UNESCO-IHE
Institute for Water Education

MASTER PROGRAMME UWS 2016-2018

UWS General description UNESCO-IHE

Study guide part 1

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1 UNESCO-IHE

1.1 Introduction

UNESCO-IHE 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.

In November 2001, UNESCO's 31st General Conference decided to make IHE an integral part of the Organisation. By March 2003, the necessary treaties and agreements between the IHE Delft Foundation, UNESCO and the Netherlands Government were signed, allowing for the entry into operation of the new UNESCO-IHE Institute for Water Education. UNESCO-IHE is governed by a thirteen-member Governing Board appointed by the Director General, and is managed by a Director and Deputy Director. The IHE Delft Foundation provides all other staff and facilities to UNESCO-IHE.

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.

UNESCO-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 WL/Delft Hydraulics, GeoDelft, and The Netherlands Organisation for Applied Scientific Research are situated nearby. UNESCO-IHE 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
- 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

UNESCO-IHE 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 UNESCO-IHE together with a Dutch university. Candidates should preferably hold a UNESCO-IHE 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. The organisation is structured into departments, which are further subdivided into various sections. Within the organisation structure, three academic departments are distinguished:

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

These departments have one or more academic cores in the major fields, each with a leading professor, who is assisted by academic staff and research fellows. Process management support units and a education bureau provide administrative support.

Besides the academic staff of UNESCO-IHE, 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 Master of Science Degree Programmes

The Institute provides 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
- the master programme in Water Science and Engineering.

These programmes have a nominal duration of 18 months and are leading towards a Master of Science (MSc) degree in the respective field upon successful completion. Each programme has several distinct specialisations, in which students follow a programme curriculum best suited to their preference.

The minimum study load of the programmes is 106 credit points, expressed in units defined by the European Credit Transfer and Accumulation System (ECTS).

2.2 Academic Regulations

The *Education and Examination Regulations* (separately included in this handbook) provide the basic data of the programme, including the major rules around the examinations and the rights of students to inspect the results of the examination assessment.

The 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.

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

2.3 Structure of the Programmes

The curriculum follows 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 is formed by 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 defense, followed by a period of six months of individual research and writing of the thesis. The MSc thesis is defended publically at the end.

2.4 Curriculum Information

All components of the programme curriculum are described by a syllabus (summary) in the programme-specific part of the handbook providing the following information, which is further detailed in the sections below:

- the name and code of the subject;
- 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.

2.5 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 subjects in the modules usually aim to achieve a further detailed subset of the module learning objectives.

2.6 Teaching Methods

The programmes are conducted using a combination of lectures, exercises, assignments and examinations. The latter are described separately in the next section.

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 groupwork 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 Examinations

Examinations serve to test if students have achieved the learning objectives of a module, and ultimately those of the programme itself. The examination for a module may be composed of multiple parts. For example, a combination of a written or oral test and one or more assignments to handed in separately.

Examination work can also be produced by (small) groups of students working together on an assignment, e.g. the groupwork 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 examination, students are informed about the assessment results via e-mail. When all examinations 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

Lectures and exercises 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 educational activities;
- required lecture notes, textbooks and other course-related material;
- announcements of examination planning details; and
- statements on examination 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 Education and Examination regulations

See for the Education and Examination regulations the separate part after the Academic Calendar

3.2 Library regulations

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

The UNESCO-IHE 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 UNESCO-IHE 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' are 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 UNESCO-IHE

In consideration of the need for rules and regulations concerning the safety and the proper use of the buildings, grounds and facilities of UNESCO-IHE 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 Director

The director of UNESCO-IHE

1.3 the Rectorate

The director and the deputy director

1.4 Central services department

The central services department of UNESCO-IHE

1.5 Facilities

The institute buildings, the interior and equipments as well as rented office and accommodation facilities

1.6 Buildings

The buildings of UNESCO-IHE, located at Westvest 7, Delft

1.7 Student

Anyone who is enrolled at UNESCO-IHE for the purpose of education provided by UNESCO-IHE and who uses the educational and examination facilities of UNESCO-IHE 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 UNESCO-IHE 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 UNESCO-IHE 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 UNESCO-IHE or to other persons who are present on the grounds or in the buildings of UNESCO-IHE or who make use of the facilities of UNESCO-IHE, nor that he or she causes nuisance or annoyance;

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

c. h e 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 UNESCO-IHE 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 UNESCO-IHE or from one or more parts of UNESCO-IHE, 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 UNESCO-IHE;

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 UNESCO-IHE and/or the facilities or use of the facilities of UNESCO-IHE 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 non-compliance.

Article 5 Termination of the exclusion order

5.1 T he 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 UNESCO-IHE”.

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 UNESCO-IHE's 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 UNESCO-IHE, 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' (see annex). 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.[Oxford English Dictionary]

This act is considered as academic fraud. (in the sense of the word as established by Article 2.1 of the Education and Examination Regulations.) 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, (as stipulated by 17. 2 of the Education and Examination Regulations.) 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

UNESCO-IHE uses a computer program called Turnitin® to assist with the detection of plagiarism. The plagiarism detection service is an online service that enables UNESCO-IHE 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 UNESCO-IHE 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 UNESCO-IHE 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 UNESCO-IHE buildings and facilities are located on a single compound at the Westvest 7 in the centre of Delft. The buildings provide a pleasant and 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 well being. 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

UNESCO-IHE provides modern computing (IT) facilities for education and research. A local wired- and wireless network is available in UNESCO-IHE's building. Through UNESCO-IHE's networks all computers have access to a fast Internet connection. Besides that, participants have unlimited access to Internet in all hostels provided by UNESCO-IHE.

All UNESCO-IHE desktop and laptop PCs are Intel based with Microsoft Windows operating system. The UNESCO-IHE laptop PC will be provided in order to get access to the IT-facilities. The laptop is on loan for use during studying at UNESCO-IHE. At the end of the study, UNESCO-IHE 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 UNESCO-IHE 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 UNESCO-IHE e-mail account which enables you to make use of all relevant computing facilities at the Institute. Your account will be revoked when you will have ended your study at UNESCO-IHE. 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 UNESCO-IHE.

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 UNESCO-IHE Library and Information Services

UNESCO-IHE's Library provides access to over 35,000 printed titles, among which the complete collection of UNESCO-IHE 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 UNESCO-IHE portal. For more information please visit the Library's Internet page http://www.unesco-ihe.org/library

The library is open to all UNESCO-IHE 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 UNESCO-IHE 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, M.Sc 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 Delft University of Technology and other educational and research institutions, research possibilities 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 environmental field 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 'eCampus XL', 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 (CEFR) 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 B2 choose 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

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.

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.

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.

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 proof-reading; Elements of Writing – writing skills such as making comparisons, describing results and paraphrasing; Accuracy in Writing – to improve common problems, eg 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.

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.

UNESCO-IHE
Institute for Water Education

MASTER PROGRAMME UWS 2016-2018

UWS programme description UNESCO-IHE

Study guide part 1

Table of contents

Introduction UWS programme

The UWS MSc Programme is directed predominantly at civil, environmental and (bio)chemical engineers working in water supply and wastewater companies, municipal authorities, government ministries and consulting companies dealing with water supply, sanitation and integrated urban water cycle management.

The programme offers the following three specializations covering three sub-domains:

- Water Supply Engineering (WSE): this specialization emphasizes water quality and the design and operational aspects of drinking water treatment, transport, and distribution.
- Sanitary Engineering (SE): this specialization deals with sanitation with special emphasis on the urban poor, and with wastewater and sludge treatment process design, operation and engineering of related infrastructure including urban drainage and sewerage, centralized and decentralized systems and land-based and engineered treatment plants.
- Urban Water Engineering and Management (UWEM): this specialization deals with various aspects of the urban water environment and addresses the challenges of design, engineering and delivery of essential water and wastewater infrastructure, services and management.

WSE and SE are offered both fully at UNESCO-IHE, and as double degree programmes in cooperation with partners in Ghana (KNUST) and Colombia (Univale).
UWEM is only offered as a joint degree programme together with AIT Bangkok.

Learning objectives UWS programme

The overall objective of the UWS programme is to educate the students to adequately evaluate, design, develop and manage the (urban) water cycle, thereby contributing to sustainable development.

After successful completion of the programme, UWS graduates will have achieved the following learning outcomes:

Knowledge and understanding

1. Understanding the required basic chemical, physical, (micro)biological principles commonly applied in the field of water supply and sanitation;

2. Demonstrating knowledge of relevant theories and contemporary developments in the chosen specialisation;

3. Being able to interpret the broader scientific-, engineering- and socio-economic framework covering the urban water cycle;

Applying knowledge and understanding

4. Demonstrate disciplinary knowledge, engineering skills and academic capabilities independently and within a multidisciplinary context;

5. Select and apply suitable methods and techniques for assessment, planning, design, rehabilitation, operation and maintenance;

6. Formulate the questions to identify suitable approaches, and to pose original models, tests and/or engineering solutions;

7. Collect, analyse, prioritise and structure required data and information;

8. Contribute to theoretical, methodological or application development and integrate these within the respective discipline;

Making judgements

9. Identify original ideas and approaches from the literature or other sources and evaluate the potential for application, integration or further development;

10. Prepare a research plan, including the description of the approach and the realisation of the research;

11. Critically assess own investigation results, implementation feasibility and risks, and to reflect on the ethical and socio-economic aspects connected with application;

Communication

12. Clearly report and orally communicate results, the underpinning reasoning, knowledge and assumptions;

13. Actively promote the relevant issues and raise awareness amongst non-specialist audiences;

Learning skills

14. Extend and enhance own knowledge, insight and skills in an autonomous manner;

15. Conduct independent academic research in a subsequent post-graduate (i.e. PhD) programme.

Specialisations

The programme offers the following three specializations covering three sub-domains: Urban Water Engineering and Management This specialization deals with various aspects of the urban water environment and addresses the challenges of design, engineering and delivery of essential water and wastewater infrastructure, services and management.

UWEM is offered only as a joint degree specialisation in cooperation with AIT.

The programme starts at AIT in August where students take 4 first semester courses. In January of the following year the students travel to UNESCO-IHE where they stay until August of the second year to follow the modules 4 till 10, followed by their MSc thesis proposal preparation. In August of the second year, the students return to AIT to do their MSc thesis research, co-supervised by UNESCO-IHE staff.

Sanitary Engineering This specialization deals with sanitation with special emphasis on the urban poor, and with wastewater and sludge treatment process design, operation and engineering of related infrastructure including urban drainage and sewerage, centralized and decentralized systems and land-based and engineered treatment plants.
SE is also offered only as a double degree specialisation in cooperation with Univalle, Colombia and KNUST, Ghana.

Students following the Double Degree option with Univalle join the Delft programme in January (Module 4). Students following the Double Degree option with KNUST join the Delft programme in March (Module). They all may go back for their thesis work after Module 12 (Group work), co-supervised by both partners.

Water Supply Engineering This specialization emphasizes water quality and the design and operational aspects of drinking water treatment, transport, and distribution.
WSE is also offered only as a double degree specialisation in cooperation with Univalle, Colombia and KNUST, Ghana.

Students following the Double Degree option with Univalle join the Delft programme in January (Module 4). Students following the Double Degree option with KNUST join the Delft programme in March (Module). They all may go back for their thesis work after Module 12 (Group work), co-supervised by both partners.

Sanitary Engineering

This specialisation aims at educating professionals to develop rational approaches towards sustainable waste management via pollution prevention, appropriate treatment and resources recovery and reuse as well as participation in masterplanning, feasibility studies and technology selection. It enables graduates to deal
with the process technology, engineering and design aspects of wastewater collection and treatment, sludge treatment, disposal and reuse, and solid waste collection, transport, treatment and disposal in urban agglomerations. The module primarily targets professionals

working in water and sewerage utilities, consulting firms, industries, municipal assemblies and ministries.

After successful completion of the Sanitary Engineering (SE) specialisation within the UWS Programme, graduates will be able to:

See:

Education and Examination Regulations for cohort 2016– 2018

Appendix A Qualifications of Graduates

Water supply engineering

The Water Supply Engineering specialisation aims at educating professionals dealing with engineering aspects of drinking water sources, treatment and distribution in an integrated approach. These professionals are engineers and scientists working for water authorities, consulting companies, and educational and research institutions dealing with water supply. The programme pays attention to the choice of suitable technologies and tools, ranging from low-cost to advanced, in a problem-oriented way. As such, it is appealing both to the developing- and newly industrialised countries.

The main objective of the Water Supply Specialisation is to educate the participants to adequately evaluate, develop and manage part of the water cycle starting from the raw water source and ending at the consumer's tap.

After successful completion of the Water Supply Engineering (WSE) specialisation within the UWS programme, graduates will be able to:

See:

Education and Examination Regulations for cohort 2016– 2018

Appendix A Qualifications of Graduates

Urban Water Engineering and Management

This specialisation aims at engineers who wish to develop into generalists rather than specialists. As the programme broadly covers the urban water cycle, graduates from this specialisation will normally work in any organisation dealing with urban water engineering and management, or with one or more distinct elements of the water cycle (storm water drainage, or water and wastewater services).

The programme will provide students with advanced knowledge to deal with contemporary problems and issues of the urban water environment and offer practical experience in using tools and techniques to address the challenges of delivery of essential water and wastewater services and management of the urban water cycle and associated engineered systems. Furthermore, the program will develop a set of core academic and personal skills in students which will prepare them for a variety of employment opportunities and/or further research in the broader area of urban water engineering and management.

Urban Water Engineering and Management Specialisation

After successful completion of the Urban Water Engineering and Management (UWEM) specialisation within the UWS Programme, graduates will be able to:

See:

Education and Examination Regulations for cohort 2016– 2018

Appendix A Qualifications of Graduates

UWS Programme Overview 2016-2018

			WSE Water Supply Engineering C1352			SE Sanitary Engineering C1349			UWEM Urban Water Engineering and Management C1036
		.....-23/10 24/10-30/10	Week ONE Introduction (ALL)						at AIT *(August 2013 onwards)* watershed hydrlogy, drinking water treatment, Wastewater treatment and integrated water resource mamagement
	1	31/10-06/11 07/11-13/11	Hydrology, Water supply & water demand management & GIS (UWS/01) M1386	Chemistry and public health (UWS/02) M3043	...	Hydrology, Water supply & water demand management & GIS (UWS/01) M1386	Chemistry and public health (UWS/02) M3043	...	
	2	14/11-20/11 21/11-27/11 28/11-04/12	Hydrology, Water supply & water demand management & GIS (UWS/01) M1386	Chemistry and public health (UWS/02) M3043	EPT, Microbiology & Integrated Urban Water Management (UWS/03) M3030	Hydrology, Water supply & water demand management & GIS (UWS/01) M1386	Chemistry and public health (UWS/02) M3043	EPT, Microbiology & Integrated Urban Water Management (UWS/03) M3030	
	..	05/12-11/12	Examination Week						
	3	12/12-18/12 19/12-25/12	EPT, Microbiology and Integrated Urban Water Management (UWS/03) M3030						
	..	26/12-01/01 02/01-08/01	Free Period						
	3	09/01-15/01	(UWS/03) - M3030 *continue..*						
Students enter: Univalle and AIT	4	16/01-22/01 23/01-29/01 30/01-05/02	Surface water treatment I (UWS/WSE/04) M2550			Urban drainage and sewerage (UWS/SE/UWEM/04) M3074			
	..	06/02-12/02	Examination Week						
	5	13/02-19/02 20/02-26/02 27/02-05/03	Surface water treatment II (UWS/WSE/05) M1577			Conventional wastewater treatment (UWS/SE/05) M1802			Asset management (UWS/UWEM/05) M3047
Students enter: KNUST	6	06/03-12/03 13/03-19/03 20/03-26/03	Groundwater Resources and Treatmen (UWS/WSE/06) M3033			Resource oriented wastewater treatment and sanitation (UWS/SE/06) M2384			Managing water organisations (=> WSM06) M3103
	..	27/03-02/04	Examination Week						
	7	03/04-09/04 10/04-16/04 17/04-23/04	Water transport and distribution (UWS/WSE/UWEM/07) M2553			Wastewater treatment plants design and engineering (UWS/SE/07) M2373			Water transport and distribution (UWS/WSE/UWEM/07) M2553
	8	24/04-30/04 01/05-07/05 08/05-14/05	Advanced water treatment and reuse (UWS/WSE/08) M2335			Modeling of wastewater treatment processes and plants (UWS/SE/08) M3054			Urban flood management and disaster risk mitigationn (=> WSE/HI/08B/e) M1710
	..	15/05-21/05	Examination Week						
	9	22/05-28/05 29/05-04/06	International fieldtrip and fieldwork (UWS/09)						
			Click here to choose your summer course (UWS12)						
	13	07/08-13/08 14/08-20/08 21/08-27/08	Groupwork Sint Maarten (UWS/13) M3114						MSc research proposal development for UWEM, ETSuD and AWMELWP (UWS/UWEM/11) M3039
AIT leaves	..	28/08-03/09	Examination Week						
	..	04/09-10/09	Free						
Univalle and KNUST leave	14	11/09-17/09 18/09-24/09 25/09-01/10 02/10-08/10 09/10-15/10	MSc Preparatory Course and Thesis Research Proposal for UWS (UWS/14) M3012						at AIT
	..	16/10-22/10	Examination Week						
	15	23/10/15 .... 15/04/16	MSc research, thesis and defence (6 months) (UWS/15) M2927						
	..	16/04-22/04 23/04-29/04	Final Examination Week - Diploma awarding 24/04/2017						

UNESCO-IHE
Institute for Water Education

MASTER PROGRAMME UWS 2016-2018

Exam regulation UNESCO-IHE

Study guide part 1

UNESCO-IHE
Institute for Water Education

Education and Examination Regulations for cohort 2016– 2018

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 Sep 2016, and ending Sep 2017)
- Graduate professional diploma programmes

Approved by the Rectorate of UNESCO-IHE, [19-07-2016]

Table of Contents

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;

Consent agreement: a negotiated agreement of examining committee members to an examination which resolves the disputed issues;

Co- mentor: a staff member from an external institute or different chair group within UNESCO-IHE 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;

ECTS transfer: the procedure of granting credits to a student for studies completed at another institute;

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 student's 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;

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 or ideas 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;

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.

2 General Information

Article 1 Scope of the regulations

1.1 The present regulations apply to the education offerings and examinations within: 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 master programmes
Graduate Professional Diploma Programmes (GPDP)

referred to hereafter as 'the programmes'.

The programmes are executed by the UNESCO-IHE 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 4 joint degree specialisations separate examination regulations apply:

- Urban Water Engineering and Management (UWEM);
- Limnology and Wetland Management (LWM);
- International Master of Science in Environmental Technology and Engineering (IMETE);
- 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	UNESCO-IHE	UNESCO-IHE degree
	• UNESCO-IHE • Kwame Nkrumah University of Science and Technology, Ghana	Double degree
	• UNESCO-IHE • Universidad de Valle, Cali, Colombia	Double degree
2. Sanitary Engineering	UNESCO-IHE	UNESCO-IHE degree
	• UNESCO-IHE • Kwame Nkrumah University of Science and Technology, Ghana	Double degree
	• UNESCO-IHE • Universidad de Valle, Cali, Colombia	Double degree
3. Urban Water Engineering and Management	• UNESCO-IHE • Asian Institute of Technology,Thailand	Joint degree

2. Environmental Science programme:

Specialisation	Offered by	Type of degree
1. Environmental Science and Technology	UNESCO-IHE	UNESCO-IHE degree
	• UNESCO-IHE • Universidad de Valle, Cali, Colombia	Double degree
2. Environmental Planning and Management	UNESCO-IHE	UNESCO-IHE degree
3. Water Quality Management	UNESCO-IHE	UNESCO-IHE degree
4. Limnology and Wetland Management	• UNESCO-IHE • BOKU - University of Natural Resources and Life Sciences, Vienna, Austria • Egerton University, Egerton, Kenya	Joint degree
5. Environmental Technology for Sustainable Development	• UNESCO-IHE • Asian Institute of Technology,Thailand	Joint degree
6. Environmental Technology and Engineering (Erasmus Mundus programme)	• UNESCO-IHE • Ghent University, Belgium, • ICTP, Prague, Czech Republic	Joint degree

3. Water Management programme:

Specialisation	Offered by	Type of degree
1. Water Management	UNESCO-IHE	UNESCO-IHE degree
2. Water Resources Management	UNESCO-IHE	UNESCO-IHE degree
3. Water Services Management	UNESCO-IHE	UNESCO-IHE degree
4. Water Quality Management	UNESCO-IHE	UNESCO-IHE degree
5. Water Conflict Management	UNESCO-IHE	UNESCO-IHE degree

4. Water Science and Engineering programme:

Specialisation	Offered by	Type of degree
1. Hydrology and Water Resources	UNESCO-IHE	UNESCO-IHE degree
	• UNESCO-IHE • Hohai University, China P.R.	UNESCO-IHE degree
2. Hydraulic Engineering - River Basin Development	UNESCO-IHE	UNESCO-IHE degree
	• UNESCO-IHE • University of Kuala Lumpur	Double degree
3. Coastal Engineering and Port Development	UNESCO-IHE	UNESCO-IHE degree
	• UNESCO-IHE • Hohai University, China P.R.	UNESCO-IHE degree
4. Land and Water development	UNESCO-IHE	UNESCO-IHE degree
	• UNESCO-IHE • Asian Institute of Technology Thailand	Double degree
	• UNESCO-IHE • University of Nebraska -Lincoln, USA	Double degree
5. Hydroinformatics- Modelling and information systems for water management	UNESCO-IHE	UNESCO-IHE degree
	• UNESCO-IHE • Hohai University, China P.R.;	UNESCO-IHE degree
	• UNESCO-IHE • Universidad del Valle, Colombia	UNESCO-IHE degree

6. Flood Risk Management (Erasmus Mundus programme).	• UNESCO-IHE • 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).	• UNESCO-IHE • TU Dresden, Germany • University of Lisbon, Portugal	Multiple degree

5. **Graduate professional diploma programmes**:

Name	Offered by	
Sanitation and Sanitary Engineering	• UNESCO-IHE	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 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.

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 UNESCO-IHE 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 of the study guides.

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.

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 Students of a short and online course can sit for the assessment only once.

6.6 In case a student fails the examination of a GPDP module twice, the student can either redo the whole module again, or choose another module. In both cases agreement of the programme coordinator is needed.

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

6.8 Written and oral examinations for short and online course participants are held within two weeks after the end of the module.

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

6.10 Students of short courses or online courses are eligible to sit for the assessment of the course they are registered for provided that the fee to sit for these assessments has been paid.

6.11 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 examination work 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.

6.12 In the case of a combination of an oral and written examination 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.

7.2 Written and oral re-examinations take place during the following examination period as indicated in the academic calendar. Dates and times of written re-examinations are announced in the programme schedules. Not reading or misreading the schedules is

not accepted as legitimate reason for failure to participate in a re-examination. All students will take the re-sit of a written examination at the same time.

7.3 The dates and times of written and oral (re-)examinations during the thesis period are set by the module coordinator in collaboration with the programme coordinator and the education bureau.

7.4 Students will only be allowed to re-sit an assessment for which a fail (i.e. mark lower than 6.0) has been obtained. The highest mark obtained (first assessment or re-sit) for the assessment will be used to compute the final module mark.

7.5 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) during the taught part of the programme ('modules' does not include the MSc proposal defence).

7.6 The format of a re-examination may deviate from that of the first examination for the same module.

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

Article 8 The organisation of the examinations

8.1 Examinations 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 examination 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 examinations

9.1 Oral examinations are taken individually (only one student at a time). During oral examinations, a second staff member is present as an observer.

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

9.3 Oral examinations 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 maximum 2 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 present their defence 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 Exemptions and transfer of credit points

11.1 Exemptions for assessments are 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.

12.4 For all cases mentioned under art 12.2 and 12.3 the programme coordinator will inform the Examination Board and the planning office.

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 exclude the student concerned 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.

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 All written examination work of the students will, where feasible, be blind marked by the examiners involved.

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

14.6 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.

14.7 After the assessment of a module has been completed, the student receives a written statement from the Education Bureau mentioning the overall module mark, the marks given for the different assessments, and if successful also the credit points granted for the module.

14.8 After a successful re-sit of an assessment, the mark for the module is recalculated according to the weighted average of the assessment results. However, the maximum module mark which can be awarded when there has been a re-assessment is 7.0.

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.

6 Thesis Examination

Article 18 The organisation of the thesis examination

18.1 The thesis will be assessed by a thesis examination committee, normally 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 UNESCO-IHE mentor is a PhD fellow, mentoring the MSc student in the context of his/her own research, is a member of the committee, an additional staff member is compulsory.

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

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

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:
- are not involved in the thesis work (independent)
- 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.

18.2 The opportunity to sit the thesis examination is offered once every calendar month.

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

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

18.5 If the outcome of the thesis examination, including the defence, is negative, 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 nor financial support.
The re-sit shall be taken within three months after the first attempt and will, in principle, be assessed by the same committee as for the first attempt.
In special circumstances 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 their mentor.

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:

SINGLE DEGREES:

- For the single UNESCO-IHE degree programmes:
  - Successfully completed all modules of the programme; and
  - Obtained a minimum of 106 ECTS.

- For the single UNESCO-IHE GPDP diploma:
  - Successfully obtained a minimum of 20 ECTS for the programme.

JOINT DEGREES:

- For the joint degree Limnology and Wetland Management programme (LWM):
  - Successfully completed all modules of the programme, according to the grading rules of BOKU, Egerton University and UNESCO-IHE; and
  - Obtained a minimum of 120 ECTS.

- For the joint degree International Master of Science in Environmental Technology and Engineering programme (IMETE) (Erasmus Mundus programme):
  - Successfully completed all modules of the programme, according to the grading rules of Ghent University, Institute of Chemical Technology in Prague and UNESCO-IHE; and
  - Obtained a minimum of 120 ECTS.

- For the joint degree Environmental Technology for Sustainable Development (ETSuD) conducted with the Asian Institute of Technology (AIT):
  - Obtained a minimum of 48 AIT credits / 125 ECTS credits, and
  - Obtained a minimum cumulative GPA of 2,75 for courses taken at AIT, and
  - Passed all modules taken at UNESCO-IHE, and
  - Has obtained a grade 'fair' or higher for their Master's thesis at AIT.

- For the joint degree Urban Water Engineering and Management (UWEM) conducted with the Asian Institute of Technology (AIT):
  - Obtained a minimum of 48 AIT credits / 120 ECTS credits, and
  - Obtained a minimum cumulative GPA of 2,75 for courses taken at AIT, and
  - Passed all modules taken at UNESCO-IHE, and
  - Has obtained a grade 'fair' or higher for their Master's thesis at AIT.

DOUBLE / MULTIPLE DEGREES:

- For the double degree programme Land and Water development conducted with the Asian Institute of Technology (AIT):
  - Obtained a minimum of 48 AIT credits / 120 ECTS credits, and
  - Obtained a minimum cumulative GPA of 2,75 for courses taken at AIT, and
  - Passed all modules taken at UNESCO-IHE, and
  - Has obtained a grade 'fair' or higher for their Master's thesis at AIT.

- For the double degree programmes in Water Supply Engineering, Sanitary Engineering, and Environmental Science and Technology conducted with Universidad del Valle:
  - Obtained a GPA of 3.5 or higher for the course work done at Univalle; and

- Successfully completed all modules at UNESCO-IHE; and
- Achieved a mark '6' or higher for the thesis examination; and
- Obtained a minimum of 113,36 ECTS.

- For the double degree programmes in Water Supply Engineering, and Sanitary Engineering conducted with KNUST:
  - Obtained a CWA of 55% or higher for the course work done at KNUST; and
  - Successfully completed all modules at UNESCO-IHE; and
  - Achieved a pass for the thesis examination at KNUST; and
  - Obtained a minimum of 118 ECTS.

- For the double degree programme Land and Water development conducted with the University of Nebraska-Lincoln:
  - Successfully completed all modules of the programme; and
  - Obtained a minimum of 112 ECTS.

- For the double degree programme River basin development conducted with the University of Kuala Lumpur:
  - Successfully completed all modules of the programme; and
  - Obtained a minimum of 108.7 ECTS.

DOUBLE / MULTIPLE DEGREES (Erasmus Mundus programmes):

- For the multiple degree programme on Flood Risk Management:
  - Successfully completed all modules of the programme, according to the grading rules of TU-Dresden, University of Ljublijana, TU-Catalonia and UNESCO-IHE; and
  - Obtained a minimum of 120 ECTS.

- For the double degree programme Water Co-operation and Peace conducted with the University of Peace and University of Oregon:
  - Successfully completed all modules of the programme, according to the grading rules of UPEACE, University of Oregon, and UNESCO-IHE; and
  - Obtained a minimum of 120 ECTS.

- For the multiple degree programme in Groundwatch:
  - Successfully completed all modules of the programme, according to the grading rules of the University of Lisbon, Technical University Dresden, and UNESCO-IHE; and
  - Obtained a minimum of 120 ECTS.

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 at the next scheduled degree awarding ceremony. The degree is signed by the Chairman 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 Master of Science degree can be awarded with distinction by the Examination Board if:

For single degree programmes:

- the candidate obtained a mark of 8.5 or higher for the thesis examination, and an arithmetic average mark at UNESCO-IHE 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 UNESCO-IHE:

- the candidate obtained a mark of 8.5 or higher for the thesis examination, and
- an arithmetic average mark at UNESCO-IHE 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 UNESCO-IHE 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).

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.

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 2016 – 2018. Approved by the Rectorate of UNESCO-IHE on 19-07-2016

Appendix A Qualifications of Graduates

1. Urban Water and Sanitation Programme

1.1 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.

1.2 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;

1.3 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.

1.4 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.

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	

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	5. 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	6. 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.

3. Water Management Programme

3.1 Water 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. 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 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.
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 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.

4. Water Science and Engineering Programme

4.1 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.

4.2 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

4.3 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.

4.4 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.

4.5 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;

4.7 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	4. 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; 5. 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; 6. 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; 7. 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	8. 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	9. develop the academic attitude and learning skills to enhance and broaden the acquired knowledge and application skills in a largely independent manner.

4.8 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;
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. identify and cross-evaluate alternative land and water development options for areas under different land uses and assess their feasibility; technologically, economically, and environmentally; 3. 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.
Making judgements	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; 2. identify and develop available water resources for food production; 3. enhance the of on-farm irrigation systems through better design and management;
Communication	
Lifelong learning skills	

4.10 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.

4.11 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	
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 student card and displays it on his 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, UNESCO-IHE 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. Kwame Nkrumah University of Science & Technology (KNUST)

Grading scale of 0 to 100%, where 50% or higher implies a pass.
The minimum grade needed to have a postgraduate degree conferred upon an individual is a CWA of 55%.
CWA (Cumulative Weighted Average) = sum [credits x mark] / sum of all credits

Example:

Module	**Credit**	**Mark obtained**	**Total Module mark**
A	3	60	180
B	2	70	140
C	1	65	65
Total Credit of Student A	**6**		
Cumulative Mark			**385**

CWA= Cumulative Mark/Total Credit = 385/6 = **64.17**

2. 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

3. Universidad del Valle

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)

5. Egerton University

70% and above A (Excellent)
60-69% B (Good)
50-59% C (Average)…
0-49% F (Fail)

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

6. BOKU

is using the Austrian grading system, which is a five step grading system ranging from (1,very good to 5, not sufficient). Grade 1 to 4 indicate a successful result.
The following grading scale is used:

Austrian grade	ECTS grade	Verbal
1 (sehr gut)	A/B	excellent/very good
2 (gut)	C	good
3 (befriedigend)	D	satisfactory
4 (genügend)	E	pass

6. Gent, Prague

ECTS		Gent University		UNESCO-IHE*		ICTP
A++ (exceptional only 1%)		19 or 20		10		100
A (top 5%)		18		9.2		90-100 A
A (top 10%)		17		8.8		
B (top 20%)		16		8.4		80-89 B
B (top 35%)		15		8		
C (top 50%)		14		7.6		70-79 C
C (top 65%)		13		7.2		
D (top 80%)		12		6.8		60-69 D
E (top 90%)		11		6.4		50-59 E
E (just pass)		10		6		
F (fail)		9		5.4		0-49 F
		8		4.8		
		7		4.2		
		6		3.6		
		5		3		
		4		2.4		
		3		1.8		

		2		1.2		
		1		0.6		
		0		0		

7. TU Dresden:
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.

8. University of Ljubljana
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).

9 TU-Catalonia
Scale from 0-10
MH Honors (is given on exceptional cases)
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

10 University of Lisbon
A (excellent) 20-18
B (very good, with few errors) 17-16
C (good, with some errors) 15-14
D (satisfactory, with many errors) 13-12
E (sufficient) 11-10

Appendix D MSc modules: names, credits & assessment methods

1. Urban Water and Sanitation programme

SANITARY ENGINEERING		C1349								
Module number	Module Name	Code	Module coordinator	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)
1	Hydrology, Water supply and water demand management and GIS	M1386	Salinas	5	75		25			
2	Chemistry and public health	M3043	Slokar	5	60		35		5	
3	EPT, Microbiology and Integrated Urban Water	M3030	vd Steen	5	70		30			
4	Urban drainage and sewerage	M3074	Sanchez Torres	5	60		40			
5	Conventional wastewater treatment	M1802	Lopez	5	80		20			
6	Resource oriented wastewater treatment and sanitation	M2384	Ronteltap	5	80		20			
7	Wastewater treatment plants design and engineering	M2373	Lopez	5	50	25	25			
8	Modelling of wastewater treatment processes and plants	M3054	Hooymans	5	60		40			
9	International fieldtrip and fieldwork	M1421	Slokar	5			100			
12	Summer course			1						
13	Groupwork Sint Maarten	M3114	Slokar	5			80	20		
14	MSc research methodology and proposal development	M3040	Garcia	9		100				
15	MSc thesis research and thesis writing	M2927	various	36		100				
	Electives modules:									
10	Industrial effluents treatment and residuals management	M3102	Garcia	5	60		40			
10	Water treatment processes and plants	M2371	Sharma	5		60	40			
10	Urban water systems	M3006	Voijnovic	5	40		60			
11	Solid waste management	M1331	Siebel	5	60		35	5		
11	Strategic Planning for River Basins and Deltas	M3086	Yong	5	50		50			
11	IWRM as a tool for adaptation to climate change	M2155	de Ruyter	5	70		30			
11	Wetlands for livelihoods and conservation	M3089	Hes	5			80	20		
11	Urban water governance	M1568	Acevedo Guerre	5			100			
11	Advanced water transport and distribution	M2602	Trifunovic	5	60		40			
11	Faecal Sludge Management	M2873	Ronteltap	5	85		15			
11	Decentralised Water Supply and Sanitation	M2810	Sharma	5	60		30	10		
11	Hydroinformatics for Decision Support	M3001	Jonoski	5			100			
11	Water Sensitive Cities	M3048	Pathirana	5						
11	Modelling river systems and lakes	M3075	Cattapan	5	60		40			
11	Flood Protection in Lowland Areas	M3104	Roelvink	5	60		40			
11	Remote sensing, GIS and modelling for agricultural water use	M3027	Karimi	5	25		75			

WATER SUPPLY ENGINEERING		C1352								
Module number	Module Name	Code	Module coordinator	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)
1	Hydrology, Water supply and water demand management and GIS	M1386	Salinas	5	75		25			
2	Chemistry and public health	M3043	Slokar	5	60		35		5	
3	EPT, Microbiology and Integrated Urban Water	M3030	vd Steen	5	70		30			
4	Surface water treatment I	M2550	Kennedy	5	60		20		20	
5	Surface water treatment II	M1577	Ferrero	5	70		10		20	
6	Groundwater resources and treatment	M3033	Petrusevski	5	70		15		15	
7	Water transport and distribution	M2553	Trifunovic	5	60		40			
8	Advanced water treatment and reuse	M2335	Salinas	5	70		20		10	
9	International fieldtrip and fieldwork	M1421	Slokar	5			100			
12	Summer course									
13	Groupwork Sint Maarten	M3114	Slokar	5			80	20		
14	MSc research methodology and proposal development	M3040	Garcia	9		100				
15	MSc thesis research and thesis writing	M2927	various	36			100			
	Electives modules:									
10	Industrial effluents treatment and residuals management	M3102	Garcia	5	60		40			
10	Water treatment processes and plants	M2371	Sharma	5		60	40			
10	Urban water systems	M3006	Voijnovic	5	40		60			
11	Solid waste management	M1331	Siebel	5	60		35	5		
11	Strategic Planning for River Basins and Deltas	M3086	Yong	5	50		50			
11	IWRM as a tool for adaptation to climate change	M2155	de Ruyter	5	70		30			
11	Wetlands for livelihoods and conservation	M3089	Hes	5			80	20		
11	Urban water governance	M1568	Acevedo Guerre	5			100			
11	Advanced water transport and distribution	M2602	Trifunovic	5	60		40			
11	Faecal Sludge Management	M2873	Ronteltap	5	85		15			
11	Decentralised Water Supply and Sanitation	M2810	Sharma	5	60		30	10		
11	Hydroinformatics for Decision Support	M3001	Jonoski	5			100			
11	Water Sensitive Cities	M3048	Pathirana	5						
11	Modelling river systems and lakes	M3075	Cattapan	5	60		40			
11	Flood Protection in Lowland Areas	M3104	Roelvink	5	60		40			
11	Remote sensing, GIS and modelling for agricultural water use	M3027	Karimi	5	25		75			

URBAN WATER ENGINEERING AND MANAGEMENT											
Location	Module number	Module Name	Code	Module coordinator	AIT credits / ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)
AIT		Watershed hydrology			3 (7.5)	x		x			
		Drinking water treatment			3 (7.5)	x					
		Wastewater treatment			3 (7.5)	x		x			
		Integrated water resources management			3 (7.5)	x		x			
U-IHE	4	Urban drainage and sewerage	M3074	Sanchez Torres	E	5	60		40		
	5	Asset management	M3047	Pathirana	2 (5.0)		50	50			
	6	Managing water organisations	M3103	Schwartz	2 (5.0)			100			
	7	Water transport and distribution	M2553	Trifunovic	2 (5.0)	60		40			
	8	Urban flood management and disaster risk mitigation	M1710	Vojinovic	2 (5.0)	40		60			
	9	International fieldtrip and fieldwork	M1421	Slokar	2 (5.0)			100			
		Electives:									
	10	Industrial effluents treatment and residuals management	M3102	Garcia	2 (5.0)	60		40			
	10	Water treatment processes and plants	M2371	Sharma	2 (5.0)		60	40			
	10	Urban water systems	M3006	Voijnovic	2 (5.0)	40		60			
		Summer course			0.4 (1)						
		Total coursework			26 (65)						
		MSc research proposal development for UWEM/EtSUD/AWMELW	M3040	Garcia	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 KNUST			C1030 /C1039								
Location	Module number	Module Name	Code	Module coordinator	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation	Lab Report (%)	Home work (%)
KNUST	KN1	Module (KN) 1 Introduction to Environmental Sanitation			5	70		30			
	KN2	Module (KN) 2 Mathematical and research methods			4	70		30			
	KN3	Module (KN) 3 Environmental science and process technology			6	70		30			
	KN4	Module (KN) 4 Environmental quality			3	70		30			
	KN5	Module (KN) 5 water supply			2	70		30			
U-IHE	6	Resource oriented wastewater treatment and sanitation	M2384	Ronteltap	5	80		20			
	7	Wastewater treatment plants design and engineering	M2373	Lopez	5	50	25	25			
	8	Modelling of wastewater treatment processes and plants	M3054	Hooymans	5	60		40			
	OR										
	6	Groundwater resources and treatment	M3033	Petrusevski	5	70		15		15	
	7	Water transport and distribution	M2553	Trifunovic	5	60		40			
	8	Advanced water treatment and reuse	M2335	Salinas	5	70		20		10	
	9	International fieldtrip and fieldwork	M1421	Slokar	5			100			
	12	Summer course			1						
	13	Groupwork Sint Maarten	M3114	Slokar	5			80	20		
		Electives modules:									
	10	Industrial effluents treatment and residuals management	M3102	Garcia	5	60		40			
	10	Water treatment processes and plants	M2371	Sharma	5		60	40			
	10	Urban water systems	M3006	Voijnovic	5	40		60			
	11	MSc proposal preparation	M3040	Garcia	5						
U-IHE / KNUST	15	MSc thesis research and thesis writing	M2384	various	36		100				

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	UVC /ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)
Univalle	C1	C1 Chemistry of Environmental Pollution			3 /5.13	50		20		30	
	C2	C2 Environmental Pollution Microbiology			3 /5.13	x		x	x	x	
	C3	C3 Fundamentals of Environmental Processes			3 /5.13	60		20		20	20
	C4	C4 Environmental and Development			3 /5.13	35		30	35		
	C5	C5 Engineering Research Introduction			2/3.42			100		20	
U-IHE	4	Urban drainage and sewerage	M3074	Sanchez Torres	5	60		40			
	5	Conventional wastewater treatment	M1802	Lopez	5	80		20			
	6	Resource oriented wastewater treatment and sanitation	M2384	Ronteltap	5	80		20			
	7	Wastewater treatment plants design and engineering	M2373	Lopez	5	50	25	25			
	8	Modelling of wastewater treatment processes and plants	M3054	Hooymans	5	60		40			
	9	International fieldtrip and fieldwork	M1421	Slokar	5			100			
	12	Summer course			1						
	13	Groupwork Sint Maarten	M3114	Slokar	5			80	20		
		Electives modules:									
	10	Industrial effluents treatment and residuals management	M3102	Garcia	5	60		40			
	10	Water treatment processes and plants	M2371	Sharma	5		60	40			
	10	Urban water systems	M3006	Voijnovic	5	40		60			
	11	MSc proposal preparation	M3040	Garcia	5						
Univalle	C9	Engineering research I (4 UVC)			4/6.84						
	C10	Engineering Research II (8 UVC)			8/13.68						
		MSc thesis (14 UVC)			14/23.94						

Joint MSc programme in Urban Water and Sanitation with specialisation Water Supply Engineering with Universidad del Valle, Colombia											
Location	Module number	Module Name	Code	Module coordinator	UVC /ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)
Univalle	C1	C1 Chemistry of Environmental Pollution			3 /5.13	50		20		30	
	C2	C2 Environmental Pollution Microbiology			3 /5.13	x		x	x	x	
	C3	C3 Fundamentals of Environmental Processes			3 /5.13	60		20		20	20
	C4	C4 Environmental and Development			3 /5.13	35		30	35		
	C5	C5 Engineering Research Introduction			2/3.42			100		20	
U-IHE	4	Surface water treatment I	M2550	Kennedy	5	60		20		20	
	5	Surface water treatment II	M1577	Ferrero	5	70		10		20	
	6	Groundwater resources and treatment	M3033	Petrusevski	5	70		15		15	
	7	Water transport and distribution	M2553	Trifunovic	5	60		40			
	8	Advanced water treatment and reuse	M2335	Salinas	5	70		20		10	
	9	International fieldtrip and fieldwork	M1421	Slokar	5			100			
	12	Summer course									
	13	Groupwork Sint Maarten	M3114	Slokar	5			80	20		
		Electives modules:									
	10	Industrial effluents treatment and residuals management	M3102	Garcia	5	60		40			
	10	Water treatment processes and plants	M2371	Sharma	5		60	40			
	10	Urban water systems	M3006	Voijnovic	5	40		60			
	11	MSc proposal preparation	M3040	Garcia	5						
Univalle	C9	Engineering research I (4 UVC)			4/6.84						
	C10	Engineering Research II (8 UVC)			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	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
1	Introduction to environmental science 1 +2	M3026	de Ruyter	5	80+20		20+35				
3	Introduction to environmental science 3	M3038	de Ruyter				100				
4	Integrated project environmental science	M3031	vd Steen	5			70	30			
5	Industrial Resource Management & Cleaner Production	M1953	Raj	5	60		35	5			
6	Environmental systems analysis	M3034	Irvine	5	30		60	10			
7	Environmental engineering	M3081	Raj	5	75		25				
8	Environmental monitoring and modelling	M2658	Irvine	5	70		15		15		
9	Foreign fieldtrip and fieldwork ES	M1766	de Ruyter	5			100				
12	Summer courses			1			100				
13	Groupwork ES	M2240	van Bruggen	5			100				
14	MSc research methodology and proposal development	M1288	van Bruggen	9			100				
15	MSc research	M2927	various	36			100				
	Elective modules:										
10	Aquatic ecosystems: processes and applications	M2122	Gettel	5			90	10			
10	Environmental assessment for water related policies and develo	M3080	Mendoza	5	50		50				
11	Solid waste management	M1331	Siebel	5	60		35	5			
11	Strategic Planning for River Basins and Deltas	M3086	Yong	5	50		50				
11	IWRM as a tool for adaptation to climate change	M2155	de Ruyter	5	70		30				
11	Wetlands for livelihoods and conservation	M3089	Hes	5			80	20			
11	Urban water governance	M1568	Acevedo Guerre	5			100				
11	Advanced water transport and distribution	M2602	Trifunovic	5	60		40				
11	Faecal Sludge Management	M2873	Ronteltap	5	85		15				
11	Decentralised Water Supply and Sanitation	M2810	Sharma	5	60		30	10			
11	Hydroinformatics for Decision Support	M3001	Jonoski	5			100				
11	Water Sensitive Cities	M3048	Pathirana	5							
11	Modelling river systems and lakes	M3075	Cattapan	5	60		40				
11	Flood Protection in Lowland Areas	M3104	Roelvink	5	60		40				
11	Remote sensing, GIS and modelling for agricultural water use	M3027	Karimi	5	25		75				

ENVIRONMENTAL POLICY MAKING		C1127									
Module number	Module Name	Code	Module coordinator	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
1	Introduction to environmental science 1 +2	M3026	de Ruyter	5	80+20		20+35				
3	Introduction to environmental science 3	M3038	de Ruyter				100				
4	Integrated project environmental science	M3031	vd Steen	5			70	30			
5	Water and environmental law	M1003	Jaspers	5	70		30				
6	Environmental systems analysis	M3034	Irvine	5	30		60	10			
7	Water and environmental policy making	M3082	Douven	5	50		50				
8	Environmental planning and implementation	M3021	Evers	5	50		50				
9	Foreign fieldtrip and fieldwork ES	M1766	de Ruyter	5			100				
12	Summer courses			1			100				
13	Groupwork ES	M2240	van Bruggen	5			100				
14	MSc research methodology and proposal development	M1288	van Bruggen	9			100				
15	MSc research	M2927	various	36			100				
	Elective modules:										
10	Aquatic ecosystems: processes and applications	M2122	Gettel	5			90	10			
10	Environmental assessment for water related policies and develo	M3080	Mendoza	5	50		50				
11	Solid waste management	M1331	Siebel	5	60		35	5			
11	Strategic Planning for River Basins and Deltas	M3086	Yong	5	50		50				
11	IWRM as a tool for adaptation to climate change	M2155	de Ruyter	5	70		30				
11	Wetlands for livelihoods and conservation	M3089	Hes	5			80	20			
11	Urban water governance	M1568	Acevedo Guerre	5			100				
11	Advanced water transport and distribution	M2602	Trifunovic	5	60		40				
11	Faecal Sludge Management	M2873	Ronteltap	5	85		15				
11	Decentralised Water Supply and Sanitation	M2810	Sharma	5	60		30	10			
11	Hydroinformatics for Decision Support	M3001	Jonoski	5			100				
11	Water Sensitive Cities	M3048	Pathirana	5							
11	Modelling river systems and lakes	M3075	Cattapan	5	60		40				
11	Flood Protection in Lowland Areas	M3104	Roelvink	5	60		40				
11	Remote sensing, GIS and modelling for agricultural water use	M3027	Karimi	5	25		75				

WATER QUALITY MANAGEMENT		C1166									
Module number	Module Name	Code	Module coordinator	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
1	Introduction to environmental science 1 +2	M3026	de Ruyter	5	80+20		20+35				
3	Introduction to environmental science 3	M3038	de Ruyter				100				
4	Integrated project environmental science	M3031	vd Steen	5			70	30			
5	Water and environmental law	M1003	Jaspers	5	70		30				
6	Water quality assessment	M2835	de Ruyter	5	60		30		10		
7	Constructed wetlands for wastewater treatment	M2216	van Bruggen	5	60		40				
8	Environmental planning and implementation	M3021	Evers	5	50		50				
9	Foreign fieldtrip and fieldwork ES	M1766	de Ruyter	5			100				
12	Summer courses			1			100				
13	Groupwork ES	M2240	van Bruggen	5			100				
14	MSc research methodology and proposal development	M1288	van Bruggen	9			100				
15	MSc research	M2927	various	36			100				
	Elective modules:										
10	Aquatic ecosystems: processes and applications	M2122	Gettel	5			90	10			
10	Environmental assessment for water related policies and develo	M3080	Mendoza	5	50		50				
11	Solid waste management	M1331	Siebel	5	60		35	5			
11	Strategic Planning for River Basins and Deltas	M3086	Yong	5	50		50				
11	IWRM as a tool for adaptation to climate change	M2155	de Ruyter	5	70		30				
11	Wetlands for livelihoods and conservation	M3089	Hes	5			80	20			
11	Urban water governance	M1568	Acevedo Guerre	5			100				
11	Advanced water transport and distribution	M2602	Trifunovic	5	60		40				
11	Faecal Sludge Management	M2873	Ronteltap	5	85		15				
11	Decentralised Water Supply and Sanitation	M2810	Sharma	5	60		30	10			
11	Hydroinformatics for Decision Support	M3001	Jonoski	5			100				
11	Water Sensitive Cities	M3048	Pathirana	5							
11	Modelling river systems and lakes	M3075	Cattapan	5	60		40				
11	Flood Protection in Lowland Areas	M3104	Roelvink	5	60		40				
11	Remote sensing, GIS and modelling for agricultural water use	M3027	Karimi	5	25		75				

ENVIRONMENTAL SCIENCE AND TECHNOLOGY WITH UNIVALLE			C1019									
Location	Module number	Module Name	Code	Module coordinator	UVC /ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
Univalle	C1	C1 Chemistry of Environmental Pollution			3 /5.13	50		20		30		
	C2	C2 Environmental Pollution Microbiology			3 /5.13	x		x	x	x		
	C3	C3 Fundamentals of Environmental Processes			3 /5.13	60		20		20	20	
	C4	C4 Environmental and Development			3 /5.13	35		30	35			
	C5	C5 Engineering Research Introduction			2 /3.42			100		20		
U-IHE	4	Integrated project environmental science	M3031	vd Steen	5			70	30			
	5	Industrial Resource Management & Cleaner Production	M1953	Raj	5	60		35	5			
	6	Environmental systems analysis	M3034	Irvine	5	30		60	10			
	7	Environmental engineering	M3081	Raj	5	75		25				
	8	Environmental monitoring and modelling	M2658	Irvine	5	70		15		15		
	9	Foreign fieldtrip and fieldwork ES	M1766	de Ruyter	5			100				
	12	Summer courses			1			100				
	13	Groupwork ES	M2240	van Bruggen	5			100				
Univalle		MSc thesis (14 UVC)		various	14 / 23.94							
		Total ECTS			113.5							
U-IHE		Elective modules:										
	10	Aquatic ecosystems: processes and applications	M2122	Gettel	5			90	10			
	10	Environmental assessment for water related policies and develo	M3080	Mendoza	5	50		50				
	11	Solid waste management	M1331	Siebel	5	60		35	5			
	11	Strategic Planning for River Basins and Deltas	M3086	Yong	5	50		50				
	11	IWRM as a tool for adaptation to climate change	M2155	de Ruyter	5	70		30				
	11	Wetlands for livelihoods and conservation	M3089	Hes	5			80	20			
	11	Urban water governance	M1568	Acevedo Guerre	5			100				
	11	Advanced water transport and distribution	M2602	Trifunovic	5	60		40				
	11	Faecal Sludge Management	M2873	Ronteltap	5	85		15				
	11	Decentralised Water Supply and Sanitation	M2810	Sharma	5	60		30	10			
	11	Hydroinformatics for Decision Support	M3001	Jonoski	5			100				
	11	Water Sensitive Cities	M3048	Pathirana	5							
	11	Modelling river systems and lakes	M3075	Cattapan	5	60		40				
	11	Flood Protection in Lowland Areas	M3104	Roelvink	5	60		40				
	11	Remote sensing, GIS and modelling for agricultural water use	M3027	Karimi	5	25		75				

ENVIRONMENTAL SCIENCE WITH AIT			C1029									
Location	Module number	Module Name	Code	Module coordinator	AIT creditis / ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
AIT		Environmental chemistry and laboratory			3 (7.5)	x		x				
		Environmental quality management			3 (7.5)	x		x				
		Any two course out of:										
		- Air pollution and management			6 (15.0)	x		x				
		- Solid waste management										
		- Environmental impact assessment										
		- Industrial waste abatement and management										
U-IHE	4	Integrated project environmental science	M3031	vd Steen	2 (5.0)			70	30			
	5	Industrial Resource Management & Cleaner Production	M1953	Raj	2 (5.0)	60		35	5			
	6	Environmental systems analysis	M3034	Irvine	2 (5.0)	30		60	10			
	7	Constructed wetlands for wastewater treatment	M2216	van Bruggen	2 (5.0)	60		40				
	8	Environmental monitoring and modelling	M2658	Irvine	2 (5.0)	70		15		15		
	9	Foreign fieldtrip and fieldwork ES	M1766	de Ruyter	2 (5.0)			100				
		Elective modules:										
	10	Aquatic ecosystems: processes and applications	M2122	Gettel	2 (5.0)			90	10			
	10	Environmental assessment for water related policies and develo	M3080	Mendoza	2 (5.0)	50		50				
	11	MSc research proposal development for UWEM/EtSUD/AWMELW	M3039	Raj	0			x	x			
		Total coursework			26 (65)							
AIT												
		Elective			2 (5.0)	x		x				
		MSc thesis work			22 (55)			x	x			
		Grand total (coursework + thesis)			50 (125)							

ENVIRONMENTAL TECHNOLOGY ERASMUS MUNDUS			C1024									
1 General Courses												
Location	**Module number**	**Module name**	**Code**	**Module coordinator**	**74 ECTS**	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
U-IHE	1	Introduction to environmental science 1 +2	M3026	de Ruyter	5	80+20		20+35				
	3	Introduction to environmental science 3	M3038	de Ruyter				100				
	4	Integrated project environmental science	M3031	vd Steen	5			70	30			
		Seminars Environmental Technology and Engineering I			2							
Prague		Environmental Microbiology			4							
		Environmental Engineering			4							
		Wastewater Treatment			5							
		Sludge Management			3							
		Atmosphere Protection Technology			2							
		Waste Management and Treatment			4							
		Elective Project			5							
		Laboratory Training in Environmental Technology			3							
Ghent		Scientific Skills			4							
		Clean Technology			3							
		Environmental Fate and Management of Heavy Metals and Metalloids			5							
		Basics of Control Engineering and Process Engineering			4							
		Microbial Re-use Technology			3							
		Seminars Environmental Technology and Engineering II			3							
2 Elective Courses					**16 ECTS**							
Prague		Basics of Czech			2							
Ghent		Advanced Waste Gas Treatment			3							
		Applied Isotopes			5							
		Applied Statistics			5							
		Ecological Risk Assessment			7							
		Environmental Constructions			5							
		Environmental Ecology			7							
		Environmental Noise			3							
		Geostatistics			5							
		Life Cycle Assessment			3							
		Membrane Processes in Environmental Technology			3							
		Modeling and Control of Waste Water Treatment Plants			3							
		Quality of Groundwater Resources			5							
		Soil Degradation			3							
		Soil Water Management			3							
		Urban and Indoor Air Pollution			5							
		Internship			6							
		Environmental Legislation			3							
U-IHE		Basic Dutch for Foreigners	M1380	vd Vossenberg	2	50	50					
		Cleaner Production and the Water Cycle			5							
		Constructed Wetlands for Wastewater Treatment	M2216	van Bruggen	5	60		40				
		Ecological Sanitation			5							
		Modelling Sanitation Systems			5							
3 Master Dissertation					**30**							

LIMNOLOGY AND WETLAND MANAGEMENT			C1155									
Location	Module number	Module Name	Code	Module coordinator	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab report (%)	Home work (%)	Integrated in modules (%)
BOKU	LWM1	Basics in Limnology			9							
	LWM2	Ecology of Aquatic Organisms			6							
	LWM3	Basics in Applied Limnology			6							
	LWM4	Aquatic Ecosystem Management			4							
	LWM5	Scientific Methods			3							
EGERTON	ES05bL	Lake Ecology			5.6	60		10	20	10		
	ES06L	Stream & River Ecology			5.6	60			20	20		
	ES07L	Wetlands for Water Quality			5.6	60		10	20			10
	ES08L	Fisheries & Aquaculture			5.6	60			20			20
UNESCO-IHE	9	Data Analysis and Modeling for Aquatic Ecosystems	M1212	van Dam	5.6	40		40	20			
	10	Aquatic ecosystems: processes and applications	M2122	Gettel	5			90	10			
	11	Wetlands for livelihoods and conservation	M3089	Hes	5			80	20			
	12	Summer courses			1			100				
	13	Groupwork ES	M2240	van Bruggen	5			100				
	14	MSc research methodology and proposal development	M1288	van Bruggen	9			100				
	15	MSc research	M2927	various	36							
		TOTAL			120							

3. Water Science and Engineering programme

RIVER BASIN DEVELOPMENT		C1477									
Module number	Module Name	Code	Module coordinator	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
1	Introduction to Water Science and Engineering	M2131	Foppen	5	55		45				
2	Hydrology and hydraulics	M2208	Maskey	5	80		20				
3	River basin hydraulics, geotechnics and remote sensing	M2307	Paron	5	75		25				
4	River morphodynamics	M2730	Crosato	5	80		20				
5	Data collection and analysis and design	M3090	Werner	5	70		30				
6	River Basin Development and EIA	M1703	Masih	5	50		50				
7	River structures	M1171	Cattapan	5	100						
9	Fieldtrip and fieldwork WSE	M3101	Duker	5						100	
12	Summer courses			1			100				
13	Groupwork WSE	M1284	Veerbeek	5				100			
14	MSc preparatory course and thesis research proposal	M1679	Foppen	9			100				
15	MSc research	M2927	various	36			100				
	Elective modules:										
8	Dams and hydropower	M3009	Marence	5		50		50			
8	Planning and delivery of flood resilience	M2135	Gersonius	5		50		50			
10	Applied Groundwater Modelling	M2841	Zhou	5			100				
10	Flood Risk Management	M3083	Bhattacharya	5	30		70				
10	Drought Management and Reservoir Operations	M3036	Werner								
10	Geotechnical Engineering and Dredging	M2214	vd Wegen	5		60	40				
10	Innovative Water Systems for Agriculture	M3092	Karimi	5	40		60				
11	Solid waste management	M1331	Siebel	5	60		35	5			
11	Strategic Planning for River Basins and Deltas	M3086	Yong	5	50		50				
11	IWRM as a tool for adaptation to climate change	M2155	de Ruyter	5	70		30				
11	Wetlands for livelihoods and conservation	M3089	Hes	5			80	20			
11	Urban water governance	M1568	Acevedo Guerrero	5			100				
11	Advanced water transport and distribution	M2602	Trifunovic	5	60		40				
11	Faecal Sludge Management	M2873	Ronteltap	5	85		15				
11	Decentralised Water Supply and Sanitation	M2810	Sharma	5	60		30	10			
11	Hydroinformatics for Decision Support	M3001	Jonoski	5			100				
11	Water Sensitive Cities	M3048	Pathirana	5							
11	Modelling river systems and lakes	M3075	Cattapan	5	60		40				
11	Flood Protection in Lowland Areas	M3104	Roelvink	5	60		40				
11	Remote sensing, GIS and modelling for agricultural water use	M3027	Karimi	5	25		75				

COASTAL ENGINEERING AND PORT DEVELOPEMENT		C1427									
Module number	Module Name	Code	Module coordinator	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
1	Introduction to Water Science and Engineering	M2131	Foppen	5	55		45				
2	Hydrology and hydraulics	M2208	Maskey	5	80		20				
3	Introduction to coastal science and engineering	M1026	Semedo	5	90		10				
4	Port planning and infrastructure design	M1433	Dastgheib	5			100				
5	Coastal systems	M1553	Ranasinghe	5	70		30				
6	Coastal and port structures	M2033	Dastgheib	5			100				
7	Environmental aspects of coasts and ports	M2831	vd Wegen	5	60		40				
9	Fieldtrip and fieldwork WSE	M3101	Duker	5						100	
12	Summer courses			1			100				
13	Groupwork WSE	M1284	Veerbeek	5				100			
14	MSc research proposal development for WSE	M1679	Foppen	9			100				
15	MSc research	M2927	various	36			100				
	Elective modules:										
8	Management of coasts and ports (International Port Seminar)	M3078	van Schuylenburg	5				100			
8	Management of coasts and ports (ICZM)	M3079	vd Wegen	5		100					
8	Dams and hydropower	M3009	Marence	5	90		10				
10	Applied Groundwater Modelling	M2841	Zhou	5			100				
10	Flood Risk Management	M3083	Bhattacharya	5	30		70				
10	Drought Management and Reservoir Operations	M3036	Werner								
10	Geotechnical Engineering and Dredging	M2214	vd Wegen	5		60	40				
10	Innovative Water Systems for Agriculture	M3092	Karimi	5	40		60				
11	Solid waste management	M1331	Siebel	5	60		35	5			
11	Strategic Planning for River Basins and Deltas	M3086	Yong	5	50		50				
11	IWRM as a tool for adaptation to climate change	M2155	de Ruyter	5	70		30				
11	Wetlands for livelihoods and conservation	M3089	Hes	5			80	20			
11	Urban water governance	M1568	Acevedo Guerrero	5			100				
11	Advanced water transport and distribution	M2602	Trifunovic	5	60		40				
11	Faecal Sludge Management	M2873	Ronteltap	5	85		15				
11	Decentralised Water Supply and Sanitation	M2810	Sharma	5	60		30	10			
11	Hydroinformatics for Decision Support	M3001	Jonoski	5			100				
11	Water Sensitive Cities	M3048	Pathirana	5							
11	Modelling river systems and lakes	M3075	Cattapan	5	60		40				
11	Flood Protection in Lowland Areas	M3104	Roelvink	5	60		40				
11	Remote sensing, GIS and modelling for agricultural water use	M3027	Karimi	5	25		75				

LAND AND WATER DEVELOPMENT		C1505									
Module number	Module Name	Code	Module coordinator	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
1	Introduction to Water Science and Engineering	M2131	Foppen	5	55		45				
2	Hydrology and hydraulics	M2208	Maskey	5	80		20				
3	Principles and practices of land and water development	M3024	Karimi	5	30		80				
4	Design aspects of irrigation and drainage	M3087	Hayde	5	30		70				
5	Tertiary unit design and hydraulics	M2255	Hayde	5	40		60				
6	Socio-economic and environmental aspects of land and water de	M3023	Duker	5	30		70				
7	Conveyance and irrigation structures	M3025	Suryadi	5	35		65				
8	Management of irrigation and drainage systems	M3022	Duker	5	60		40				
9	Fieldtrip and fieldwork WSE	M3101	Duker	5						100	
12	Summer courses			1			100				
13	Groupwork WSE	M1284	Veerbeek	5				100			
14	MSc research proposal development for WSE	M1679	Foppen	9			100				
15	MSc research	M2927	various	36			100				
	Elective modules:										
10	Applied Groundwater Modelling	M2841	Zhou	5			100				
10	Flood Risk Management	M3083	Bhattacharya	5	30		70				
10	Drought Management and Reservoir Operations	M3036	Werner								
10	Geotechnical Engineering and Dredging	M2214	vd Wegen	5		60	40				
10	Innovative Water Systems for Agriculture	M3092	Karimi	5	40		60				
11	Solid waste management	M1331	Siebel	5	60		35	5			
11	Strategic Planning for River Basins and Deltas	M3086	Yong	5	50		50				
11	IWRM as a tool for adaptation to climate change	M2155	de Ruyter	5	70		30				
11	Wetlands for livelihoods and conservation	M3089	Hes	5			80	20			
11	Urban water governance	M1568	Acevedo Guerrero	5			100				
11	Advanced water transport and distribution	M2602	Trifunovic	5	60		40				
11	Faecal Sludge Management	M2873	Ronteltap	5	85		15				
11	Decentralised Water Supply and Sanitation	M2810	Sharma	5	60		30	10			
11	Hydroinformatics for Decision Support	M3001	Jonoski	5			100				
11	Water Sensitive Cities	M3048	Pathirana	5							
11	Modelling river systems and lakes	M3075	Cattapan	5	60		40				
11	Flood Protection in Lowland Areas	M3104	Roelvink	5	60		40				
11	Remote sensing, GIS and modelling for agricultural water use	M3027	Karimi	5	25		75				

LAND AND WATER DEVELOPMENT WITH NEBRASKA												
	Module number	Module Name	Code	Module coordinator	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	5	55		45				
	2	Hydrology and hydraulics	M2208	Maskey	5	80		20				
	3	Principles and practices of land and water development	M3024	Karimi	5	30		80				
	4	Design aspects of irrigation and drainage	M3087	Hayde	5	30		70				
	5	Tertiary unit design and hydraulics	M2255	Hayde	5	40		60				
	6	Socio-economic and environmental aspects of land and water de	M3023	Duker	5	30		70				
	7	Conveyance and irrigation structures	M3025	Suryadi	5	35		65				
	8	Management of irrigation and drainage systems	M3022	Duker	5	60		40				
	9	Fieldtrip and fieldwork WSE	M3101	Duker	5						100	
University of Nebraska, Lincoln, USA		Field Course: Measurement Techniques in Hydrology and Irrigation			3 (5)							
		Research Methodology & Thesis Research Proposal			2 (14)							
		Plant-Water Relations			3 (5)							
		Groundwater Geology			3 (5)							
		Advanced Irrigation and Drainage Systems Engineering			3 (5)							
		Advanced Irrigation Management			3 (5)							
		Water Law, Planning and Policy			3 (5)							
		Masters Research Project			4 (28)			100				

LAND AND WATER DEVELOPMENT WITH AIT			C1054									
Location	Module number	Module Name	Code	Module coordinator	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				
U-IHE	4	Design aspects of irrigation and drainage	M3087	Hayde	5	30		70				
	5	Tertiary unit design and hydraulics	M2255	Hayde	5	40		60				
	6	Socio-economic and environmental aspects of land and water de	M3023	Duker	5	30		70				
	7	Conveyance and irrigation structures	M3025	Suryadi	5	35		65				
	8	Management of irrigation and drainage systems	M3022	Duker	5	60		40				
	9	Fieldtrip and fieldwork WSE	M3101	Duker	5						100	
	11	MSc research proposal development for UWEM/EtSUD/AWMELW	M3039	Raj	0			x	x			
AIT		MSc research work			22							
		Elective modules:										
	10	Applied Groundwater Modelling	M2841	Zhou	5			100				
	10	Flood Risk Management	M3083	Bhattacharya	5	30		70				
	10	Drought Management and Reservoir Operations	M3036	Werner								
	10	Geotechnical Engineering and Dredging	M2214	vd Wegen	5		60	40				
	10	Innovative Water Systems for Agriculture	M3092	Karimi	5	40		60				

HYDROINFORMATICS		C1490									
Module number	Module Name	Code	Module coordinator	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
1	Introduction to Water Science and Engineering	M2131	Foppen	5	55		45				
2	Hydrology and hydraulics	M2208	Maskey	5	80		20				
3	Information technology and software engineering	M2191	Alfonso Segura	5	50		50				
4	Modelling theory and Computational Hydraulics	M1507	Popescu	5	55	25	20				
5	Modelling and information systems development	M2128	van Andel	5			100				
6	Computational Intelligence and Operational water management	M2847	Solomatine	5	55		45				
7	River basin modelling	M2665	Jonoski	5	100						
9	Fieldtrip and fieldwork WSE	M3101	Duker	5						100	
12	Summer courses			1			100				
13	Groupwork WSE	M1284	Veerbeek	5				100			
14	MSc research proposal development for WSE	M1679	Foppen	9			100				
15	MSc research	M2927	various	36			100				
	Elective modules:										
8	River Flood Analysis and Modelling	M2709	Popescu	5	50		50				
8	Urban flood management and disaster risk mitigation	M1710	Vojnovic	5	60		40				
10	Applied Groundwater Modelling	M2841	Zhou	5			100				
10	Flood Risk Management	M3083	Bhattacharya	5	30		70				
10	Drought Management and Reservoir Operations	M3036	Werner								
10	Geotechnical Engineering and Dredging	M2214	vd Wegen	5		60	40				
10	Innovative Water Systems for Agriculture	M3092	Karimi	5	40		60				
11	Solid waste management	M1331	Siebel	5	60		35	5			
11	Strategic Planning for River Basins and Deltas	M3086	Yong	5	50		50				
11	IWRM as a tool for adaptation to climate change	M2155	de Ruyter	5	70		30				
11	Wetlands for livelihoods and conservation	M3089	Hes	5			80	20			
11	Urban water governance	M1568	Acevedo Guerrero	5			100				
11	Advanced water transport and distribution	M2602	Trifunovic	5	60		40				
11	Faecal Sludge Management	M2873	Ronteltap	5	85		15				
11	Decentralised Water Supply and Sanitation	M2810	Sharma	5	60		30	10			
11	Hydroinformatics for Decision Support	M3001	Jonoski	5			100				
11	Water Sensitive Cities	M3048	Pathirana	5							
11	Modelling river systems and lakes	M3075	Cattapan	5	60		40				
11	Flood Protection in Lowland Areas	M3104	Roelvink	5	60		40				
11	Remote sensing, GIS and modelling for agricultural water use	M3027	Karimi	5	25		75				

HYDROLOGY AND WATER RESOURCES		C1501									
Module number	Module Name	Code	Module coordinator	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
1	Introduction to Water Science and Engineering	M2131	Foppen	5	55		45				
2	Hydrology and hydraulics	M2208	Maskey	5	80		20				
3	Hydrogeology	M2166	Zhou	5	70		30				
4	Surface hydrology	M2367	Venneker	5	70		30				
5	Water quality	M2497	McClain	5	70		30				
6	Tracer hydrology and flow systems analysis	M1903	Foppen	5	100						
8	Integrated hydrological and river modelling	M1309	Maskey	5			85	15			
9	Fieldtrip and fieldwork WSE	M3101	Duker	5						100	
12	Summer courses			1			100				
13	Groupwork WSE	M1284	Veerbeek	5				100			
14	MSc research proposal development for WSE	M1679	Foppen	9			100				
15	MSc research	M2927	various	36			100				
	Elective modules:										
7	Hydrological data collection and processing	M1554	Venneker	5	60				40		
7	Groundwater data collection and interpretation	M2227	Stigter	5	40		60				
10	Applied Groundwater Modelling	M2841	Zhou	5			100				
10	Flood Risk Management	M3083	Bhattacharya	5	30		70				
10	Drought Management and Reservoir Operations	M3036	Werner								
10	Geotechnical Engineering and Dredging	M2214	vd Wegen	5		60	40				
10	Innovative Water Systems for Agriculture	M3092	Karimi	5	40		60				
11	Solid waste management	M1331	Siebel	5	60		35	5			
11	Strategic Planning for River Basins and Deltas	M3086	Yong	5	50		50				
11	IWRM as a tool for adaptation to climate change	M2155	de Ruyter	5	70		30				
11	Wetlands for livelihoods and conservation	M3089	Hes	5			80	20			
11	Urban water governance	M1568	Acevedo Guerrero	5			100				
11	Advanced water transport and distribution	M2602	Trifunovic	5	60		40				
11	Faecal Sludge Management	M2873	Ronteltap	5	85		15				
11	Decentralised Water Supply and Sanitation	M2810	Sharma	5	60		30	10			
11	Hydroinformatics for Decision Support	M3001	Jonoski	5			100				
11	Water Sensitive Cities	M3048	Pathirana	5							
11	Modelling river systems and lakes	M3075	Cattapan	5	60		40				
11	Flood Protection in Lowland Areas	M3104	Roelvink	5	60		40				
11	Remote sensing, GIS and modelling for agricultural water use	M3027	Karimi	5	25		75				

FLOOD RISK MANAGEMENT			C1440									
Location	Module number	Module Name	Code	Module coordinator	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
TU-Dresden		Introduction to 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	5	55		45				
	7	River basin modelling	M2665	Jonoski	5	100						
		One course out of the following two:										
	8a	River Flood Analysis and Modelling	M2709	Popescu	5	50		50				
	8b	Urban flood management and disaster risk mitigation	M1710	Vojnovic	5	40		60				
	9	International Fieldtrip (12 days)			5						100	
	10	Flood Risk Management	M3083	Bhattacharya	5	30		70				
	11	Hydroinformatics for Decision Support	M3001	Jonoski	5			100				
				Total ECTS	**30**							
UPC		Global warming effects, Flood and Drought			3		40	60				
		Coastal flooding: impacts, conflicts and risks			3	100						
		Fluvial morphodynamics			5							
		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	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							
		Ocean and Atmospheric Physics			4,5							
		Integrated River Basin Management			4,5							
		Groundwater Pollution and Protection			6							
		Global Environmental Policies			4,5							
U-IHE	6	Tracer hydrology and flow systems analysis	M1903	Foppen	5	100						
	7	Groundwater data collection and interpretation	M2227	Stigter	5	40		60				
	8	Groundwater adaptation to global change impacts	M3096	Stigter	5			100				
	9	Fieldtrip and Fieldwork	M2440	Duker	5						100	
	10	Applied Groundwater Modelling	M2841	Zhou	5			100				
	11	IWRM as a Tool for Adaptation to Climate Change	M2155	de Ruyter	5	70			30			
TU-Dresden		Climate Systems and Climate Modelling			5							
		Soil Water			5							
		Study Project IWRM			10							
		Ecology (optional)			5							
		Advanced Watershed Management (optional)			5							
		Integrated Land Use Management in the Landscape (optional)			5							
		Drinking Water Supply (optional)			5							
		Water Quality adn Water Treatment (optinal)			5							
IST/IHE/TUD		MSc thesis work			30							

4. Water Management programme

WATER RESOURCES MANAGEMENT		C1396									
Module number	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	M3084	Evers	5	45		55				
2	The water resources system	M3042	Susnik	5	70		30				
3	Water governance	M3032	Kemerink	5		40	60				
4	Water economics	M3028	Yong	5	70		30				
5	Water and environmental law	M1003	Jaspers	5	70		30				
6	Water resources assessment	M1617	Yasir	5	65		35				
7	Water systems modelling	M2054	Graas	5	60			40			
8	Water resources planning	M2535	Cauwenberg	5	60		40				
9	International fieldwork	M3045	Tutusaus Luque	5			100				
12	Summer course			1			100				
13	IWRM Groupwork	M2252	Susnik	5			100				
14	MSc preparatory course and thesis research proposal for WM	M2169	Kooy	9		100					
15	MSc thesis research and thesis writing	M2927	various	36		100					
	Elective modules:										
10	Partnerships for Water Supply and Sanitation	M2711	Schwartz	5		50	50				
10	Aquatic Ecosystems Processes and Applications	M2122	Gettel	5			90	10			
10	Institutional Analysis	M3007	Smit	5			80	20			
11	Solid waste management	M1331	Siebel	5	60		35	5			
11	Strategic Planning for River Basins and Deltas	M3086	Yong	5	50		50				
11	IWRM as a tool for adaptation to climate change	M2155	de Ruyter	5	70		30				
11	Wetlands for livelihoods and conservation	M3089	Hes	5			80	20			
11	Urban water governance	M1568	Acevedo Guerre	5			100				
11	Advanced water transport and distribution	M2602	Trifunovic	5	60		40				
11	Faecal Sludge Management	M2873	Ronteltap	5	85		15				
11	Decentralised Water Supply and Sanitation	M2810	Sharma	5	60		30	10			
11	Hydroinformatics for Decision Support	M3001	Jonoski	5			100				
11	Water Sensitive Cities	M3048	Pathirana	5							
11	Modelling river systems and lakes	M3075	Cattapan	5	60		40				
11	Flood Protection in Lowland Areas	M3104	Roelvink	5	60		40				
11	Remote sensing, GIS and modelling for agricultural water use	M3027	Karimi	5	25		75				

WATER CONFLICT MANAGEMENT		C1370									
Module number	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	M3084	Evers	5	45		55				
2	The water resources system	M3042	Susnik	5	70		30				
3	Water governance	M3032	Kemerink	5		40	60				
4	Water economics	M3028	Yong	5	70		30				
5	Water and environmental law	M1003	Jaspers	5	70		30				
6	Water conflict management 1	M3069	Shubber	5	50		50				
7	Water conflict management 2	M3070	Shubber	5	60		40				
8	Water resources planning	M2535	Cauwenberg	5	60		40				
9	International fieldwork	M3045	Tutusaus Luque	5			100				
12	Summer course			1			100				
13	IWRM Groupwork	M2252	Susnik	5			100				
14	MSc preparatory course and thesis research proposal for WM	M2169	Kooy	9		100					
15	MSc thesis research and thesis writing	M2927	various	36		100					
	Elective modules:										
10	Partnerships for Water Supply and Sanitation	M2711	Schwartz	5		50	50				
10	Aquatic Ecosystems Processes and Applications	M2122	Gettel	5			90	10			
10	Institutional Analysis	M3007	Smit	5			80	20			
11	Solid waste management	M1331	Siebel	5	60		35	5			
11	Strategic Planning for River Basins and Deltas	M3086	Yong	5	50		50				
11	IWRM as a tool for adaptation to climate change	M2155	de Ruyter	5	70		30				
11	Wetlands for livelihoods and conservation	M3089	Hes	5			80	20			
11	Urban water governance	M1568	Acevedo Guerre	5			100				
11	Advanced water transport and distribution	M2602	Trifunovic	5	60		40				
11	Faecal Sludge Management	M2873	Ronteltap	5	85		15				
11	Decentralised Water Supply and Sanitation	M2810	Sharma	5	60		30	10			
11	Hydroinformatics for Decision Support	M3001	Jonoski	5			100				
11	Water Sensitive Cities	M3048	Pathirana	5							
11	Modelling river systems and lakes	M3075	Cattapan	5	60		40				
11	Flood Protection in Lowland Areas	M3104	Roelvink	5	60		40				
11	Remote sensing, GIS and modelling for agricultural water use	M3027	Karimi	5	25		75				

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	M3084	Evers	5	45		55				
2	The water resources system	M3042	Susnik	5	70		30				
3	Water governance	M3032	Kemerink	5		40	60				
4	Water economics	M3028	Yong	5	70		30				
5	Water and environmental law	M1003	Jaspers	5	70		30				
9	International fieldwork	M3045	Tutusaus Luque	5			100				
12	Summer course			1			100				
13	IWRM Groupwork	M2252	Susnik	5			100				
14	MSc preparatory course and thesis research proposal for WM	M2169	Kooy	9		100					
15	MSc thesis research and thesis writing	M2927	various	36		100					
	Elective modules:										
6	Water quality assessment	M2835	de Ruyter	5	60		30		10		
6	Water resources assessment	M1617	Yasir	5	65		35				
6	Water conflict management 1	M3069	Shubber	5	50		50				
6	Managing water organisations	M3103	Schwartz	5			100				
7	Environmental Engineering	M3081	Raj	5	75		25				
7	Water systems modelling	M2054	Graas	5	60			40			
7	Water conflict management 2	M3070	Shubber	5	60		40				
7	Environmental management and water services	M3041	Bichai	5		50	50				
8	Environmental planning and implementation	M3021	Evers	5	50		50				
8	Water resources planning	M2535	Cauwenberg	5	60		40				
8	Financial management in the water sector	M3044	Tutusaus Luque	5	50		50				
10	Partnerships for Water Supply and Sanitation	M2711	Schwartz	5		50	50				
10	Aquatic Ecosystems Processes and Applications	M2122	Gettel	5			90	10			
10	Institutional Analysis	M3007	Smit	5			80	20			
11	Solid waste management	M1331	Siebel	5	60		35	5			
11	Strategic Planning for River Basins and Deltas	M3086	Yong	5	50		50				
11	IWRM as a tool for adaptation to climate change	M2155	de Ruyter	5	70		30				
11	Wetlands for livelihoods and conservation	M3089	Hes	5			80	20			
11	Urban water governance	M1568	Acevedo Guerre	5			100				
11	Advanced water transport and distribution	M2602	Trifunovic	5	60		40				
11	Faecal Sludge Management	M2873	Ronteltap	5	85		15				
11	Decentralised Water Supply and Sanitation	M2810	Sharma	5	60		30	10			
11	Hydroinformatics for Decision Support	M3001	Jonoski	5			100				
11	Water Sensitive Cities	M3048	Pathirana	5							
11	Modelling river systems and lakes	M3075	Cattapan	5	60		40				
11	Flood Protection in Lowland Areas	M3104	Roelvink	5	60		40				
11	Remote sensing, GIS and modelling for agricultural water use	M3027	Karimi	5	25		75				

WATER SERVICES MANAGEMENT		C1409									
Module number	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	M3084	Evers	5	45		55				
2	The water resources system	M3042	Susnik	5	70		30				
3	Water governance	M3032	Kemerink	5		40	60				
4	Water economics	M3028	Yong	5	70		30				
5	Water and environmental law	M1003	Jaspers	5	70		30				
6	Managing water organisations	M3103	Schwartz	5			100				
7	Environmental management and water services	M3041	Bichai	5		50	50				
8	Financial management in the water sector	M3044	Tutusaus Luque	5	50		50				
9	International fieldwork	M3045	Tutusaus Luque	5			100				
12	Summer course			1			100				
13	IWRM Groupwork	M2252	Susnik	5			100				
14	MSc preparatory course and thesis research proposal for WM	M2169	Kooy	9		100					
15	MSc thesis research and thesis writing	M2927	various	36		100					
	Elective modules:										
10	Partnerships for Water Supply and Sanitation	M2711	Schwartz	5		50	50				
10	Aquatic Ecosystems Processes and Applications	M2122	Gettel	5			90	10			
10	Institutional Analysis	M3007	Smit	5			80	20			
11	Solid waste management	M1331	Siebel	5	60		35	5			
11	Strategic Planning for River Basins and Deltas	M3086	Yong	5	50		50				
11	IWRM as a tool for adaptation to climate change	M2155	de Ruyter	5	70		30				
11	Wetlands for livelihoods and conservation	M3089	Hes	5			80	20			
11	Urban water governance	M1568	Acevedo Guerre	5			100				
11	Advanced water transport and distribution	M2602	Trifunovic	5	60		40				
11	Faecal Sludge Management	M2873	Ronteltap	5	85		15				
11	Decentralised Water Supply and Sanitation	M2810	Sharma	5	60		30	10			
11	Hydroinformatics for Decision Support	M3001	Jonoski	5			100				
11	Water Sensitive Cities	M3048	Pathirana	5							
11	Modelling river systems and lakes	M3075	Cattapan	5	60		40				
11	Flood Protection in Lowland Areas	M3104	Roelvink	5	60		40				
11	Remote sensing, GIS and modelling for agricultural water use	M3027	Karimi	5	25		75				

WATER QUALITY MANAGEMENT		C1383									
Module number	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	M3084	Evers	5	45		55				
2	The water resources system	M3042	Susnik	5	70		30				
3	Water governance	M3032	Kemerink	5		40	60				
4	Water economics	M3028	Yong	5	70		30				
5	Water and environmental law	M1003	Jaspers	5	70		30				
6	Water quality assessment	M2835	de Ruyter	5	60		30		10		
7	Environmental Engineering	M3081	Raj	5	75		25				
8	Environmental planning and implementation	M3021	Evers	5	50		50				
9	International fieldwork	M3045	Tutusaus Luque	5			100				
12	Summer course			1			100				
13	IWRM Groupwork	M2252	Susnik	5			100				
14	MSc preparatory course and thesis research proposal for WM	M2169	Kooy	9		100					
15	MSc thesis research and thesis writing	M2927	various	36		100					
	Elective modules:										
10	Partnerships for Water Supply and Sanitation	M2711	Schwartz	5		50	50				
10	Aquatic Ecosystems Processes and Applications	M2122	Gettel	5			90	10			
10	Institutional Analysis	M3007	Smit	5			80	20			
11	Solid waste management	M1331	Siebel	5	60		35	5			
11	Strategic Planning for River Basins and Deltas	M3086	Yong	5	50		50				
11	IWRM as a tool for adaptation to climate change	M2155	de Ruyter	5	70		30				
11	Wetlands for livelihoods and conservation	M3089	Hes	5			80	20			
11	Urban water governance	M1568	Acevedo Guerre	5			100				
11	Advanced water transport and distribution	M2602	Trifunovic	5	60		40				
11	Faecal Sludge Management	M2873	Ronteltap	5	85		15				
11	Decentralised Water Supply and Sanitation	M2810	Sharma	5	60		30	10			
11	Hydroinformatics for Decision Support	M3001	Jonoski	5			100				
11	Water Sensitive Cities	M3048	Pathirana	5							
11	Modelling river systems and lakes	M3075	Cattapan	5	60		40				
11	Flood Protection in Lowland Areas	M3104	Roelvink	5	60		40				
11	Remote sensing, GIS and modelling for agricultural water use	M3027	Karimi	5	25		75				

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 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.

UNESCO-IHE - Academic Calendar 2016/2018

YEAR 1	2016											2017																
	October		November				December					January				February				March				April				
Week	42	43	44	45	46	47	48	49	50	51	52	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17
Mon	17	24	31	07	14	21	28	05	12	19	26	02	09	16	23	30	06	13	20	27	06	13	20	27	03	10	17	24
Tue	18	25	01	08	15	22	29	06	13	20	27	03	10	17	24	31	07	14	21	28	07	14	21	28	04	11	18	25
Wed	19	26	02	09	16	23	30	07	14	21	28	04	11	18	25	01	08	15	22	01	08	15	22	29	05	12	19	26
Thu	20	27	03	10	17	24	01	08	15	22	29	05	12	19	26	02	09	16	23	02	09	16	23	30	06	13	20	27
Fri	21	28	04	11	18	25	02	09	16	23	30	06	13	20	27	03	10	17	24	03	10	17	24	31	07	14	21	28
Sat	22	29	05	12	19	26	03	10	17	24	31	07	14	21	28	04	11	18	25	04	11	18	25	01	08	15	22	29
Sun	23	30	06	13	20	27	04	11	18	25	01	08	15	22	29	05	12	19	26	05	12	19	26	02	09	16	23	30
		(2x5 ECTS)							(2x5 ECTS)									(2x5 ECTS)								(2x5 ECTS)		
		Module 1			Module 2				Module 3					Module 4				Module 5			Module 6				Module 7			Module 8

YEAR 1	2017			fieldtrip			2017								Groupwork			2017							
	May				June				July					August				September				October			
Week	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
Mon	01	08	15	22	29	05	12	19	26	03	10	17	24	31	07	14	21	28	04	11	18	25	02	09	16
Tue	02	09	16	23	30	06	13	20	27	04	11	18	25	01	08	15	22	29	05	12	19	26	03	10	17
Wed	03	10	17	24	31	07	14	21	28	05	12	19	26	02	09	16	23	30	06	13	20	27	04	11	18
Thu	04	11	18	25	01	08	15	22	29	06	13	20	27	03	10	17	24	31	07	14	21	28	05	12	19
Fri	05	12	19	26	02	09	16	23	30	07	14	21	28	04	11	18	25	01	08	15	22	29	06	13	20
Sat	06	13	20	27	03	10	17	24	01	08	15	22	29	05	12	19	26	02	09	16	23	30	07	14	21
Sun	07	14	21	28	04	11	18	25	02	09	16	23	30	06	13	20	27	03	10	17	24	01	08	15	22
				(1x5 ECTS)			(2x5 ECTS)							1	(1x5 ECTS)					(4+5 ECTS)					
				Module 9			Module 10			Module 11				M12	Module 13					Module 14					

YEAR 2	2017										2018																	
	October	November				December					January				February				March				April					M..
Week	43	44	45	46	47	48	49	50	51	52	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18
Mon	23	30	06	13	20	27	04	11	18	25	01	08	15	22	29	05	12	19	26	05	12	19	26	02	09	16	23	30
Tue	24	31	07	14	21	28	05	12	19	26	02	09	16	23	30	06	13	20	27	06	13	20	27	03	10	17	24	01
Wed	25	01	08	15	22	29	06	13	20	27	03	10	17	24	31	07	14	21	28	07	14	21	28	04	11	18	25	02
Thu	26	02	09	16	23	30	07	14	21	28	04	11	18	25	01	08	15	22	01	08	15	22	29	05	12	19	26	03
Fri	27	03	10	17	24	01	08	15	22	29	05	12	19	26	02	09	16	23	02	09	16	23	30	06	13	20	27	04
Sat	28	04	11	18	25	02	09	16	23	30	06	13	20	27	03	10	17	24	03	10	17	24	31	07	14	21	28	05
Sun	29	05	12	19	26	03	10	17	24	31	07	14	21	28	04	11	18	25	04	11	18	25	01	08	15	22	29	06
	(36 ECTS)																											
	Module 15																											

Legend

- = Lecture period
- = Examination days
- = MSC thesis w riting
- = Holiday/free time
- = Opening acad. year
- = Diploma aw arding
- = Summer course

Christmas:	Dec 25/26 2016
Good Friday:	April 14 2017
Easter:	April 16/17 2017
Kingsday:	April 27 2017
Liberationday:	May 5 2017
Ascencion:	May 25 2017
Pentecost:	Juni 4/5 2017
Christmas:	Dec 25/26 2017
Good Friday:	March 30 2018
Easter:	April 1/2 2018
Kingsday:	27 April 2018

Urban Water and Sanitation

Certificate course

2016/2017

Online Course on Biological Wastewater Treatment: Principles, Modelling and Design

M1386

Hydrology, Water Supply and Water Demand Management and GIS

Term	201617T01
Coordinator	S.G. Salinas Rodríguez
Credit points	5.000000000
Specialization	Core Program

Target Group

Programme target group

Prerequisites

Programme prerequisites

Learning Objectives

1 identify and discuss the basic elements of hydrology, and apply hydrological principles in water and wastewater engineering.

2 Forecast water demand in a city, based on population forecasts, per capita use and Water Demand Management measures.

Assessments

%	Type	Name
25	Assignment	GIS
45	Written examination (closed book)	Hydrology/Hydraulics
30	Written examination (closed book)	Water Supply and Water Demand Management

Topics

1 Hydrology and Hydraulics

Hydrological cycle, precipitation, evaporation, run-off, river systems, unsaturated zone and groundwater systems; rock and water, porosity, permeability, aquifers and aquitards, groundwater balances, groundwater availability, use and method of groundwater

2 Water Supply and Water Demand Management

Different types of water demand, factors affecting water demand, demand forecasting, urban water demand management approaches, measures and case studies.

3 Geographic Information Systems (GIS)

A practical introduction to the use of geographic information systems, remote sensing technologies and GIS-based modelling for the analysis and solution of different water and environmental problems. State of the art open source software will be used for

Topics

4 Hydrology and Hydraulics (2)

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Hydrology and Hydraulics	12	0	8	0	0	0	20	44	S.G. Salinas Rodríguez
2	Water Supply and Water Demand Management	8	0	0	0	0	0	8	24	S.K. Sharma
3	Geographic Information Systems (GIS)	8	8	0	0	0	0	8	32	J. van der Kwast
4	Hydrology and Hydraulics (2)	0	0	0	0	0	0	0	0	J.W. Wenninger, T.Y. Stigter
	Total	28	8	8	0	0	0	36	100	

Education Material

Lecture notes	Lecture notes GIS
Lecture notes	Lecture notes Hydrology
Lecture notes	Lecture notes Water Supply and Water Demand Management

Scientific Software

M3043

Chemistry and Public Health

Term	201617T02
Coordinator	Y.M. Slokar
Credit points	5.000000000
Specialization	Core Program

Target Group

Programme target group

Prerequisites

Programme prerequisites

Learning Objectives

1 Describe bonds between elements and identify chemical reactions.
2 Calculate stoichiometric relationships in reactions and balance them.
3 Describe reactions in water treatment (flocculation, adsorption, disinfection, softening, etc.).
4 Describe waterborne infectious diseases and the pathogens.
5 List legislative requirements for safe water, and explain Water Safety Plan and QMRA concepts for waterborne infections.
6 Reproduce pathogen reductions by treatment processes.

Assessments

%	Type	Name
5	Lab. Report	Chemistry
60	Written examination (closed book)	Chemistry
35	Assignment	Public health

Topics

1 Chemistry

Atoms, ions, molecules; Periodic table of elements; Chemical bonds; Physical properties of matter; Basic principles of chemical reactions; Reaction rate; Equilibrium; Acid-base reactions; Precipitation vs. solubility; Redox reactions; Adsorption phenomenon and mechanisms; Ion exchange; Reactions in water treatment (flocculation, disinfection, iron removal, removal of aggressivity, softening); Introduction to organic chemistry.

2 Public health

Waterborne infectious diseases; Global situation and regulations concerning water quality (WHO, UN, etc.); Current and innovative water treatment processes - focus on pathogen reduction; Water Safety Plans and risk assessment; Detection methodologies for microbial indicators and pathogens (e.g. ISO).

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Chemistry	12	0	10	4	0	0	26	54	Y.M. Slokar
2	Public health	8	6	6	0	0	0	14	36	G. Ferrero
	Total	20	6	16	4	0	0	40	90	

Education Material

Lecture notes	Chemistry: self-study material, lecture notes, laboratory notes.
Lecture notes	Public health: lecture notes.

Scientific Software

M3030

EPT, Microbiology and Integrated Urban Water Management

Term	201617T03
Coordinator	N.P. van der Steen
Credit points	5.000000000
Specialization	Core Program

Target Group

Prerequisites

Learning Objectives

1 Apply mass balance analysis to natural and engineered water systems, especially for the analysis of microbial growth and substrate conversion in CFST and plug flow reactors.

2 Apply microbiological principles in water and wastewater engineering.

3 Develop strategies for Integrated Urban Water Management, and to evaluate consequences for the wider social, economic and environmental context. The specific learning objectives for IUWM are:

Assessments

%	Type	Name
35	Written examination (closed book)	EPT
30	Assignment	IUWM
35	Written examination (closed book)	Microbiology

Topics

1 **Environmental Process Technology (EPT)**

2 **Microbiology**

3 **Integrated Urban Water Management (IUWM)**

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Environmental Process Technology (EPT)	18	0	4	0	0	0	22	58	N.P. van der Steen
2	Microbiology	12	0	0	16	0	0	28	68	J.J.A. van Bruggen, J.L.C.M van de Vossenberg
3	Integrated Urban Water Management (IUWM)	21	20	9	0	0	0	30	92	D. Brdanovic, J.G. Evers, N.P. van der Steen, W.J. Sturrock
	Total	51	20	13	16	0	0	80	218	

Education Material

Scientific Software

M2550

Surface Water Treatment I

Term	201617T04
Coordinator	M.D. Kennedy
Credit points	5.000000000
Specialization	

Target Group

Mid-career professionals dealing with technical aspects of water and wastewater treatment plants, working for municipalities, water supply agencies or consulting firms.

Prerequisites

BSc degree in Engineering or similar technical background meeting the MSc Programme entry requirements.

Learning Objectives

1 Describe the theoretical principles of the unit processes: coagulation, filtration, sedimentation and dissolved air flotation in conventional surface water treatment

2 Link theoretical principles with practical aspects

3 Determine design parameters from experimental studies

4 Design a sedimentation tank

Assessments

%	Type	Name
20	Assignment	
20	Lab. Report	
60	Written examination (closed book)	

Topics

1 Coagulation

Theory of coagulation and flocculation processes: colloidal stability and mechanisms of destabilization, rapid and slow mixing, coagulation in practice and natural coagulants.

2 Sedimentation

Hydrodynamic principles of sedimentation and flotation, Stokes Law, principles of discrete settling, flocculent settling and hindered settling. Horizontal and vertical continuous flow basins, settling tanks, shape of inlets and outlets. Design of a rectan

3 Dissolved air flotation

Key design parameters, Henry's law, nucleus theory, Stokes law, rate of rise theory, hydraulic loading rate, solids loading

Topics

4 Filtration

General introduction to various types of filtration systems, Mechanical filtration, Slow sand filtration, Rapid sand filtration (pilot experiments, removal mechanisms, hydraulics, filter elements, rate control, backwashing, multi-layer filtration, applica

5 Design asects of surface water treatment

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Coagulation	6	0	2	4	0	0	12	28	JP Buiteman, M.D. Kennedy
2	Sedimentation	10	4	6	3	0	0	19	46	S.K. Sharma
3	Dissolved air flotation	2	0	2	0	0	0	4	8	
4	Filtration	12	0	6	4	0	0	22	50	JP Buiteman, S.K. Sharma
5	Design asects of surface water treatment	0	0	0	0	8	0	8	8	M.D. Kennedy, S.K. Sharma
	Total	30	4	16	11	8	0	65	140	

Education Material

Scientific Software

M3074

Urban Drainage and Sewerage

Term	201617T04
Coordinator	Z. Vojinovic
Credit points	5.000000000
Specialization	Core Program

Target Group

The same as the specializations' (SE, UWEM) target groups.

Prerequisites

The same as the specializations' (SE, UWEM) per-requisites and having followed all the preceding modules.

Learning Objectives

1 Critically assess and analyse quantity and quality characteristics of stormwater and wastewaters originating from urban environments as a basis for the design, operation and maintenances of urban drainage system facilities.

2 Describe the chemical and biological processes that take place within sewer systems, and evaluate their implications for the design and operate of urban drainage systems

3 Explain the standard practice in designing urban drainage systems. Prepare drainage system designs by integrating information on hydrological, hydraulic, economic and practical engineering concerns, and evaluating different design options.

Assessments

%	Type	Name
20	Assignment	Computer workshops and Individual assignment
20	Assignment	Design Exercises
60	Written examination (closed book)	Intro. to urban drainage and sewerage, Rainfall characteristics and wet weather flows quantitative, Sewerage layout and design and design exercise and pumping stations, Hydraulics for ur

Topics

1 **Introduction to Module**

2 **Introduction to urban drainage and sewerage and Types of drainage and sewer system**

purpose, types and historical development, system components and layout.

3 **Urban hydrological and hydraulic processes**

4 **Sewerage layout and design and design exercise and pumping stations**

5 **Sewer processes**

Topics

6 Data acquisition for urban drainage and sewerage studies

7 Model-based design and simulation

8 Hydraulics of urban drainage and sewerage

9 Dry and wet weather flows quantitative characterization and exercise

10 Conventional sewer design exercise

11 Pumping stations and CSOs

12 Current Practice and Multifunctional Design

Sustainable urban drainage measures (SUDS), BMPs, LIDS, Multi functional design, Multiple Benefits, tools for technology selection

13 Field trip

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Introduction to Module	1	0	0	0	0	0	1	3	A. Sanchez Torres
2	Introduction to urban drainage and sewerage and Types of drainage and sewer system	2	0	0	0	0	0	2	6	A. Sanchez Torres
3	Urban hydrological and hydraulic processes	6	0	0	0	0	0	6	18	P.D.A. Pathirana
4	Sewerage layout and design and design exercise and pumping stations	4	0	0	0	0	0	4	12	A. Sanchez Torres
5	Sewer processes	8	0	4	0	0	0	12	28	
6	Data acquisition for urban drainage and sewerage studies	2	0	0	0	0	0	2	6	Z. Vojinovic
7	Model-based design and simulation	2	0	4	0	0	0	6	10	A. Sanchez Torres, Z. Vojinovic
8	Hydraulics of urban drainage and sewerage	6	0	0	0	0	0	6	18	A. Sanchez Torres
9	Dry and wet weather flows quantitative characterization and exercise	4	0	0	0	0	0	4	12	D. Brdanovic
10	Conventional sewer design exercise	0	0	0	0	0	6	6	18	
11	Pumping stations and CSOs	2	0	0	0	0	0	2	6	A. Sanchez Torres
12	Current Practice and Multifunctional Design	2	0	0	0	0	0	2	6	A. Sanchez Torres, Z. Vojinovic
13	Field trip	0	0	0	0	3	0	3	3	A. Sanchez Torres
	Total	39	0	8	0	3	6	56	146	

Education Material

Scientific Software
Mike Urban

M3047

Asset Management

Term	201617T05
Coordinator	P.D.A. Pathirana
Credit points	5.000000000
Specialization	

Target Group

Engineers and Managers of organizations involved in Water, Wastewater, Drainage and Flood management in cities. However, this course assumes very little as pre-requisites, so, if you are from another discipline, but interested in the content (see description and learning objectives below), you are welcome to apply.

Prerequisites

A first degree in Engineering, Science or a related field. However,enthusiastic participants who possess degrees of different backgroundswould be admitted on case-by-case basis.

Learning Objectives

1	Explain the historical processes that made asset management approach important for urban infrastructure engineers and managers and describe the drivers that make asset management crucial for sustainable provision of water related infrastructure services
2	o Define asset management in your own words. List and describe the essential steps of an asset management plan and provide example problems from one's own experience which asset management approach would be/ would have been able to solve;
3	Describe the techniques used in asset inventories (e.g. condition rating) and describe the importance of data for asset management process.
4	Define databases and describe what a relational database is. Design a simple relational database (on paper!). Lis the important features of a relational database and appraise the use of data driven models in Asset Management. Describe sample approaches
5	Explain Risk-based asset management decision making. Apply hydraulic modelling to establish significance of asset components of water distribution/drainage systems;
6	Describe asset condition modelling approaches. Recommend suitable modelling approaches for practical problems and appraise the recent developments in the field of Asset Management of water infrastructure.
7	Describe the concept of asset life-cycle costing. Perform LCC calculations using spreadsheet; o Describe the role of optimization in asset management. Apply optimization techniques for solving simple urban water problems.

Assessments

%	Type	Name
0,5	Assignment	All assignments including workshops and homework
0,5	Oral examination	

Topics

1	**Introduction + Overview of the course**
2	**Asset Inventory**
3	**Data/Databases**
4	**Relational databases in Asset Management**
5	**Making sense of data - data mining in AM**
6	**Risk-based decision making in AM**
7	**Risk-based decision making - workshop**
8	**Condition Modelling**
9	**Condition Modelling exercise**
10	**Field trip**
11	**Advancements in Asset Management**
12	**Economics of AM**
13	**Failure registration in AM**
14	**Special considerations in applying AM in developing countries**
15	**Historical context of modern Asset Management**
16	**Sustainable Water Services and AM**

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Introduction + Overview of the course	1	0	0	0	0	0	1	3	P.D.A. Pathirana
2	Asset Inventory	2	0	0	0	0	0	2	6	B. Gersonius
3	Data/Databases	1	0	0	0	0	0	1	3	S.D. Seyoum
4	Relational databases in Asset Management	2	0	2	0	0	0	4	8	P.D.A. Pathirana
5	Making sense of data - data mining in AM	2	0	4	0	0	0	6	10	P.D.A. Pathirana, S.D. Seyoum
6	Risk-based decision making in AM	2	0	0	0	0	0	2	6	P.D.A. Pathirana
7	Risk-based decision making - workshop	1	0	8	0	0	0	9	11	P.D.A. Pathirana
8	Condition Modelling	8	0	0	0	0	0	8	24	
9	Condition Modelling exercise	0	0	10	0	0	0	10	10	
10	Field trip	0	0	0	0	8	0	8	8	P.D.A. Pathirana
11	Advancements in Asset Management	6	0	2	0	0	0	8	20	P.D.A. Pathirana
12	Economics of AM	2	0	0	0	0	0	2	6	J.A. van Dijk
13	Failure registration in AM	2	0	0	0	0	0	2	6	
14	Special considerations in applying AM in developing countries	2	0	2	0	0	0	4	8	P.D.A. Pathirana
15	Historical context of modern Asset Management	1	0	0	0	0	0	1	3	P.D.A. Pathirana
16	Sustainable Water Services and AM	6	0	0	0	0	0	6	18	R.M. Ashley
	Total	38	0	28	0	8	0	74	150	

Education Material

Scientific Software

M1802

Conventional Wastewater Treatment

Term	201617T05
Coordinator	C.M. Lopez Vazquez
Credit points	5.000000000
Specialization	

Target Group

MSc participants enroled in the Municipal Water Infrastructure program from the Sanitary Engineering Specialization (MWI-SE). Wastewater professionals with background and/or proven qualifications in sanitary engineering, environmental sciences, microbiology, civil engineers, chemical engineering, biochemical engineering, environmental engineering and/or environmental biotechnology.

Prerequisites

Preceding modules of the MWI-SE program and/or, in the case of short-course participants, required background on sanitary and wastewater engineering (see target group) in full compliance with UNESCO-IHE admission regulations.

Learning Objectives

1 critically determine and analyse quality and quantity characteristics of wastewater originating from urban environments as a basis for the design, control and operation of sewage treatment facilities.

2 discuss the physical, chemical, and biological processes applied for sewage purification and the complex interactions among them occurring in wastewater treatment systems.

3 apply the knowledge on biological treatment processes and engineering on the process design and critical assessment of wastewater treatment systems and configurations for the removal of organic matter (as COD) and nutrients (nitrogen and phosphorus)

4 discuss the principles, fundamentals and applicability of recently developed wastewater treatment processes such as innovative nitrogen removal processes and membrane bioreactors.

Assessments

%	Type	Name
20	Assignment	
80	Written examination (closed book)	

Topics

1 **Wastewater characterization and sampling**

Description and analysis of the different factors that affect the quantity and quality of wastewater generated in urban environments. Discussion of relevant components and activities commonly used to assess and determine the wastewater quality and strengt

2 **Primary treatment**

Topics

3 Biological processes for the removal of organic matter, nitrogen and phosphorus

4 Organic matter removal

5 Nitrification

6 Denitrification

7 Enhanced biological phosporus removal

8 Final settling

9 Innovative nitrogen removal

10 Membrane bioreactors

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Wastewater characterization and sampling	4	0	0	0	0	0	4	12	D. Brdanovic
2	Primary treatment	4	0	0	0	0	0	4	12	D. Brdanovic
3	Biological processes for the removal of organic matter, nitrogen and phosphorus	0	0	0	0	0	0	0	0	C.M. Lopez Vazquez, L. Welles
4	Organic matter removal	4	0	1	1	0	2	8	21	C.M. Lopez Vazquez, L. Welles
5	Nitrification	4	0	1	1	1	2	9	22	C.M. Lopez Vazquez, L. Welles
6	Denitrification	4	0	1	1	0	2	8	21	C.M. Lopez Vazquez, L. Welles
7	Enhanced biological phosporus removal	4	0	1	1	1	2	9	22	C.M. Lopez Vazquez, L. Welles
8	Final settling	4	0	1	0	0	0	5	13	C.M. Lopez Vazquez
9	Innovative nitrogen removal	4	0	0	0	0	0	4	12	C.M. Lopez Vazquez
10	Membrane bioreactors	4	0	1	0	0	0	5	13	H.A. Garcia Hernandez
	Total	36	0	6	4	2	8	56	148	

Education Material

Scientific Software

M1577

Surface Water Treatment II

Term	201617T05
Coordinator	G. Ferrero
Credit points	5.000000000
Specialization	

Target Group

Students of the MWI master programme. Professionals in water treatment, consulting agencies, ministries and equipment suppliers.

Prerequisites

Participants should meet the general UNESCO-IHE admission criteria, and possess a BSc degree in chemical, environmental, or civil engineering.

Learning Objectives

1 Explain the principles of disinfection, drinking water quality, natural treatment systems, adsorption and activated carbon filtration processes

2 Integrate theoretical principles of disinfection with practical aspects of evaluation of disinfection systems

3 Prepare conceptual design of appropriate processes depending on the nature of impurities to be removed and the intended use of the treated water

Assessments

%	Type	Name
10	Assignment	
20	Lab. Report	
70	Written examination (closed book)	

Topics

1 Drinking water quality

2 Surface water collection and storage

3 Disinfection

Basic principles of disinfection; chemical disinfection; disinfection by products; ozone disinfection; UV disinfection.

4 Adsorption

Theoretical background of adsorptive processes.

5 Activated carbon

Granular and powdered activated carbon, modelling and design.

Topics

6 Natural treatment systems

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Drinking water quality	4	8	0	0	0	0	4	20	G. Ferrero
2	Surface water collection and storage	4	0	2	0	0	0	6	14	M.D. Kennedy
3	Disinfection	12	0	4	8	4	4	32	72	G. Ferrero
4	Adsorption	4	0	2	0	0	0	6	14	S.K. Sharma
5	Activated carbon	4	0	2	2	0	0	8	18	S.K. Sharma
6	Natural treatment systems	4	0	0	0	0	0	4	12	S.K. Sharma
	Total	32	8	10	10	4	4	60	150	

Education Material

Scientific Software

M2874

Anaerobic Wastewater Treatment

Term	201617T06
Coordinator	M. Ronteltap
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	have a proper understanding of Anaerobic wastewater treatment (AnWT) and technologies making use of anaerobic treatment
2	know how to calculate on COD balances
3	be able to design a basic UASB reactor
4	know how anaerobic reactor effluent can be treated
5	be introduced to innovations in anaerobic wastewater treatment such as anaerobic MBRs

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

M3033

Groundwater Resources and Treatment

Term	201617T06
Coordinator	B. Petrusevski
Credit points	5.000000000
Specialization	

Target Group

The module specifically targets professionals in water treatment companies, consulting agencies, ministries and equipment suppliers.

Prerequisites

Participants should meet the general UNESCO-IHE admission criteria, and possess a BSc degree in Chemical, Environmental, Civil or Sanitary Engineering.

Learning Objectives

1 Assess if given (ground)water is aggressive against materials used in water a supply system and propose appropriate neutralisation technique.

2 Assess overall quality of a given groundwater.

3 Establish appropriate treatment approach for groundwater containing commonly occurring impurities and pollutant including iron, manganese, ammonia, fluoride, and hydrogen sulphate.

4 Understand advanced groundwater treatment approaches applied in The Netherlands

Assessments

%	Type	Name
15	Assignment	
15	Lab. Report	
70	Written examination (closed book)	

Topics

1 Introduction to the module

2 Aeration

3 Water Quality & Treatment

removal of taste and odour, aggressive characteristics of water, neutralisation of aggressive nature of water, aeration.

3.1 Aggressive properties of (ground)water

3.2 Neutralisation of (ground)water aggressivity

Topics

3.3 Taste & Odour of (ground)water

4 Groundwater quality

5 Patogens transport in soil

6 Conventional groundwater treatment

Quality of groundwater, Conventional and advanced concepts in the removal of iron, manganese, ammonia, arsenic, fluoride and hydrogen sulphide.

6.1 Iron removal

6.2 Manganese removal

6.3 Ammonia removal

7 Arsenic removal

Sources of arsenic in groundwater, arsenic chemistry, arsenic and health, arsenic removal methods, research on arsenic removal at IHE Delft, analysis of arsenic (colorimetric and AAS-GF).

8 Fluoride removal

Sources of fluoride in groundwater, fluoride removal methods, research on fluoride removal at IHE Delft

9 Computer exercise groundwater treatment

Computer programmes will be used to (i) establish and optimise design of conventional groundwater treatment plants and (ii) examine the applicability of adsorptive iron removal.

10 Hydrogen sulphide removal

11 GW treatment in Belgium

12 Introduction to IGRAC

13 Advanced groundwater treatment in The Netherlands

14 Fieldtrip - design exercise

Field visit to a groundwater treatment plant in The Netherlands incl. small design exercises.

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	1	0	0	0	2	4	B. Petrusevski
2	Aeration	4	0	2	0	0	0	6	14	Y.M. Slokar
3	Water Quality & Treatment	4	0	6	0	0	0	10	18	B. Petrusevski
3.1	Aggressive properties of (ground)water	0	0	0	0	0	0	0	0	B. Petrusevski
3.2	Neutralisation of (ground)water aggressivity	0	0	0	0	0	0	0	0	B. Petrusevski
3.3	Taste & Odour of (ground)water	1	0	1	0	0	0	2	4	B. Petrusevski
4	Groundwater quality	2	0	2	0	0	0	4	8	B. Petrusevski
5	Patogens transport in soil	1	0	1	0	0	0	2	4	J.W.A. Foppen
6	Conventional groundwater treatment	7	0	3	4	0	0	14	32	B. Petrusevski, Y.M. Slokar
6.1	Iron removal	0	0	0	0	0	0	0	0	
6.2	Manganese removal	0	0	0	0	0	0	0	0	
6.3	Ammonia removal	0	0	0	0	0	0	0	0	
7	Arsenic removal	2	0	3	4	0	0	9	17	B. Petrusevski, Y.M. Slokar
8	Fluoride removal	2	0	1	0	0	0	3	7	B. Petrusevski
9	Computer exercise groundwater treatment	0	2	6	0	0	4	10	20	
10	Hydrogen sulphide removal	2	0	0	0	0	0	2	6	B. Petrusevski
11	GW treatment in Belgium	2	0	2	0	0	0	4	8	
12	Introduction to IGRAC	0	0	1	0	0	0	1	1	
13	Advanced groundwater treatment in The Netherlands	3	0	0	0	1	0	4	10	
14	Fieldtrip - design exercise	0	0	4	0	4	0	8	8	B. Petrusevski
	Total	31	2	33	8	5	4	81	161	

Education Material

Lecture notes	B. Petrusevski, Groundwater Treatment: Removal of Arsenic & Fluoride (LN 0485.16.1)
Lecture notes	B. Petrusevski, J.C. Schippers, Aggressive Characteristics & Neutralisation Techniques (LN0482.16.1)
Lecture notes	B. Petrusevski, J.C. Schippers, Module Introduction, Taste & Odour, Quality of Groundwater (LN 0490.16.1)
Lecture notes	B. Petrusevski, S.K. Sharma and J.C. Schippers, Groundwater Treatment: Removal of Iron, Manganese & Ammonia (LN 0484.16.1)
Lecture notes	J. W. Foppen, Pathogen Transfer in Groundwater
Lecture notes	K. Huysman, From ground water to drinking / process water at Pidpa
Lecture notes	S. K. Sharma, Hydrogen Sulphide Removal

Scientific Software

M3103

Managing Water Organisations

Term	201617T06
Coordinator	K.H. Schwartz
Credit points	5.000000000
Specialization	Core Program

Target Group

Young and mid-career professionals with an interest in strategic and operational management of water supply and sanitation organisations (including regulators).

Prerequisites

Preferably experience in the water sector. A bachelors degree or equivalent. Basic PC-computer knowledge. Good command of English language.

Learning Objectives

1 Relate academic debates concerning water supply and sanitation provisioning to the management of water organisations

2 Explain the position and strategy of a water organisation in relation to its institutional environment.

3 Diagnose challenges for a water organisation in relation to its context and develop strategic plans accordingly, including the management of change

5 The first block focuses on understanding the water services sector in which a water organisation develops. During this block the regulatory and policy context of water organisations is elaborated upon.

6 During the second block, the module focuses on specific elements of organisational management. This includes strategic management, change management, human resources management and customer management.

Assessments

%	Type	Name
70	Assignment	Essay
20	Assignment	Research assignment
10	Assignment	Simulation game

Topics

1 Sector overview

2 Performance

3 Policy Analysis

4 Regulatory Models

Topics

5 Public Sector Reform

6 Strategic Management

7 Water Utilty Simulation Game

8 Benchmarking

9 Benchmarking Game

10 Change Management

13 Water Utility Research Assignment

15 Introduction Exam

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Sector overview	3	0	0	0	0	0	3	9	K.H. Schwartz
2	Performance	1	0	2	0	0	0	3	5	K.H. Schwartz
3	Policy Analysis	3	0	0	0	0	0	3	9	K.H. Schwartz
4	Regulatory Models	0	0	0	0	0	0	0	0	
5	Public Sector Reform	3	0	0	0	0	0	3	9	K.H. Schwartz
6	Strategic Management	3	0	0	0	0	0	3	9	K.H. Schwartz
7	Water Utilty Simulation Game	1	7	0	0	0	0	1	10	A. Cabrera Flamini, K.H. Schwartz, M. Tutusaus Luqu
8	Benchmarking	1	0	0	0	0	0	1	3	M. Tutusaus Luque
9	Benchmarking Game	0	0	4	0	0	0	4	4	M. Tutusaus Luque
10	Change Management	3	0	0	0	0	0	3	9	
13	Water Utility Research Assignment	1	23	0	0	0	0	1	26	K.H. Schwartz, M. Tutusaus Luque
15	Introduction Exam	1	0	0	0	0	0	1	3	M. Tutusaus Luque
	Total	20	30	6	0	0	0	26	96	

Education Material

Scientific Software

M2384

Resource Oriented Wastewater Treatment and Sanitation

Term	201617T06
Coordinator	M. Ronteltap
Credit points	5.000000000
Specialization	

Target Group

Participants of the MWI/SE programme, short course participants. SENSE participants

Prerequisites

Preceding Sanitary Engineering Modules.

Learning Objectives

1 describe the physical, chemical and microbiological processes occurring in anaerobic reactors and a number of natural systems

2 critically reflect on the current sanitation systems encountered in many urban areas and to indicate ways to improve this situation in a sustainable manner;

3 evaluate the possibilities for closing cycles of energy, water and nutrients

4 evaluate the feasibility of the application of the technologies studied in this module in urban settings in the developing world

5 carry out preliminary process design of treatment and reuse systems to assess the needs for capital, land, equipment and operation and maintenance

Assessments

%	Type	Name
20	Assignment	
80	Written examination (closed book)	

Topics

1 **Anaerobic Wastewater Treatment**

Fundamentals about anaerobic degradation and its application in wastewater treatment.

2 **Waste Stabilisation Ponds**

3 **Urine Treatment**

4 **Field trip**

Topics

5 Effluent reuse in agriculture

6 Algae photobioreactors

7 Constructed Wetlands

8 Algae Conference

Students are invited to the Algae Conference here at UNESCO-IHE for one day

This international conference brings together scientists, algaeneers and practitioners to exchange the latest knowledge on the application of algae for wastewater treatment and resource recovery.

Wastewater engineers using algae can benefit from knowledge coming from the use of algae to produce biofuels, food supplements or green pharmaceuticals. Likewise, wastewater as a cheap source of nutrients and inorganic carbon is promising for the production of algae-based commodities. For example, algae based treatment systems in developing world tropical countries, may reduce wastewater treatment costs via the recovery of its inherent resources.

The conference offers an overview and discussion of the latest scientific developments and practical applications in these fields.

9 Introduction into resource orientation in wastewater treatment and sanitation

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Anaerobic Wastewater Treatment	15	4	5	4	0	0	24	62	J.B. van Lier, J.L.C.M. van de Vossenberg, N.P. van de Steen
2	Waste Stabilisation Ponds	3	0	0	0	0	2	5	15	N.P. van der Steen
3	Urine Treatment	6	0	0	3	0	0	9	24	M. Ronteltap
4	Field trip	0	0	0	0	8	0	8	8	M. Ronteltap
5	Effluent reuse in agriculture	4	0	0	0	0	0	4	12	A.E.C. Duker, J.B. van Lier
6	Algae photobioreactors	4	0	0	0	0	0	4	12	N.P. van der Steen
7	Constructed Wetlands	4	0	0	0	0	2	6	18	DPL Rousseau, J.J.A. van Bruggen
8	Algae Conference	0	0	6	0	0	0	6	6	N.P. van der Steen
9	Introduction into resource orientation in wastewater treatment and sanitation	8	0	0	0	0	0	8	24	M. Ronteltap
	Total	44	4	11	7	8	4	74	181	

Education Material

Lecture notes	Lecture notes.

Scientific Software

M2373

Wastewater Treatment Plants Design and Engineering

Term	201617T07
Coordinator	C.M. Lopez Vazquez
Credit points	5.000000000
Specialization	Sanitary Engineering

Target Group

MSc participants enrolled in the Urban Water and Sanitation program from the Sanitary Engineering Specialization (UWS-SE). Wastewater professionals with background and/or proven qualifications in sanitary engineering.

Prerequisites

Preceding modules of the UWS-SE program and/or, in the case of short-course participants, required background on sanitary and wastewater engineering (see target group) in full compliance with UNESCO-IHE admission regulations.

Learning Objectives

1 Select the most suitable and cost-effective wastewater treatment process technology to treat certain wastewater stream given its composition and characteristics and taking into account the required effluent standards.

2 Carry out a preliminary design of a wastewater treatment system (based on the most widely applied anaerobic, aerobic, land-based and on-site systems) including the engineering process lay-out, hydraulic profile and process flow-diagram (PFD).

3 Identify and estimate the construction, operational and maintenance costs of a wastewater treatment plant and the investments required to secure its satisfactory operation throughout the expected life-span of the system.

4 Describe the main elements and components involved in the project planning, project management, and project administration for the design, engineering, construction, start-up and operation of a wastewater treatment plant.

Assessments

%	Type	Name
25	Assignment	
25	Oral examination	Based on the development of a design project.
50	Written examination (closed book)	

Topics

1 Technology Selection

Review of the most commonly applied wastewater treatment process technologies (among anaerobic, aerobic, land-based and on-site systems). Criteria selection guidelines for the determination of a suitable wastewater treatment process technology to treat a wastewater stream to the required degree to meet the required effluent standards taking into account local conditions and resources availability. Technology selection software tools.

2 Engineering Economics

Fundamentals and principles of economics (such as cash-flow, interest factors, return of investment and benefit-cost analyses, among others). Evaluation, comparison and selection of cost-effective wastewater treatment system alternatives.

3 Costing

Fundamentals and principles of costing. Identification and estimation of direct and indirect costs involved in the design, construction, operation and maintenance of wastewater treatment systems. (Project) budgeting.

4 Engineering process layouts and process flow diagrams

Design and calculation of engineering process layouts and process flow diagrams for the design and operation of wastewater treatment plants (for conventional anaerobic, aerobic, land-based and on-site systems). A detailed design exercise will be carried out on a selected wastewater treatment processes lay-out.

5 Hydraulic design

Calculation and design of hydraulic profiles (based on the behaviour and performance of hydraulic structures and elements) for the design and operation of wastewater treatment plants.

6 Design and Engineering of Conventional Activated Sludge (CAS) Systems

Preliminary design, including influent characteristics, sizing and dimensioning of a conventional activated sludge and conventional anaerobic wastewater treatment plant. Design and selection of equipment for monitoring, operation and control. Review of case-studies including planning, project management, and project administration of the construction and operation.

7 Design and Engineering of Conventional UASB systems

Preliminary design, including influent characteristics, sizing and dimensioning of a conventional activated sludge and conventional anaerobic wastewater treatment plant. Design and selection of equipment for monitoring, operation and control. Review of case-studies including planning, project management, and project administration of the construction and operation.

8 Design and Engineering of land-based wastewater treatment systems

Preliminary design, including influent characteristics, sizing and dimensioning of a land-based wastewater treatment plant (e.g. pond systems,constructed wetlands) and on-site sanitation systems. Design and selection of equipment for monitoring and operation. Review of case-studies including planning, project management, and project administration of the construction and operation.

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Technology Selection	4	0	2	0	0	0	6	14	C.M. Hooijmans
2	Engineering Economics	4	0	2	0	0	0	6	14	
3	Costing	4	0	2	0	0	0	6	14	
4	Engineering process layouts and process flow diagrams	4	0	2	0	0	2	8	20	D. Brdanovic
5	Hydraulic design	4	0	2	0	0	2	8	20	C.M. Lopez Vazquez
6	Design and Engineering of Conventional Activated Sludge (CAS) Systems	4	0	2	0	0	2	8	20	
7	Design and Engineering of Conventional UASB systems	4	0	2	0	0	2	8	20	J.B. van Lier
8	Design and Engineering of land-based wastewater treatment systems	4	0	2	0	0	2	8	20	
	Total	32	0	16	0	0	10	58	142	

Education Material

Scientific Software

M2553

Water Transport and Distribution

Term	201617T07
Coordinator	N. Trifunovic
Credit points	5.000000000
Specialization	Core Program

Target Group

Mid-career professionals dealing with technical aspects of drinking water transport & distribution, working for water supply companies, municipal assemblies or consulting bureaus.

Prerequisites

BSc degree in Civil Engineering or similar technical background; general PC-computer knowledge; good English command.

Learning Objectives

1 demonstrate understanding of the steady-state hydraulics by being able to select appropriate pipe diameters, indicate optimum location of reservoirs and identify pumps capable to supply the demand;

2 apply the above theoretical knowledge by learning to perform computer-aided hydraulic calculations and predict the consequences of demand growth on the hydraulic performance of particular WTD system

3 analyse the implications of various operational modes of pumping stations and compare the investment and operational costs for various network layouts and supplying schemes;

4 propose preliminary hydraulic design that will integrate economic aspects, choose adequate components, and judge technical solutions dealing with the network maintenance, rehabilitation, and expansion.

5 distinguish between different network configurations and supplying schemes; recognise various consumption categories and their growth patterns, including water leakage; define the relation between the main hydraulic parameters

Assessments

%	Type	Name
40	Assignment	Design exercise assignment Water Distribution, using EPANET network modelling software. Individual report should be submitted.
60	Written examination (open book)	The exam includes the part on Chapters 2 to 4 of the introductory subject and the other one on the leakage management and control.

Topics

1 Introduction to Water Transport and Distribution

Main objectives and components of WTD systems; water demand categories, patterns, calculation and forecasting; steady-state hydraulics of pressurised flows, single pipe calculation, branched and looped networks, pressure driven demand; hydraulics of storage and pumps; hydraulic design: choice of supply scheme, network layouts, design of pumping stations, power requirements and energy consumption; engineering design: choice of pipe materials, valves and other equipment; network construction: pipe laying, testing and disinfection; operation & maintenance: regular & irregular supply, network cleaning and rehabilitation.

2 Water Loss Management and Control

Definition of non-revenue water and IWA terminology used in the sector, components of water losses, methods of reducing and controlling real- and apparent network losses; quantification of leakage in distribution systems, leak location and repair techniques, pressure management.

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Introduction to Water Transport and Distribution	23	0	9	0	0	12	44	114	N. Trifunovic, P.D.A. Pathirana
2	Water Loss Management and Control	8	0	2	0	0	0	10	26	S.K. Sharma
	Total	31	0	11	0	0	12	54	140	

Education Material

Lecture notes	S.Sharma - Water Losses in Distribution Systems, lecture notes UNESCO-IHE 2010 (LN/0346/10/1)

Scientific Software

Epanet

M2335

Advanced Water Treatment and Re-use

Term	201617T08
Coordinator	S.G. Salinas Rodríguez
Credit points	5.000000000
Specialization	

Target Group

Students of the Urban Water and Sanitation master programme with specialization in Water Supply engineering. Professionals in water treatment, consulting agencies, ministries and equipment suppliers.

Prerequisites

Participants should meet the general UNESCO-IHE admission criteria, and possess a BSc degree in chemical, environmental, or civil engineering.

Learning Objectives

1 DESALINATION TECHNOLOGIES - identify technologies for desalination - explain and compare membrane-based and thermal-based desalination - tell current capacity of desalination in the world

2 SOFTENING AND ION EXCHANGE - explain the basic principles of chemical softening and ion exchange.

3 ADVANCED OXIDATION PROCESSES - explain and identify advantages of various AOPs - design AOPs for removal of contaminants

4 WATER REUSE - assess potential applications of water reuse systems - define water reuse and describe various case studies

5 LOW PRESSURE MEBRANES (UF and MF)

6 REVERSE OSMOSIS

Assessments

%	Type	Name
20	Assignment	Computer aided RO design
10	Lab. Report	
70	Written examination (closed book)	

Topics

1 **Introduction to Desalination and Mem. Tech.**

2 **Microfiltration and Ultrafiltration**

basic principles of membrane filtration, micro and ultrafiltration elements and systems, fouling and cleaning, membrane disinfection, exercises

Topics

3 Reverse Osmosis

fundamentals of desalination, reverse osmosis elements and systems, particulate and inorganic fouling, organic fouling and bioufouling, scaling, pre- and post-treatment; process design of RO systems

4 Ion Exchange and Softening

Basic principles of ion exchange and softening

5 Advanced oxidation processes

fundamentals of AOPs including ozone, H2O2, UV and combinations; applications

6 Introduction to Water Reuse

Fundamentals of water reuse, applications and case studies for potable reuse, industrial reuse and aquifer recharge

7 Interactive field trip Mem. Tech.

8 Ion Exchange

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Introduction to Desalination and Mem. Tech.	2	0	0	0	0	0	2	6	M.D. Kennedy
2	Microfiltration and Ultrafiltration	12	0	2	2	0	0	16	42	M.D. Kennedy, S.G. Salinas Rodríguez
3	Reverse Osmosis	12	0	2	0	0	4	18	50	M.D. Kennedy
4	Ion Exchange and Softening	2	0	1	0	0	0	3	7	JP Buiteman, S.G. Salinas Rodríguez
5	Advanced oxidation processes	4	0	0	0	0	0	4	12	
6	Introduction to Water Reuse	2	0	2	0	0	0	4	8	S.G. Salinas Rodríguez, S.K Sharma
7	Interactive field trip Mem. Tech.	0	0	0	0	6	0	6	6	M.D. Kennedy, S.G. Salinas Rodríguez
8	Ion Exchange	2	0	0	1	0	0	3	8	JP Buiteman, S.G. Salinas Rodríguez
	Total	36	0	7	3	6	4	56	139	

Education Material

Scientific Software

M3054

Modelling of Wastewater Treatment Processes and Plants

Term	201617T08
Coordinator	C.M. Hooijmans
Credit points	5.000000000
Specialization	

Target Group

The module primarily targets professionals working in water and sewerage companies, consulting firms, industry, municipalities, universities and ministries.

Prerequisites

General admission criteria IHE and a B.Sc. degree in preferably Civil Eng., Env. Eng., Microbiology, Chemistry or Chemical Engineeing

Learning Objectives

1 Can memorize the basics of wastewater treatment modelling (kinetics, stoichiometry, mass balances, hydraulics and matrix notations). Can develop a matrix for a biological model.

2 Can use the computer software AQUASIM as a tool for modelling wastewater treatment processes. Can put a model in AQUASIM and explain the outcome of the model run and the implications for wastewater treatment.

3 Can discuss the application of modelling in wastewater treatment using practical examples.

4 Can explain the modeling history and the state of the art of activated sludge modelling.

5 Can evaluate data and processes of an activated sludge wastewater treatment plant. Apply the theory with respec to modeling in a case study using Excel and BioWin. Can discuss and explain the outcome of the model.

6 Can relate the activated sludge computer exercise in BioWin with the real wastewater treatment plant.

7 Can explain the modeling of MBR systems. Can simulate an existing model using BioWin and explain the results.

Assessments

%	Type	Name
0,15	Assignment	Assessment of application skills: Modelling of a MBR reactor using BioWin
0,25	Assignment	Assessment of application skills: Modelling of an activated sludge WWTP using BioWin
0,6	Written examination (closed book)	Assessment of theoretical knowledge and application skills

Topics

1 **Module introduction, Modelling approach, Exercise: set up matrix**

Topics

2 Introduction to aquatic systems modelling AQUASIM, modelling exercises

3 Modelling application examples

4 State of the art of activated sludge process modelling

5 Modelling activated sludge systems: data and process evaluation, BioWin modelling exercise

6 Field trip

7 Modelling MBR systems, BioWin exercise.

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Module introduction, Modelling approach, Exercise: set up matrix	3	0	1	0	0	0	4	10	C.M. Hooijmans
2	Introduction to aquatic systems modelling AQUASIM, modelling exercises	4	0	12	0	0	0	16	24	
3	Modelling application examples	4	0	0	0	0	0	4	12	
4	State of the art of activated sludge process modelling	4	0	0	0	0	0	4	12	
5	Modelling activated sludge systems: data and process evaluation, BioWin modelling exercise	4	16	18	0	0	0	22	46	S.C.F. Meijer
6	Field trip	0	0	0	0	4	0	4	4	
7	Modelling MBR systems, BioWin exercise.	2	8	10	0	0	0	12	24	H.A. Garcia Hernandez, S.C.F. Meijer
	Total	21	24	41	0	4	0	66	132	

Education Material

Lecture notes	A Practical Guide to Activated Sludge Modelling
Handout	AQUASIM Manual and Tutorial including Exercises
Handout	BioWin Tutorial
Scientific journal	Various background papers
Handout	Various presentations

Scientific Software

Aquasim

Biowin

M1710

Urban Flood Management and Disaster Risk Mitigation

Term	201617T08
Coordinator	Z. Vojinovic
Credit points	5.000000000
Specialization	Core Program

Target Group

Participants in WSE programmme; Participants in short course "Urban Flood Management and Disaster Risk Mitigation"

Prerequisites

Basic knowledge of hydrology and hydraulics

Learning Objectives

1 Develop understanding of how to use the models to assess the performance of existing systems and how to design the new ones within the context of different flood risks (pluvial, fluvial, coastal and flash floods)

2 Learn how to produce different flood risk maps in a GIS environment and how to calculate different types of flood damages, and

3 Develop understanding of structural and non-structural flood resilience measures such as, conventional and innovative structures, early warning systems, etc., and understand how to develop effective flood disaster management plans

Assessments

%	Type	Name
40	Written examination (closed book)	All Topics
60	Assignment	

Topics

1 Application domains of Hydroinformatics: floods, urban systems and environment

Introduction to floods and flooding. Introduction to urban floods and urban water systems. Introduction to environmental systems.

2 Climate change and its impact on hydrology

Introduction to the effects of climate variability on the hydrology that affects urban areas, urban hydrology as a very fast rainfall-runoff process, selection of appropriate time steps in urban runoff modelling, global, regional and local climate models, development of climate change scenarios.

3 Ethics of risk

Introduction to the basic theory of ethics and its application to the flood risk management.

Topics

4 Introduction to 1D2D, 2D modelling

Introduction to the basic principles of 2D modelling, solutions of the 2D shallow-water equations, schemes for dealing with high velocity flows at shallow depths, numerical issues concerning interaction between 1D and 2D flow domains, below ground and above ground flows, subcritical and supercritical flows over urban floodplains, treatment of buildings in 2D models, etc

5 Urban Flood Modelling and Evaluation of Flood Risks

Stormwater collection systems; services provided, beneficiaries, structure and concepts of draiange networks, rainfall input, rainfall-runoff modelling, free-surface and pressurised pipe flows, LIDAR filtering of urban features, rainfall and flow measurements, instrumentation, SCADA, telemetry, weather radar, numerical weather forecasts, build-up, wash-off, surface runoff water quality modeling in pipe networks, familiarisation with MOUSE, MIKE11, MIKE21 and SWMM software, setting up 1D and 1D-2D models, calibrating and verifying models using flow survey data, calculation of flood damages (tangible, intangible, direct, indirect damages), production of flood hazard maps, sensitivity-based flood risk attribution.

6 Structural and Non-structural Urban Flood Management Measures

Sustainable structural and nonstructural urban flood management measures such as: amplification of pipe networks, open channels, detention/retention basins, on-site-detention, on-site-infiltration, on-site-retention, SUDS, stormwater sensitive urban design, asset management and multi-objective optimization of rehabilitation measures (use of computational intelligence), design and employment of early warning systems.

7 Managing urban flood disasters

Framework for urban flood disaster management (pre-disaster, during disaster, post disaster phase), disaster morphology, evaluation of disaster scenarios, development and testing of plans, emergency preparedness and response activities, use of GIS and communication and information systems.

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Application domains of Hydroinformatics: floods, urban systems and environment	4	0	2	0	0	0	6	14	AE Mynett, RK Price, Z. Vojinovic
2	Climate change and its impact on hydrology	4	0	2	0	0	0	6	14	P.D.A. Pathirana
3	Ethics of risk	2	0	0	0	0	0	2	6	
4	Introduction to 1D2D, 2D modelling	7	0	7	0	0	0	14	28	I.I. Popescu
5	Urban Flood Modelling and Evaluation of Flood Risks	9	0	0	3	0	0	12	33	Z. Vojinovic
6	Structural and Non-structural Urban Flood Management Measures	4	0	0	2	0	0	6	16	B. Gersonius, Z. Vojinovic
7	Managing urban flood disasters	6	0	0	4	0	0	10	26	
	Total	36	0	11	9	0	0	56	137	

Education Material

Scientific Software
Aposs
Mike 11
Mike 21
Mike Flood
Mike Urban
SWMM

M1421

International Fieldtrip and Fieldwork UWS

Term	201617T09
Coordinator	Y.M. Slokar
Credit points	5.000000000
Specialization	Core Program

Target Group

Students of the SE, WSE and UWEM specialisation within the UWS programme

Prerequisites

Previous Modules of UWS Programme

Learning Objectives

1 International Field Trip: To expose the participants to different international practises in the design, operation and management of water supply, wastewater, solid waste and urban civil infrastructure networks.

2 Fieldwork: To familiarize the participants with performing research on location, how to process real data, and how to apply the newly acquired knowledge to a practical situation.

Assessments

%	Type	Name
100	Assignment	Fieldwork

Topics

1 International Field Trip

The International Field Trip takes place for up to 2 weeks (continuously) in a European country other than The Netherlands. During this time, the participants visit various water and wastewater treatment plants, research institutes and water companies dealing with overall urban water structure.

2 Fieldwork

The Fieldwork lasts for up to 5 days. During this time the participants, with a group of staff members and laboratory staff, travel to a location typically within The Netherlands to carry our different types of measurements in the field.

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	International Field Trip	0	0	0	6	96	0	102	108	M. Mulenga, Y.M. Slokar
2	Fieldwork	0	0	0	6	30	0	36	42	
	Total	0	0	0	12	126	0	138	150	

Education Material

Handout	Handouts for each of the activities (Field Trip and Fieldwork) will be handed out prior to beginning of the activities, providing information relevant for the sites to be visited

Scientific Software

M3104

Flood Protection in Lowland Areas

Term	201617T10
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 (assignment, oral discussion)
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	JH 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

M3102

Industrial Effluents Treatment and Residuals Management

Term	201617T10
Coordinator	H.A. Garcia Hernandez
Credit points	5.000000000
Specialization	Core Program

Target Group

Mid-career professionals dealing with the technical, environmental, and management aspects pertaining to industrial pollution control, wastewater treatment, residuals/waste minimization, and disposal and reuse

Prerequisites

MSc programme entry requirements

Learning Objectives

1	Define and implement cleaner production activities, industrial water management strategies for pollution and toxicity prevention
11	Design sludge thickeners and anaerobic sludge digesters and describe sludge drying and incineration processes
13	Recognize wastewater treatment technologies applied to indsutrial waste treatment and analyze industrial waste schemes from case studies presented from a diverse range of industries
14	Integrate cleaner production, industrial water management, wastewater treatment processes, and sludge handling and disposal in the design on an industrial waste treatment process for a selected industry
7	Define the most commonly applied wastewater treatment technologies and explain their most suitable industrial waste treatment applications as well as their advantages and disadvantages
8	Select the most appropriate treatment technology and design a wastewater treatment train (sequence of treatmen processes) to treat an industrial effluent stream for a selected industry
9	Define and describe sludge handle and sludge treatment and explain the needs for sludge handle and treatment activities in the context of industrial wastewater treatment

Assessments

%	Type	Name
6	Written examination (open book)	Cumulative final exam
4	Assignment	Final project related to a particular industry

Topics

1 Introduction

Topics

2 Cleaner Production

Trend-setting introduction of industrial pollution; Theoretical concept of Eco-efficiency; What is cleaner production; Financial benefits of cleaner production; A future prospective

3 Industrial Water Management

Impact of industry on water resources; Industrial water quality; Water audit; Waste minimization; Treatment options; Appropiate technology; and Implementation

4 Toxicity

Measures of toxicity; Kinetic models for toxic substrates; and Dealing with toxicity

5 Case Studies (Pollution Prevention)

6 Pre and Primary Treatment

7 Secondary Treatment

8 Physical Chemical Treatment

Contaminants/Classes and Process selection; Physical-Chemical Transformation Processes; Physical-Chemical Separation Processes; and Coagulation/Flocculation

9 Case Study: Aquaculture

10 Case study: Oil Industry

11 Case Study: Industrial Waste and Resource Recovery

12 Case Study: Potato, Sugar, Tannery, and Water Reuse

13 Case Study: Water Reuse (Dow Chemical)

14 Case Study: Sugar, Steel, and Water Resue

15 Case Study: Wastewater Reuse (Evides)

16 Case Study: Field Trip (Heineken)

17 Case Study: Process Water and Reuse

18 Case Study: Leachate Treatment

19 Case Study: Metal Surface Treatment

20 Case Study: Brewery Industry

21 Sludge Management

Sludge conditioning; Sludge thickening; Sludge stabilization; Sludge dewatering; Design Problems; Aerobic digestion; and Anaerobic digestion

22 Sludge Treatment

23 Sludge Incineration

24 Sludge Drying

25 Final Project

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Introduction	1	0	0	0	0	0	1	3	H.A. Garcia Hernandez
2	Cleaner Production	3	0	0	0	0	0	3	9	MS Moussa
3	Industrial Water Management	6	0	0	0	0	0	6	18	MS Moussa
4	Toxicity	2	0	0	0	0	0	2	6	MS Moussa
5	Case Studies (Pollution Prevention)	0	0	3	0	0	0	3	3	MS Moussa
6	Pre and Primary Treatment	4	0	0	0	0	0	4	12	H.A. Garcia Hernandez
7	Secondary Treatment	2	0	0	0	0	0	2	6	J.B. van Lier
8	Physical Chemical Treatment	3	0	0	0	0	0	3	9	H.A. Garcia Hernandez
9	Case Study: Aquaculture	0	0	2	0	0	0	2	2	D. Brdanovic
10	Case study: Oil Industry	0	0	1	0	0	0	1	1	
11	Case Study: Industrial Waste and Resource Recovery	0	0	2	0	0	0	2	2	
12	Case Study: Potato, Sugar, Tannery, and Water Reuse	0	0	0	0	0	0	0	0	
13	Case Study: Water Reuse (Dow Chemical)	0	0	1	0	0	0	1	1	
14	Case Study: Sugar, Steel, and Water Resue	2	0	0	0	0	0	2	6	
15	Case Study: Wastewater Reuse (Evides)	0	0	1	0	0	0	1	1	
16	Case Study: Field Trip (Heineken)	0	0	4	0	0	0	4	4	H.A. Garcia Hernandez
17	Case Study: Process Water and Reuse	0	0	2	0	0	0	2	2	
18	Case Study: Leachate Treatment	0	0	1	0	0	0	1	1	
19	Case Study: Metal Surface Treatment	0	0	2	0	0	0	2	2	
20	Case Study: Brewery Industry	0	0	1	0	0	0	1	1	
21	Sludge Management	6	0	3	0	0	0	9	21	
22	Sludge Treatment	9	0	3	0	0	0	12	30	
23	Sludge Incineration	0	0	3	0	0	0	3	3	D. Brdanovic
24	Sludge Drying	0	0	1	0	0	0	1	1	
25	Final Project	0	8	0	0	0	0	0	8	H.A. Garcia Hernandez
	Total	38	8	30	0	0	0	68	152	

Education Material

Lecture notes	Lecture notes posted on the e-campus webiste
Book	Suggested lecturing material: (1) Industrial Wastewater Management, Treatment, and Disposal (WEF) (2) Physical/Chemical Treatment Processes for Water and Wastewater (D. Lawler) (3) Handbook of Industrial and Hazardous Wastes Treatment (L. Wang et al)

Scientific Software

M3027

Remote Sensing, GIS and Modelling for Agricultural Water Use

Term	201617T10
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 GIS and remote sensing.

Learning Objectives

1 Explain the use of modern tools as RS and GIS in combination with the use of computer models
2 Explain and use the principles of Surefce Energy Balance in estimating Evapotranspiration
3 Reflect on the advanced applications of RS in irrigation management
4 Identify problems, constraints and potentials of lowland and flood prone areas for sustainable development
5 Discuss the design principles of the lowland, flood prone areas and polder water management systems
6 Reflect on the importance of environmental and socio-economic consideration in the low land and flood prone araes and prepare the operation and maintenance and management plans and options.

Assessments

%	Type	Name
0,6	Assignment	Irrigation and remote sensing
0,25	Written examination (open book)	Low lands and flood prone areas
0,15	Assignment	Water system modeling & GIS

Topics

1 Water system modeling

Water management system of land and water development, the use of computer models in the design, operation and maintenance of hydraulic control structures, pumping stations, etc., calibration, verification and sensitivity analysis of the model, and hydraulic performance of the water management system. The use of GIS in analyzing and evaluating land suitability, drainability and irrigability of an area.

Topics

2 Land use and Water in Flood Prone Areas

Basic principle of lowland and flood prone areas development; - to create optimal conditions for agriculture as well as urban; - components of polder water management systems; - to create an understanding of the consequences of applying certain infrastructural layouts and water management techniques; effect of sea level rise and land subsidence to lowland and flood prone areas; - design aspects of lowlands and flood prone areas; -operation, maintenance, socio-economic and environmental considerations of lowland and flood prone areas development; - modeling of polder water management systems

3 Remote sensing data for Agricultural Water Management

4 Remote sensing for Evapotransipration assessment (SEBAL)

5 Remote sensing for irrigation performance assessment

6 Water productivity as a tool for design, management, and evaluation of irrigation systems

7 Remote Sensing for Water Accounting

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Water system modeling	6	0	8	0	0	2	16	32	F.X. Suryadi
2	Land use and Water in Flood Prone Areas	8	0	0	0	0	0	8	24	F.X. Suryadi
3	Remote sensing data for Agricultural Water Management	4	0	2	0	0	0	6	14	X. Cai
4	Remote sensing for Evapotransipration assessment (SEBAL)	6	0	4	0	0	0	10	22	J.D. van Opstal, P. Karimi
5	Remote sensing for irrigation performance assessment	2	0	4	0	0	0	6	10	P. Karimi
6	Water productivity as a tool for design, management, and evaluation of irrigation systems	2	0	2	0	0	0	4	8	X. Cai
7	Remote Sensing for Water Accounting	8	0	6	0	0	0	14	30	P. Karimi
	Total	36	0	26	0	0	2	64	140	

Education Material

Book	Man made lowlands, G.P. van de Ven (Ed), 2004
Book	Suryadi, 2010. GIS and computer modelling of Water Management Systems.
Book	Urban polder guideline, Vol 1,2, 3 and 4, UNESCO-IHE, 2009

Scientific Software

M3086

Strategic Planning for River Basins and Deltas

Term	201617T10
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 hydrology, development economics, agronomy or geography (preferably a relevant water science or engineering related bachelor's degree or equivalent) and preferably experience in watershed and / or 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	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

During the course, students will work on integrated application of the concepts, theories and methods introduced in this course on a case. A limited number of cases will be prepared, so that students can focus on a field of their interest. 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	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

M3006

Urban Water Systems

Term	201617T10
Coordinator	Z. Vojinovic
Credit points	5.000000000
Specialization	Core Program

Target Group

Programme target group

Prerequisites

Urban Drainage I (recommended, but not essential)

Learning Objectives

1 describe the processes that are necessary for analysis and planning of urban water systems.

2 explain the processes that are necessary for modelling, analysis and planning of water distribution systems.

3 give a detailed decription of the processes that are necessary for modelling, analysis and planning of sewerage and drainage systems.

4 Explain in detail the processes that are necessary for the modelling, analysis and planning of wastewater treatment plants.

5 understand and evaluate the impacts of urban water systems on the receiving environment.

Assessments

%	Type	Name
60	Assignment	Computer workshop, Homework, Class work, participation
40	Written examination (closed book)	Written exam

Topics

1 Urban Water Systems Theory and Workshops

2 Hydrology for Urban Drainage

3 Water Quality for Urban Drainage

4 Impacts on Receiving Environment

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Urban Water Systems Theory and Workshops	20	10	20	0	0	0	40	90	A. Sanchez Torres, N. Trifunovic, Z. Vojinovic
2	Hydrology for Urban Drainage	4	0	0	0	0	0	4	12	P.D.A. Pathirana
3	Water Quality for Urban Drainage	2	4	0	0	0	0	2	10	Z. Vojinovic
4	Impacts on Receiving Environment	1	3	0	0	0	0	1	6	A.B.K. van Griensven, AE Mynett, M.E. McClain
	Total	27	17	20	0	0	0	47	118	

Education Material

Lecture notes	Lecture notes (provided by each lecturer) Workshop material (including the case study date) Additional material provided on the module web site.

Scientific Software

Aposs
ArcGIS
Epanet
Mike Flood
Mike Urban
West

M3048

Water Sensitive Cities

Term	201617T10
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

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

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

M2371

Water Treatment Processes and Plants

Term	201617T10
Coordinator	S.K. Sharma
Credit points	5.000000000
Specialization	Core Program

Target Group

Mid-career professionals dealing with technical aspects of water abstraction and drinking water treatment, working for municipal assemblies, water supply companies or consulting agencies.

Prerequisites

BSc degree in Civil Engineering or similar technical background; good command of English language; basic knowledge of water treatment methods.

Learning Objectives

1 apply (gained) knowledge and experience regarding water quality and treatment methods in design, operation & maintenance and rehabilitation of conventional water treatment processes and plants;

2 analyse water quality data and to select the most attractive raw water resource;

3 design and engineer a water treatment plant (conventional and advanced) for both groundwater and surface wate treatment);

4 execute plant performance studies and to evaluate results, as well as to propose improvements in order to rehabilitate a malfunctioning plant;

5 show professional knowledge and know-how for operating (process & quality control, troubleshooting) and maintaining water treatment plants;

6 acquire and improve their skills on problem solving, decision making, oral presentations, writing reports, working i small task forces.

Assessments

%	Type	Name
40	Assignment	Design exercise
60	Oral examination	and presentation

Topics

1 Water Treatment Processes and Plants

Raw water and drinking water quality aspects. Conventional treatment processes for groundwater and surface water. Introduction to process, plant and plant-site design.

Topics

2 Process modelling

Identification of model structure and parameters; integrated hydraulic, water quality models; use of the Stimela model for the design of drinking water plants.

3 Operation & Maintenance and Residual Management

Importance of adequate O&M, O&M of individual units, equipment and plants, Basics of process and quality control, water quality control during all steps of water supply system, Management of residuals: treatment, disposal and reuse

4 Water Treatment Plant Design

Examples/Case studies of the detailed design of conventional water treatment plants

5 Design Exercise WTP

Identification of water resources, comparison and evaluation of various treatment methods and processes for ground and surface water, calculation of water demand, process design, calculation of achieved drinking water quality, calculation of cost, engineering details.

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Water Treatment Processes and Plants	5	0	4	0	0	0	9	19	JP Buiteman, S.K. Sharma
2	Process modelling	2	0	4	0	0	0	6	10	
3	Operation & Maintenance and Residual Management	4	0	4	0	0	0	8	16	
4	Water Treatment Plant Design	0	0	4	0	7	0	11	11	B. Petrusevski, S.K. Sharma
5	Design Exercise WTP	0	0	0	0	0	28	28	84	JP Buiteman, S.K. Sharma
	Total	11	0	16	0	7	28	62	140	

Education Material

Handout Sharma, S. (2016) Water Treatment Processes and Plants - Introduction

Scientific Software

Matlab

M3089

Wetlands for Livelihoods and Conservation

Term	201617T10
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 concept of ecosystem functions and services, and means of assessing it;
2 develop adaptive management for wetlands in response to climate change;
3 analyse problems and formulate objectives according to the Objective Oriented Planning (OOP) method;
4 analyse systematically the role that stakeholders have in wetland planning and management;
5 develop and carry out stakeholder interviews and surveys;
6 construct a wetland management plan based on the guidelines of the Ramsar Convention.

Assessments

%	Type	Name
10	Presentation	Group presentation
10	Attendance	Individual performance during fieldweek
80	Assignment	Individual written assignment

Topics

1 Ecosystem functions and services

2 Climate change as a driver of change in wetland management planning

3 Objective Oriented Planning

4 Stakeholder analysis and participatory approaches

5 Assignment

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Ecosystem functions and services	8	0	4	0	16	0	28	44	
2	Climate change as a driver of change in wetland management planning	8	0	4	0	0	0	12	28	
3	Objective Oriented Planning	2	0	16	0	16	0	34	38	
4	Stakeholder analysis and participatory approaches	2	0	14	0	8	0	24	28	
5	Assignment	0	2	0	0	0	0	0	2	
	Total	20	2	38	0	40	0	98	140	

Education Material

Scientific Software

M2602

Advanced Water Transport and Distribution

Term	201617T11
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 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

M2810

Decentralised Water Supply and Sanitation

Term	201617T11
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	201617T11
Coordinator	M. Ronteltap
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.
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

M3104

Flood Protection in Lowland Areas

Term	201617T11
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 (assignment, oral discussion)
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	JH 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

M3001

Hydroinformatics for Decision Support

Term	201617T11
Coordinator	A. Jonoski
Credit points	5.000000000
Specialization	Core Program

Target Group

Participants from all Master Programmes of UNESCO-IHE. The participants need to choose either *Software technologies for integration* OR *Flood resilience of urban areas and communities*.

Prerequisites

Hydrological and hydraulic modelling concepts; Basic programming skills

Learning Objectives

1 Understand 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 OR Explain and analyse the key qualities of urban areas and communities that improve resilience for flooding

5 Understand the potential of newly available data sources (e.g. remote sensing, web resources, data generated from climate and meteorological models) in advanced integrated modelling and decision support

Assessments

%	Type	Name
30	Assignment	Exercise report on Decision support systems
30	Assignment	Exercise report on Software technologies for integration OR Assignment Flood resilience
40	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.

Topics

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.

3 Software technologies for integration OR Flood resilience of urban areas and communities

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.

OR

Introduction to methods for explaining and analysing flood resilience: Manageability of flood impacts in an area. Set of adaptive capacities of a community. Preparedness and emergency response: Protection of critical infrastructure. Building community resilience. Flood insurance.

4 Integration of weather prediction and water models

Approaches and methods for integration of weather models with hydrological and hydraulic models. Integration of remote sensing data. Downscaling and upscaling issues.

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	DP Loucks
2	Decision support systems	6	0	4	4	0	0	14	30	A. Jonoski, I.I. Popescu
3	Software technologies for integration OR Flood resilience of urban areas and communities	4	0	10	10	0	0	24	42	A. Jonoski, B. Gersonius, C. Zevenbergen, G.A. Corzo Perez, J.L. Alfonso Segura, J.S. Craven, K.A. Anema, S. Rath
4	Integration of weather prediction and water models	4	0	4	0	0	0	8	16	S.J. van Andel
	Total	26	0	22	18	0	0	66	136	

Education Material

Digital files	A. Jonoski, G. Corzo, L. Alfonso, 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)
Digital files	B. Gersonius: Flood resilience of urban areas and communities (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

M2155

IWRM as a Tool for Adaptation to Climate Change

Term	201617T11
Coordinator	E.D. de Ruijter van Steveninck
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 UNESCO-IHE programme) and basic knowledge of water management.

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
30	Presentation	
70	Written examination (closed book)	

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.

Topics

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. Adaptation to climate change in an urban setting.

8 Examination

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	6	0	0	0	12	24	E.D. de Ruijter van Steveninck, 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 va 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	26	0	0	0	26	26	J.W. Wenninger, R.G.W. Venneker
6	Country presentations	0	0	3	0	0	0	3	3	E.D. de Ruijter van Steveninck
7	Field trip	0	0	0	0	6	0	6	6	B. Gersonius
8	Examination	0	0	3	0	0	0	3	3	
	Total	27	0	53	0	6	0	86	140	

Education Material

Lecture notes	Lecture notes, power point presentations, background materials

Scientific Software
WEAP

M3014

MSc Preparatory Course and Thesis Research Proposal

Term	201617T11
Coordinator	Y.M. Slokar
Credit points	5.000000000
Specialization	Core Program

Target Group

Students in the joint programme with Universidad del Valle, Cali, Colombia and students in the joint programme with Kwame Nkrumah University of Science and Technology (KNUST), Ghana (Kumasi)

Prerequisites

Learning Objectives

Assessments

%	Type	Name
1	Assignment	MSc Research Proposal

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

M3012

MSc Preparatory Course and Thesis Research Proposal for UWS

Term	201617T11
Coordinator	Y.M. Slokar
Credit points	9.000000000
Specialization	Core Program

Target Group

Prerequisites

Learning Objectives

Assessments

%	Type	Name
1	Assignment	MSc Research Proposal

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

M3039

MSc Thesis Research Proposal for AIT

Term	201617T11
Coordinator	E.R. Raj
Credit points	0.000000000
Specialization	Core Program

Target Group

Students of the following joint programme specialisations:

- Urban Water Engineering and Management (UWEM)

- Environmental Technology for Sustainable Development (ETSuD)

- Agricultural Water Management for Enhanced Land and Water Productivity (AWMELWP)

Prerequisites

Learning Objectives

Assessments

%	Type	Name
100	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

M3077

Modelling River Systems and Lakes

Term	201617T11
Coordinator	A. Cattapan
Credit points	5.000000000
Specialization	Core Program

Target Group

All participants in the WSE programme

Prerequisites

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
40	Assignment	This component is comprised of 3 components, assignments on modelling subjects of the module. (20%) Lake modelling + (10%) Hec-RAS modelling + (10%) Hec-HMS modelling
30	Written examination (closed book)	This component reffers to the Computational Hydraulics subject. (30%)
30	Written examination (closed book)	This component reffers to the hydrological and river modelling part of the course. (30%)

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.

Topics

2 Model quality assessment & uncertainty

Practical concepts for analysing quality of models used in modelling water resources. Techniques for calibration and validation. Sensitivity analysis and uncertainty estimation. Verification methods.

3 modelling river flow and corresponding hydrological run-off contributions

Description of rainfall run-off processes. Mathematical represeentation of flow processes both at catchment and river scales.

4 Modelling Applications: Hydrology

Practical experience with computational numerical models will be gained by students. The objective of this component will be the application of the theory gained in the theoretical components of the course using HEC-HMS for practical examples.

5 Modelling Applications: lakes

Practical experience with computational numerical models will be gained by students. The objective of this component will be the application of the theory gained in the theoretical components of the course.

6 Modelling Applications: rivers

Practical experience with computational numerical models will be gained by students. The objective of this component will be the application of the theory gained in the theoretical components of the course using HEC-RAS for practical examples.

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Computational Hydraulics	6	0	8	0	0	0	14	26	I.I. Popescu
2	Model quality assessment & uncertainty	2	0	0	0	0	0	2	6	I.I. Popescu
3	modelling river flow and corresponding hydrological run-off contributions	2	0	0	0	0	0	2	6	I.I. Popescu
4	Modelling Applications: Hydrology	0	0	0	12	0	0	12	24	I.I. Popescu
5	Modelling Applications: lakes	4	0	0	14	0	0	18	40	FA Bastos da Cruz Martins
6	Modelling Applications: rivers	0	0	0	16	0	0	16	32	A. Cattapan
	Total	14	0	8	42	0	0	64	134	

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
HEC-HMS
HEC-RAS
Mohid

M3027

Remote Sensing, GIS and Modelling for Agricultural Water Use

Term	201617T11
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 GIS and remote sensing.

Learning Objectives

1 Explain the use of modern tools as RS and GIS in combination with the use of computer models
2 Explain and use the principles of Surefce Energy Balance in estimating Evapotranspiration
3 Reflect on the advanced applications of RS in irrigation management
4 Identify problems, constraints and potentials of lowland and flood prone areas for sustainable development
5 Discuss the design principles of the lowland, flood prone areas and polder water management systems
6 Reflect on the importance of environmental and socio-economic consideration in the low land and flood prone araes and prepare the operation and maintenance and management plans and options.

Assessments

%	Type	Name
0,6	Assignment	Irrigation and remote sensing
0,25	Written examination (open book)	Low lands and flood prone areas
0,15	Assignment	Water system modeling & GIS

Topics

1 Water system modeling

Water management system of land and water development, the use of computer models in the design, operation and maintenance of hydraulic control structures, pumping stations, etc., calibration, verification and sensitivity analysis of the model, and hydraulic performance of the water management system. The use of GIS in analyzing and evaluating land suitability, drainability and irrigability of an area.

Topics

2 Land use and Water in Flood Prone Areas

Basic principle of lowland and flood prone areas development; - to create optimal conditions for agriculture as well as urban; - components of polder water management systems; - to create an understanding of the consequences of applying certain infrastructural layouts and water management techniques; effect of sea level rise and land subsidence to lowland and flood prone areas; - design aspects of lowlands and flood prone areas; -operation, maintenance, socio-economic and environmental considerations of lowland and flood prone areas development; - modeling of polder water management systems

3 Remote sensing data for Agricultural Water Management

4 Remote sensing for Evapotransipration assessment (SEBAL)

5 Remote sensing for irrigation performance assessment

6 Water productivity as a tool for design, management, and evaluation of irrigation systems

7 Remote Sensing for Water Accounting

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Water system modeling	6	0	8	0	0	2	16	32	F.X. Suryadi
2	Land use and Water in Flood Prone Areas	8	0	0	0	0	0	8	24	F.X. Suryadi
3	Remote sensing data for Agricultural Water Management	4	0	2	0	0	0	6	14	X. Cai
4	Remote sensing for Evapotransipration assessment (SEBAL)	6	0	4	0	0	0	10	22	J.D. van Opstal, P. Karimi
5	Remote sensing for irrigation performance assessment	2	0	4	0	0	0	6	10	P. Karimi
6	Water productivity as a tool for design, management, and evaluation of irrigation systems	2	0	2	0	0	0	4	8	X. Cai
7	Remote Sensing for Water Accounting	8	0	6	0	0	0	14	30	P. Karimi
	Total	36	0	26	0	0	2	64	140	

Education Material

Book	Man made lowlands, G.P. van de Ven (Ed), 2004
Book	Suryadi, 2010. GIS and computer modelling of Water Management Systems.
Book	Urban polder guideline, Vol 1,2, 3 and 4, UNESCO-IHE, 2009

Scientific Software

M1331

Solid Waste Management

Term	201617T11
Coordinator	M.A. Siebel
Credit points	5.000000000
Specialization	Core Program

Target Group

Engineers, academicians, staff from Non-Government Organizations, Community-based Organizations, politicians, health officials, students, scientists, local, regional or national government officials, etc., involved or interested in the management of solid waste.

Prerequisites

1) Involved in or familiar with one or more of the key elements of solid waste management, or 2) having studied the topic in a formal educational setting, or 3) having a university engineering degree.

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
35	Assignment	All s together
60	Written examination (open book)	MOODLE multiple choice
5	Presentation	Presentation Participation in class or fora

Topics

1 Introduction

what is solid waste? what are the key problems (social, financial, environmental)? who are involved?

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?

Topics

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

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	M.A. Siebel
2	Waste collection & stakeholders	1	0	9	0	0	0	10	12	M.A. Siebel, VS Rotter
3	Bioconversion processes	0	0	6	0	0	0	6	6	VS Rotter
4	Composting & anaerobic digestion	1	0	9	0	4	0	14	16	VS Rotter
5	Landfill processes	0	0	6	0	0	0	6	6	VS Rotter
6	Landfill technology	1	0	7	0	4	0	12	14	VS Rotter
7	Mechanical biologial treatment	1	0	5	0	0	0	6	8	VS Rotter
8	Incineration	1	0	7	0	0	0	8	10	VS Rotter
9	Waste prevention & recycling	1	0	5	0	2	0	8	10	M.A. Siebel
10	Finance & planning	0	0	12	0	0	0	12	12	Abarca Guerrero
11	Presentations	0	0	4	0	0	0	4	4	M.A. Siebel, VS Rotter
12	Assignments	0	24	0	0	0	0	0	24	M.A. Siebel, VS Rotter
13	Exam	0	10	4	0	0	0	4	14	M.A. Siebel
	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

M3086

Strategic Planning for River Basins and Deltas

Term	201617T11
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 hydrology, development economics, agronomy or geography (preferably a relevant water science or engineering related bachelor's degree or equivalent) and preferably experience in watershed and / or 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	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

During the course, students will work on integrated application of the concepts, theories and methods introduced in this course on a case. A limited number of cases will be prepared, so that students can focus on a field of their interest. 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	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	201617T11
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 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

M3048

Water Sensitive Cities

Term	201617T11
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

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

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

M3089

Wetlands for Livelihoods and Conservation

Term	201617T11
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 concept of ecosystem functions and services, and means of assessing it;
2 develop adaptive management for wetlands in response to climate change;
3 analyse problems and formulate objectives according to the Objective Oriented Planning (OOP) method;
4 analyse systematically the role that stakeholders have in wetland planning and management;
5 develop and carry out stakeholder interviews and surveys;
6 construct a wetland management plan based on the guidelines of the Ramsar Convention.

Assessments

%	Type	Name
10	Presentation	Group presentation
10	Attendance	Individual performance during fieldweek
80	Assignment	Individual written assignment

Topics

1 Ecosystem functions and services

2 Climate change as a driver of change in wetland management planning

3 Objective Oriented Planning

4 Stakeholder analysis and participatory approaches

5 Assignment

Study load

Nr	Topic	Lecture	Assignment	Excercise	Lab session and report	Fieldtrip	Design Excercise	SUM: contact hours	SUM: workload hours	Lecturers
1	Ecosystem functions and services	8	0	4	0	16	0	28	44	
2	Climate change as a driver of change in wetland management planning	8	0	4	0	0	0	12	28	
3	Objective Oriented Planning	2	0	16	0	16	0	34	38	
4	Stakeholder analysis and participatory approaches	2	0	14	0	8	0	24	28	
5	Assignment	0	2	0	0	0	0	0	2	
	Total	20	2	38	0	40	0	98	140	

Education Material

Scientific Software

M3114

Groupwork Sint Maarten

Term	201617T13
Coordinator	Y.M. Slokar
Credit points	5.000000000
Specialization	Core Program

Target Group

Prerequisites

Learning Objectives

1 Apply and integrate the knowledge obtained during the specialisation to solve water and sanitation related issues
2 Analyze complex water and sanitation issues in a limited time frame and with limited background information available.
3 Defend his/her input in an (interdisciplinary) team of specialists.
4 Assess his/her own strengths and weaknesses with respect to working in a group.
5 Recommend engineering solutions to water and sanitation related problems.
6 Defend the groups' findings in front of a team of experts in the field.

Assessments

%	Type	Name
20	Assignment	Phase 1: Assessment of the report (specialized assignment) by the "client"; group evaluation.
20	Presentation	Phase 1: Individual presentations of the work included in the report to the "client"; individual evaluation
10	Assignment	Phase 1: Peer scoring; individual evaluation.
20	Assignment	Phase 2: Assessment of the report (Master plan assignment) by the "panel"; group evaluation.
20	Presentation	Phase 2: Group presentations of the work included in the report to the panel; group evaluation.
10	Assignment	Phase 2: Peer scoring; individual evaluation.

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

M3012

MSc Preparatory Course and Thesis Research Proposal for UWS

Term	201617T14
Coordinator	Y.M. Slokar
Credit points	9.000000000
Specialization	Core Program

Target Group

Prerequisites

Learning Objectives

Assessments

%	Type	Name
1	Assignment	MSc Research Proposal

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

M2927

MSc research, thesis and defence

Term	201617T15
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