientists, academicians, staff from Non-Government Organizations, Community-based Organizations, politicians, health officials, students, teachers, local, regional or national government officials, etc., involved or interested in the management of solid waste.

Prerequisites

1. involvement in or more than average interested in one or more of the key elements of solid waste management, or
2. having studied the topic in a formal educational setting, or
3. being involved in teaching and/or research related to waste management.

Learning Objectives

1 suggest options for waste reduction at source so as to reduce quantities of waste generated;

2 choose from an array of options to turn waste into economic goods;

3 suggest treatment/disposal methods for waste from which the value has been taken out and to make basic calculations related to the conceptual design thereof;

4 assess the impact of waste and waste management on other environmental compartments;

5 roughly assess financial consequences of proposed management aspects in SWM;

6 conceptually develop a solid waste management scheme for an urban area.

Assessments

%	Type	Name
60	Written examination (open book)	MOODLE multiple choice
40	Assignment	All assignments together

Topics

1 Introduction

what is solid waste? what are the key problems (social, financial, environmental)? who are involved?

Topics

2 Waste collection & stakeholders

How/why is SW generated? how can generation be reduced? what are collection schemes & means, what means waste separation? at what point in the process? what are advantages? how can separation/reuse be stimulated?

3 Bioconversion processes

4 Composting & anaerobic digestion

5 Landfill processes

6 Landfill technology

What are main waste management technolgies? in more or in less developed countries? design elements, application areas? GHG issues

7 Mechanical biologial treatment

8 Incineration

9 Waste prevention & recycling

How much of our daily waste can be prevented or reduced? how would that impact upon the waste composition? What is the role of the waste generator, what is to be done to present 'clean' waste?

What are the options for collecting domestic waste? What systems exist?
What is the role of the public and private sector? What is the role of the informal sector? What are the benefits of waste recycling?

10 Finance & planning

11 Presentations

12 Assignments

13 Exam

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Introduction	0	0	4	0	0	0	4	4	C.D.M. Dupont
2	Waste collection & stakeholders	1	0	9	0	0	0	10	12	
3	Bioconversion processes	0	0	6	0	0	0	6	6	
4	Composting & anaerobic digestion	1	0	9	0	4	0	14	16	
5	Landfill processes	0	0	6	0	0	0	6	6	
6	Landfill technology	1	0	7	0	4	0	12	14	
7	Mechanical biologial treatment	1	0	5	0	0	0	6	8	
8	Incineration	1	0	7	0	0	0	8	10	
9	Waste prevention & recycling	1	0	5	0	2	0	8	10	
10	Finance & planning	0	0	12	0	0	0	12	12	
11	Presentations	0	0	4	0	0	0	4	4	
12	Assignments	0	24	0	0	0	0	0	24	
13	Exam	0	10	4	0	0	0	4	14	
	Total	6	34	78	0	10	0	94	140	

Education Material

Book	1) PPT's; reviewed paper; BOOK: Waste Technology and Management; BOOK: Vital waste statistics
Book	2) PPT's; reviewed paper; BOOK: From waste to resource; BOOK: Solid Waste Management in World Cities
Book	3) PPT's; reviewed paper; BOOK: Waste Technology and Management; Video: Anaerobic degradation processes
Book	4) PPT's; reviewed paper; BOOK: Waste Technology and Management; Video Bioreactor Landfill; UNEP SWM Landfill chapter
Book	5) PPT's; reviewed paper; BOOK: Waste Technology and Management
Book	6) PPT's; reviewed paper; BOOK: Waste Technology and Management

Scientific Software

M3211

Strategic Planning for River Basins and Deltas

Term	201718T11
Coordinator	J.G. Evers
Credit points	5.000000000
Specialization	Core Program

Target Group

Young and mid-career professionals (scientists, decision-makers) with a background in water management, environmental management, and / or watershed management.

Prerequisites

Affinity with integrated river basin / delta planning and management, spatial planning, hydrology, development economics, agronomy or geography (preferably a relevant environmental or water management / science / engineering related bachelor's degree or equivalent) and preferably experience in river basin management. Good command of English.

Learning Objectives

1 Understand strategic planning concepts and principles

2 Describe social-physical relations and interdependencies, in particular among water and environmental systems, and socio-economic development

3 Use of the concepts of adaptive and strategic planning and design for developing river basin management and development plans.

4 Use Strategic Environmental Assessment (SEA) as a planning tool for developing sustainable river basin management and development plans.

Assessments

%	Type	Name
50	Assignment	Groupwork: Case study
50	Written examination (closed book)	Written exam (closed book)

Topics

1 Introduction

In this session the participants are introduced to the modules learning objectives, learning activities , and the assessment (case study group assignment and written exam)

Topics

2 River basins as socio-physical systems

Human-water systems, driving forces and development dynamics, interdependencies of land use and development and water and environmental systems, complexity, cross-cutting models and modelling approaches, meta modelling.

3 Strategic planning and design for river basins and deltas

Strategic planning versus programming and project planning; tiering; issues of scale; spatial quality and design, land use planning; design methods from plan development to implementation; river basin/delta governance issues.

Strategic impact assessment, including environmental (SEA), economic and social impact assessment

4 Dealing with Uncertainties

Examples of key social, economic and physical uncertainties in river basin systems Concepts and methods for uncertainty identification and assessment, for system and policy design, and governance. This includes, for example, exploratory analysis, scenario planning, resilience and robustness, adaptive policy making and adaptation pathways.Uncertainties in strategic planning, concepts and methods for uncertainty identification and assessment, and for system and policy design. This includes, for example, exploratory analysis, scenario planning, resilience and robustness, and adaptive policy making.

5 Case study: groupwork assignment

During the course, students will work in small groups on integrated application of the concepts, theories and methods introduced in this course on a case. A case will be presented to the students to work and devleop a strategic plan for the area. Case options may include deltas and/or basins with different characteristics, such as heavy urbanisation; flooding problems; drought and water scarcity, subsidence, pollution and water quality, etc.

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Introduction	0	0	1	0	0	0	1	1	J.G. Evers, Y. Jiang
2	River basins as socio-physical systems	8	0	4	0	0	0	12	28	A. Mendoza - Sammet, J.G. Evers, W.A.H. Thissen, W.J.A.M. Douven, Y. Jiang
3	Strategic planning and design for river basins and deltas	8	0	4	0	0	0	12	28	A. Mendoza - Sammet, J.G. Evers, W.A.H. Thissen, W.J.A.M. Douven
4	Dealing with Uncertainties	8	0	4	0	0	0	12	28	A. Mendoza - Sammet, B. Gersonius, C. Zevenbergen, J.G. Evers, W.A.H. Thissen, W.J.A.M. Douven
5	Case study: groupwork assignment	0	55	0	0	0	0	0	55	A. Mendoza - Sammet, B. Gersonius, C. Zevenbergen, J.G. Evers, W.A.H. Thissen, W.J.A.M. Douven, Y. Jiang
	Total	24	55	13	0	0	0	37	140	

Education Material

Scientific journal	Additional reading materials
Lecture notes	Lecture Notes
Digital files	Lecture powerpoint slides

Scientific Software

M1568

Urban Water Governance

Term	201718T11
Coordinator	T. Acevedo Guerrero
Credit points	5.000000000
Specialization	Environmental Science and Technology

Target Group

The module is elective, and therefore open to all students within the WM stream, but it will build on key concepts introduced in the Water Governance core module. Students who have not taken this previous module will be expected to do additional reading to familiarize themselves with necessary terms and concepts. This module is run on the style of a seminar class. Students will be required to do the majority of work (reading, assignments) outside of class. Class time will then be used to discuss and debate what students have learned through self-study.

Prerequisites

Mandatory: High level of ability to read and discuss academic articles and book chapters in English; willingness to engage in social science theory and new conceptual frameworks; willingness to engage in cross-disciplinary discussions and applications.

Students outside the WM stream might take the module, but they will need to consult (have a short discussion with the coordinator) I am happily open to students registering in it from virtually any discipline. The key thing is that you love southern cities in all their speed and complexity. As AbdouMaliq Simone (in his 2004 epic For the City Yet to Come, p. 1) puts it:"African cities are works in progress, at the same time exceedingly creative and extremely stalled. In city after city, one can witness an incessant throbbing produced by the intense proximity of hundreds of activities: cooking, reciting, selling, loading and unloading, fighting, praying, relaxing, pounding, and buying, all side by side on stages too cramped, too deteriorated, too cloged with waste, history, and disparate energy, and sweat to sustain all of them. And yet they persist".

Learning Objectives

1 Define key terms: the "urban", "urban waters", "governance", according to assigned readings, learning activities, and class lectures;

2 Identify implications of the above definitions for urban water governance (how to define and diagnose; identify stakeholders);

3 Analyze the ways in which urban waters channel the politics of the city in presented case studies.

Assessments

%	Type	Name
30	Assignment	3 pre-class written assignments topics 1,2,3

30	Assignment	Final Essay
40	Assignment	Groupwork

Topics

1 Introduction to the module

2 Refresher: water governance

3 Urban futures

What conditions characterize current and future urban conditions, in terms of ecological sustainability and social equity?

4 What is the urban?

How do we define the urban as something more than a spatial category, and what does thinking about the urban as a process imply for thinking about water?

5 Case study: planetary urbanization

6 What is the Southern urban?

What is a southern urbanism; what conditions characterize processes happening in the global South; how do we need to think - and intervene - in Southern cities differently than in the North?

7 Case study: water in the southern city

8 The politics of water in the southern city

9 What then is urban water governance?

What are the implications for how we rethink the urban, and southern cities, for how we think about governing water in cities?

10 What then is urban water governance?

What are the implications for how we rethink the urban, and southern cities, for how we think about governing water in cities?

11 Tutorial

12 Individual and group assignments

13 Essay assignment

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Introduction to the module	1	0	0	0	0	0	1	3	M.E. Kooy
2	Refresher: water governance	1	0	0	0	0	0	1	3	M.E. Kooy
3	Urban futures	2	0	0	0	0	0	2	6	M.E. Kooy
4	What is the urban?	2	0	0	0	0	0	2	6	M.E. Kooy
5	Case study: planetary urbanization	2	0	0	0	0	0	2	6	
6	What is the Southern urban?	2	0	0	0	0	0	2	6	M.E. Kooy
7	Case study: water in the southern city	3	0	0	0	0	0	3	9	M.E. Kooy
8	The politics of water in the southern city	3	0	0	0	0	0	3	9	M.E. Kooy
9	What then is urban water governance?	2	0	0	0	0	0	2	6	M.E. Kooy
10	What then is urban water governance?	2	0	0	0	0	0	2	6	M.E. Kooy
11	Tutorial	0	1	0	0	0	0	0	1	
12	Individual and group assignments	0	48	0	0	0	0	0	48	
13	Essay assignment	0	30	0	0	0	0	0	30	
	Total	20	79	0	0	0	0	20	139	

Education Material

Scientific Software

M3261

Urban Water Governance

Term	201718T11
Coordinator	T. Acevedo Guerrero
Credit points	5.000000000
Specialization	Core Program

Target Group

The module is elective, and therefore open to all students within the WM stream, but it will build on key concepts introduced in the Water Governance core module. Students who have not taken this previous module will be expected to do additional reading to familiarize themselves with necessary terms and concepts. This module is run on the style of a seminar class. Students will be required to do the majority of work (reading, assignments) outside of class. Class time will then be used to discuss and debate what students have learned through self-study.

Prerequisites

Mandatory: High level of ability to read and discuss academic articles and book chapters in English; willingness to engage in social science theory and new conceptual frameworks; willingness to engage in cross-disciplinary discussions and applications.

Students outside the WM stream might take the module, but they will need to consult (have a short discussion with the coordinator) I am happily open to students registering in it from virtually any discipline. The key thing is that you love southern cities in all their speed and complexity. As AbdouMaliq Simone (in his 2004 epic For the City Yet to Come, p. 1) puts it:"African cities are works in progress, at the same time exceedingly creative and extremely stalled. In city after city, one can witness an incessant throbbing produced by the intense proximity of hundreds of activities: cooking, reciting, selling, loading and unloading, fighting, praying, relaxing, pounding, and buying, all side by side on stages too cramped, too deteriorated, too cloged with waste, history, and disparate energy, and sweat to sustain all of them. And yet they persist".

Learning Objectives

1 Identify the significance of the urban transformation for water governance
2 Analyze water access and quality in relation to social, economic, and demographic factors
3 Analyze water access and quality in relation to biophysical conditions and infrastructures
4 Identify/compare conceptual tools to understand urban water justice
5 Analyse urban water governance in the light of justice concerns

Assessments

%	Type	Name
30	Assignment	Daily attendance, rich picture, reading circus & study case (10% x 4) 40%

30	Assignment	Final paper: Critical analysis of urban water policy 30%
40	Assignment	Group work, handout and presentation 30%

Topics

1 Cities, citizenship, and growing inequality

Lecture: What is a city? How/why are cities becoming more unequal?

Rich picture: students organized in groups read news articles on each case study to develop a vision (poster, collage) on different types of urban segregations/inequalities. Then they present it.

Possible case studies Paris, France; Madrid, Spain; Winnipeg, Canada; Detroit, USA; Bogotá, Colombia; Mongolia; Luanda, Angola; Johannesburg, South Africa; Ahmedabad, India; Riyadh, Saudi Arabia

https://www.theguardian.com/inequality/datablog/2017/apr/26/inequality-index-where-are-the-worlds-most-unequal-countries

https://www.theguardian.com/cities/2015/oct/28/which-is-the-worlds-most-segregated-city

Introduction to the module: learning objectives, rules of the game, assessments, schedule.

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Williams, B. 2001. A River Runs Through Us. *American Anthropologist*, Vol. 103, No. 2 (Jun., 2001), pp. 409-431

Topics

2 Relating urban waters, justice, and governance

Memories of last session

Reflexion: Urban water governance, why urban water governance instead of only water governance?

Lecture: Defining, researching, and struggling for water justice

Margreet Zwarteveen

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Zwarteveen, M. & R. Boelens (2014) Defining, researching, and struggling for water justice: some conceptual building blocks for research and action, *Water International,* 39(2), 143-158

Reading circus:

– At home: groups of 4 students read 1 article together and must be able to explain this to others (by preparing a hand out)

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Wutich, A 2009, 'Intrahousehold disparities in women and men's experiences of water insecurity and emotional distress in urban Bolivia', Medical Anthropology Quarterly, vol. 23, no. 4, pp. 436-454.

Truelove, Y. (2011) (Re-)Conceptualizing water inequality in Delhi, India through a feminist political ecology framework. Geoforum, 42(2): 143-152.

Sultana, F 2011, 'Suffering for water, suffering from water: emotional geographies of resource access, control and conflict', Geoforum, vol. 42, no. 2, pp.163-172.

Topics

3 Questions of gender in urban water

Memories of last session

Lecture – Questions of gender in water storage: the case of zika in Latin America and the Caribbean

Reading circus:

– In class: groups are split into 4 teaching groups (each teaching group having one representative of the expert groups): each member explains the particular reading to the others

Presenting a study case:

– At home: 3 groups of students explore 1 study case together and must be able to explain this to others (by preparing a short presentation)

Study Case: Flint, USA

Ranganathan, M 2016, 'Thinking with Flint: Racial liberalism and the roots of an American water tragedy', Capitalism Nature Socialism, vol. 27, no. 3, pp. 17-33.

Lin, J, J. Rutter & H. Park, 2016, 'Events that Led to Flint's Water Crisis' The New York Times, http://www.nytimes.com/interactive/2016/01/21/us/flint-lead-water-timeline.html?_r=0 (last visited Mar 15, 2016).

Case Study: Accra, Ghana

Mahama, AM, Anaman KA & Osei-Akoto I 2014, 'Factors influencing householders' access to improved water in low income areas in Accra, Ghana', Water and Health, vol. 12, no. 2, pp. 318 - 331.

Case Study: Khayelitsha, South Africa

Rodina, L & L. M. Harris (2016). Water Services, Lived Citizenship, and Notions of the State in Marginalised Urban Spaces: The case of Khayelitsha, South Africa. Water Alternatives 9(2): 336-355.

Topics

4 Income, race, and other intersectional factors reflected in/reinforced through urban water flows

Memories of last session

Lecture: Income, race and other intersectional factors

Presenting a study case:

– In class: Presentations

5 Biophysical conditions and other material considerations

Memories of last session

Lecture: Flooding, droughts, climate change, and other material considerations

Lecture: The case of post-colonial infrastructure

Michelle Kooy

-

Kooy, M, & Bakker, K 2008, ‘Splintered networks: The colonial and contemporary waters of Jakarta’, Geoforum, vol. 39, no. 6, pp. 1843–1858.

Topics

6 Intellectual traditions to understand water justice

Memories of last session

Lecture: Urban Political Ecology & hydro-politics

Video: Maria Kaika – What is UPE?

https://www.youtube.com/watch?v=Z5PRfxNUBao

https://vimeo.com/180669461

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Swyngedouw, E. 1997. “Power, nature, and the city: The conquest of water and the political ecology of urbanization in Guayaquil, Ecuador, 1880-1990”. Environment and Planning A, 29 (2): 311-332.

7 Tutorial

Tutorial for group work: water security, hydro-social cycle, & the human right to water

8 Conceptual tools to understand water justice

Conceptual tools to understand water justice

GROPUWORK

9 Water security, hydro-social cycle, & the human right to water

Lecture: Recapitulating concepts - water security, hydro-social cycle, & the human right to water

Lecture: Tutorial on final essay

Topics

10 Shifting water governance in light of justice concerns

Lecture. Water privatization in Metro Manila; assessing the state of equitable water provision

Phil Torio

Waste Land - documentary

Located just outside Rio de Janeiro, Jardim Gramacho, Brazil, is the world's largest garbage landfill. Modern artist Vik Muniz works with the so-called catadores, the men and women who pick through the refuse, to create art out of recycled materials. Muniz selects six of the garbage pickers to pose as subjects in a series of photographs mimicking famous paintings. In his desire to assist the catadores and change their lives, Muniz finds himself changed as well.

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Bakker, K. 2007. “Trickle Down? Private sector participation and the pro-poor water supply debate in Jakarta, Indonesia”. Geoforum, 38 (5): 855-868.

11 The right to the city

Memories of last session

Lecture. Reading David Harvey

Lecture. Sanitation Alternatives for a just city.. yet to come

Claire Furlong

-

Harvey, D. 2008. The Right to the City. New Left Review 53: Available at: http://newleftreview.org/II/53/david-harvey-the-right-to-the-city

Topics

12 Thinking with water

Fieldtrip: Exhibition Water ZomerExpo 2017 - Museum de Fundatie, Zwolle and the Castle Nijenhuis, Heino-Wijhe (Overijssel).

13 Recapitulating concepts: hydro-social cycle

Thinking with water: short fieldtrip discussion

Memories of last session - Recapitulating concepts: hydro-social cycle

Round table: Hydro-politics and the hydrosocial cycle

Jessica Budds

University of East Anglia

Topics

14 Alternatives amongst the “crisis of imagination”

Visiting Lecturer: Araceli Rojas, Universiteit Leiden

Ancient water technology of streams, springs and runoffs

Closing reflection: Alternatives amongst the “crisis of imagination”

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Walker, B. (2010) Toxic archipelago: a history of industrial disease in Japan. Seattle: University of Washington Press, 2010. (conclusion)

Draft + Bibliography for final essay

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Cities, citizenship, and growing inequality	1	0	0	0	0	0	1	3	T. Acevedo Guerrero
2	Relating urban waters, justice, and governance	1	0	0	0	0	0	1	3	M.Z. Zwarteveen, T. Acevedo Guerrero
3	Questions of gender in urban water	2	0	0	0	0	0	2	6	T. Acevedo Guerrero
4	Income, race, and other intersectional factors reflected in/reinforced through urban water flows	2	0	0	0	0	0	2	6	T. Acevedo Guerrero
5	Biophysical conditions and other material considerations	2	0	0	0	0	0	2	6	M.E. Kooy
6	Intellectual traditions to understand water justice	2	0	0	0	0	0	2	6	T. Acevedo Guerrero
7	Tutorial	3	0	0	0	0	0	3	9	M.E. Kooy, T. Acevedo Guerrero
8	Conceptual tools to understand water justice	3	0	0	0	0	0	3	9	T. Acevedo Guerrero
9	Water security, hydro-social cycle, & the human right to water	2	0	0	0	0	0	2	6	M.E. Kooy, T. Acevedo Guerrero
10	Shifting water governance in light of justice concerns	2	0	0	0	0	0	2	6	
11	The right to the city	0	1	0	0	0	0	0	1	C. Furlong, T. Acevedo Guerrero
12	Thinking with water	0	48	0	0	0	0	0	48	M.E. Kooy, T. Acevedo Guerrero
13	Recapitulating concepts: hydro-social cycle	0	30	0	0	0	0	0	30	T. Acevedo Guerrero
14	Alternatives amongst the “crisis of imagination”	0	0	0	0	0	0	0	0	M.E. Kooy, T. Acevedo Guerrero
	Total	20	79	0	0	0	0	20	139	

Education Material

Handout Students are provided a Handout on Urban Water Governance

Scientific Software

M3048

Water Sensitive Cities

Term	201718T11
Coordinator	P.D.A. Pathirana
Credit points	5.000000000
Specialization	Core Program

Target Group

All participants and external professionals dealing with urban water and flood risk management working for municipalities, water management organisation, consulting firms, educational institutions and NGOs.

Prerequisites

BSc degree in Engineering or Social Sciences background; basic knowledge of urban water and flood risk management; good command of English.

Learning Objectives

1 Describe the historical transition of cities from the viewpoint of water management. List salient features of that transition (both positive and negative). (ILO1:History)

2 Argue that the three main components of the urban water cycle (UWC) management are interdependent. Describe the interactions with other important aspects of UWC like groundwater, urban atmosphere, etc., and how they affect each. (ILO2:Integration)

3 Identify interactions between water system components, while following 'thematic' topics (e.g. urban hydrology, water transport and distribution). Describe how to exploit such interactions to enhance livability, sustainability and resilience of cities.

4 Argue that considering multiple aspects of the water systems could provide opportunities to add extra value and create substantial additional benefits related to water management projects. Estimate such benefits using toolkits. (ILO4:MultipleValues)

5 Illustrate the importance of 'mainstreaming' water sensitive elements to general urban development process. Describe concrete examples (real-world and hypothetical) of such mainstreaming. (ILO5: Mainstreaming)

6 Analyse the stakeholder involvement in the management of water in city. Argue that for effective embedding of water-sensitive features to urban development, stakeholders should also include traditionally 'non-water' domains. (ILO6:Stakeholders)

7 Reflect on the relationship of WSC principals and practice to existing cities and their sub-components (e.g. neighbourhoods). Propose (conceptual) next steps in moving towards a more water-sensitive state for a given concrete case-study. (ILO7:Vision)

Assessments

%	Type	Name
50	Assignment	Case study reflection reports
25	Oral examination	
25	Presentation	

Topics

T1 Introduction to water sensitive cities

This module's structure is quite different from the 'traditional model' of teaching modules here at IHE. The Learning objectives are realized via a series of 'Cast Studies' (between 10 and 14) each taking a half a day or full day. Each case study has a hands-on, workshop type part as well.

This section which precedes those case studies describe:

1. What is a water sensitive city? Why it is important? How cities can strive to arrive at more water sensitive states?

2. The components of the urban water cycle (Water supply, Surface/storm water system, Wastewater system + groundwater), each as a brief inroduction and how they interact with each other and the borader urban processes that are outside the domain of water.

T2 Case studies (change every year)

List of case studies. Each case study has

1. Lecture/discussion part

2. Workshp - hands-on part.

Since the number and content of the case studies change every year this section represents the 'collection' of the case studies.

T3 Field trip

In most years, the module has a one day field trip.

T4 Final presentations

Here students present their own impressions about the concept of WSC, its implementation, challenges, suitability, etc. They do peer-assessment.

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
T1	Introduction to water sensitive cities	8	0	0	0	0	0	8	24	P.D.A. Pathirana
T2	Case studies (change every year)	28	12	28	0	0	0	56	124	
T3	Field trip	0	0	0	0	8	0	8	8	P.D.A. Pathirana, W. Veerbeek
T4	Final presentations	0	0	4	0	0	0	4	4	M. Radhakrishnan, P.D.A. Pathirana
	Total	36	12	32	0	8	0	76	160	

Education Material

Lecture notes	Every year a set of scientific papers, reports and book chapters will be provided in addition to the slides used in the class.

Scientific Software

M3214

Wetlands for Livelihoods and Conservation

Term	201718T11
Coordinator	E.M.A. Hes
Credit points	5.000000000
Specialization	Core Program

Target Group

Programme target group

Prerequisites

Programme prerequisites

Learning Objectives

1 understand the framework of ecosystem functions and services, and means of assessing it
2 develop adaptive management for wetlands in response to change
3 analyse the socioecological system by applying DPSIR and Agency Network Analysis
4 assess the state of the wetland ecosystem on the basis of HydroGeoMorphological units and applying WETHealth
5 develop and carry out stakeholder interviews and surveys
6 conduct and communicate a research project.

Assessments

%	Type	Name
10	Presentation	Group presentation
10	Attendance	Individual performance during fieldweek
80	Assignment	Individual research assignment (report)

Topics

1 Ecosystem services framework

2 Wetland Assessment

3 Driver Pressure State Impact Response

4 Agency Network Analysis

5 Stakeholder Analysis and Participatory Approaches

6 Research Assignment

7 Group Presentation

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Ecosystem services framework	8	0	4	0	0	0	12	28	A.A. van Dam, E.M.A. Hes, K.A. Irvine
2	Wetland Assessment	4	0	2	0	8	0	14	22	A.A. van Dam, E.M.A. Hes
3	Driver Pressure State Impact Response	2	0	2	0	4	0	8	12	E.M.A. Hes
4	Agency Network Analysis	4	0	4	0	6	0	14	22	L.E. Charli Joseph
5	Stakeholder Analysis and Participatory Approaches	4	0	2	0	6	0	12	20	G.J.M. Gevers
6	Research Assignment	0	24	0	0	6	0	6	30	E.M.A. Hes, G.J.M. Gevers, L.E. Charli Joseph
7	Group Presentation	0	0	0	0	6	0	6	6	E.M.A. Hes, G.J.M. Gevers, L.E. Charli Joseph
	Total	22	24	14	0	36	0	72	140	

Education Material

Scientific Software

M3318

Wetlands for Livelihoods and Conservation for LWM

Term	201718T11
Coordinator	E.M.A. Hes
Credit points	5.600000000
Specialization	

Target Group

Programme target group

Prerequisites

Programme prerequisites

Learning Objectives

1 understand the framework of ecosystem functions and services, and means of assessing it
2 develop adaptive management for wetlands in response to change
3 analyse the socioecological system by applying DPSIR and Agency Network Analysis
4 assess the state of the wetland ecosystem on the basis of HydroGeoMorphological units and applying WETHealth
5 develop and carry out stakeholder interviews and surveys
6 conduct and communicate a research project.

Assessments

%	Type	Name
10	Presentation	Group presentation
10	Attendance	Individual performance during fieldweek
80	Assignment	Individual research assignment (report)

Topics

1 **Ecosystem services framework**
2 **Wetland Assessment**
3 **Driver Pressure State Impact Response**
4 **Agency Network Analysis**
5 **Stakeholder Analysis and Participatory Approaches**
6 **Research Assignment**

Topics

7 Group Presentation

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Ecosystem services framework	8	0	4	0	0	0	12	28	A.A. van Dam, E.M.A. Hes, K.A. Irvine
2	Wetland Assessment	4	0	2	0	8	0	14	22	A.A. van Dam, E.M.A. Hes
3	Driver Pressure State Impact Response	2	0	2	0	4	0	8	12	E.M.A. Hes
4	Agency Network Analysis	4	0	4	0	6	0	14	22	L.E. Charli Joseph
5	Stakeholder Analysis and Participatory Approaches	4	0	2	0	6	0	12	20	G.J.M. Gevers
6	Research Assignment	0	24	0	0	6	0	6	30	E.M.A. Hes, G.J.M. Gevers, L.E. Charli Joseph
7	Group Presentation	0	0	0	0	6	0	6	6	E.M.A. Hes, G.J.M. Gevers, L.E. Charli Joseph
	Total	22	24	14	0	36	0	72	140	

Education Material

Scientific Software

M3197

Groupwork ES

Term	201718T13
Coordinator	A.L. Zuijdgeest
Credit points	5.000000000
Specialization	Core Program

Target Group

Students and professionals with an interest in environmental sciences and in maintaining environmental integrity to support human development.

Prerequisites

BSc or MSc in natural sciences, chemistry, environmental science, agriculture, geography, environmental economics, planning and management or engineering. Good conversational, reading and writing capabilities in the English language. Computer literacy. Professional experience in a relevant area is desirable.

Learning Objectives

1 Solve complex environmental problems by integrating the content of the preceding modules
2 Make decisions on the basis of a limited amount of information
3 Work in a team to solve complex environmental problems

Assessments

%	Type	Name
50	Assignment	Group assignments
50	Assignment	Individual assignments

Topics

1 Introduction

Rur: past, present, future

The groupwork consists of a case study in which the techniques and knowledge obtained in the preceding modules are integrated. The Rur catchment, visited during the Foreign Fieldtrip and Fieldwork in Module 9, has faced various environmental problems in the past, and is facing several future challenges. During the groupwork, the participants will address several of these problems.

2 Progress meetings with IHE staff

3 Presentations

Sessions for intermediate and final presentations

4 Working in groups on assignments

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Introduction	0	0	2	0	0	0	2	2	A. Mendoza - Sammet, A.L. Zuijdgeest, J.L.C.M. van de Vossenberg, N.P. van der Steen
2	Progress meetings with IHE staff	0	0	6	0	0	0	6	6	A. Mendoza - Sammet, A.L. Zuijdgeest, J.L.C.M. van de Vossenberg, N.P. van der Steen
3	Presentations	0	0	16	0	0	0	16	16	A. Mendoza - Sammet, A.L. Zuijdgeest, J.L.C.M. van de Vossenberg, N.P. van der Steen
4	Working in groups on assignments	0	116	0	0	0	0	0	116	A. Mendoza - Sammet, A.L. Zuijdgeest, J.L.C.M. van de Vossenberg, N.P. van der Steen
	Total	0	116	24	0	0	0	24	140	

Education Material

Handout	Handout "Rur: past, present, future"
Digital files	Selected literature is available

Scientific Software

M3317

Groupwork ES for LWM

Term	201718T13
Coordinator	A.L. Zuijdgeest
Credit points	5.600000000
Specialization	Limnology and Wetland Management

Target Group

Students and professionals with an interest in environmental sciences and in maintaining environmental integrity to support human development.

Prerequisites

BSc or MSc in natural sciences, chemistry, environmental science, agriculture, geography, environmental economics, planning and management or engineering. Good conversational, reading and writing capabilities in the English language. Computer literacy. Professional experience in a relevant area is desirable.

Learning Objectives

1 Solve complex environmental problems by integrating the content of the preceding modules
2 Make decisions on the basis of a limited amount of information
3 Work in a team to solve complex environmental problems

Assessments

%	Type	Name
50	Assignment	Group assignments
50	Assignment	Individual assignments

Topics

1 Introduction

Rur: past, present, future

The groupwork consists of a case study in which the techniques and knowledge obtained in the preceding modules are integrated. The Rur catchment, visited during the Foreign Fieldtrip and Fieldwork in Module 9, has faced various environmental problems in the past, and is facing several future challenges. During the groupwork, the participants will address several of these problems.

2 Progress meetings with IHE staff

3 Presentations

Sessions for intermediate and final presentations

4 Working in groups on assignments

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Introduction	0	0	2	0	0	0	2	2	A. Mendoza - Sammet, A.L. Zuijdgeest, J.L.C.M. van de Vossenberg, N.P. van der Steen
2	Progress meetings with IHE staff	0	0	6	0	0	0	6	6	A. Mendoza - Sammet, A.L. Zuijdgeest, J.L.C.M. van de Vossenberg, N.P. van der Steen
3	Presentations	0	0	16	0	0	0	16	16	A. Mendoza - Sammet, A.L. Zuijdgeest, J.L.C.M. van de Vossenberg, N.P. van der Steen
4	Working in groups on assignments	0	116	0	0	0	0	0	116	A. Mendoza - Sammet, A.L. Zuijdgeest, J.L.C.M. van de Vossenberg, N.P. van der Steen
	Total	0	116	24	0	0	0	24	140	

Education Material

Handout	Handout "Rur: past, present, future"
Digital files	Selected literature is available

Scientific Software

M3283

Thesis Research Proposal Development for ES

Term	201718T14
Coordinator	A. Mendoza - Sammet
Credit points	9.000000000
Specialization	Core Program

Target Group

All students of the Environmental Science programme

Prerequisites

Learning Objectives

1 concisely define the intended research topic, state precise aims and objectives, describe the research methodology, argue expected relevance and justification, and identify boundary conditions and self- or externally imposed limitations;

2 list available literature and replicate main arguments expounded in the literature on the specified research topic;

3 demonstrate analytical problem-analysis skills and the ability to distil the strategic issues to be addressed in the research phase;

4 plan the research process in weekly time-steps and indicate essential milestones, targets and indicators, required human, financial and other resources, deliverables and perceived threats and constraints at each stage of the research project;

5 develop and formulate the research proposal in a clearly written, well argued and convincing report, submitted within a set deadline;

6 develop and formulate the research proposal in a clearly written, well argued and convincing report, submitted within a set deadline; successfully present and defend individual work, cross-reference it to and critically evaluate in light of contem

Assessments

%	Type	Name
100	Assignment	Research proposal

Topics

1 General Introduction

2 Introduction for ES participants

3 Selection of Research Topic

The initial research topic of study will be selected in a consultative process with a mentor, the MSc coordinator and a professor.

Topics

4 Exercise developing research questions

5 Critical Reading Exercise

6 Proposal Drafting

Research is likely to be based primarily on a review of selected literature, to a limited extent other methods of data gathering and analysis may also be applied (e.g. interviews, laboratory and field work, computer modelling, expert consultations, etc). One hour weekly meetings with the tutor form the main stay of the proposal development process. It is however expected that the MSc candidate will be self-motivated and pro-active, taking all necessary initiatives to reach the set target in a timely fashion.

7 Proposal Presentation

The resulting proposal will be presented in written form and orally defended before an audience of critical peers and a panel of staff members.

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	General Introduction	3	0	0	0	0	0	3	9	C.M.S. de Fraiture
2	Introduction for ES participants	0	2	0	0	0	0	0	2	J.J.A. van Bruggen
3	Selection of Research Topic	0	4	0	0	0	0	0	4	
4	Exercise developing research questions	0	0	4	0	0	0	4	4	A. Mendoza - Sammet, E.R. Raj, J.J.A. van Bruggen, J.L.C.M. van de Vossenberg
5	Critical Reading Exercise	0	0	6	0	0	0	6	6	A. Mendoza - Sammet, E.R. Raj, J.L.C.M. van de Vossenberg
6	Proposal Drafting	0	221	0	0	0	0	0	221	
7	Proposal Presentation	0	4	0	0	0	0	0	4	
	Total	3	231	10	0	0	0	13	250	

Education Material

Scientific Software

M2927

MSc research, thesis and defence

Term	201718T15
Coordinator	E.A. de Jong
Credit points	36.000000000
Specialization	Core Program

Target Group

All students of the MSc programmes

Prerequisites

Learning Objectives

1 Explore the background of the research problem by critically reviewing scientific literature; Evaluate relevant theories and applying these theories to a relevant scientific problem; Assure adequate delineation and definition o the research topic

2 Formulate research questions and hypotheses

3 Conduct research, independently or in a multidisciplinary team by selecting and applying appropriate research methodologies and techniques, collecting and analysing data.

4 Formulate well-founded conclusions and recommendations based on a comprehensive discussion of the results.

5 Demonstrate academic attitude and learning skills (incl thinking in multidisciplinary dimensions & distinguishing main issues from minor ones), to enhance & keep up-to-date the acquired knowledge and application skills in a largely independent manner.

6 Communicate, debate and defend, clearly and systematically, findings and generated insights, and provide rationa underpinning of these in oral and written presentations to a variety of audiences.

Assessments

%	Type	Name
100	Presentation	Defence

Topics

Study load

Nr	Topic		Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
		Total	0	0	0	0	0	0	0	0	

Education Material

Scientific Software

M3319

MSc research, thesis and defence for LWM

Term	201718T15
Coordinator	E.A. de Jong
Credit points	30.000000000
Specialization	Limnology and Wetland Management

Target Group

All students of the MSc programmes

Prerequisites

Learning Objectives

1	Explore the background of the research problem by critically reviewing scientific literature; Evaluate relevant theories and applying these theories to a relevant scientific problem; Assure adequate delineation and definition o the research topic
2	Formulate research questions and hypotheses
3	Conduct research, independently or in a multidisciplinary team by selecting and applying appropriate research methodologies and techniques, collecting and analysing data.
4	Formulate well-founded conclusions and recommendations based on a comprehensive discussion of the results.
5	Demonstrate academic attitude and learning skills (incl thinking in multidisciplinary dimensions & distinguishing main issues from minor ones), to enhance & keep up-to-date the acquired knowledge and application skills in a largely independent manner.
6	Communicate, debate and defend, clearly and systematically, findings and generated insights, and provide rationa underpinning of these in oral and written presentations to a variety of audiences.

Assessments

%	Type	Name
100	Presentation	Defence

Topics

Study load

Nr	Topic		Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
		Total	0	0	0	0	0	0	0	0	

Education Material

Scientific Software