Handbook UWS 2013 - 2015

While UNESCO-IHE Institute for Water Education, Delft does its utmost to ensure that the programme will run as specified in this handbook, the content is subject to change. Certain modules or parts of modules may be changed, withdrawn and/or replaced by other modules. Due to logistical constraints or otherwise, participation of specified lecturers, whether from UNESCOIHE or from partner organisations cannot be guaranteed. No rights can therefore be derived from the programme as specified in this handbook.

Table of Contents

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 Municipal Water and Infrastructure;
- 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 programmes are conducted over a period of 18 months during two academic years. The general planning structure is shown in the *Academic Calendar*.

In the first year, the calendar is divided into 14 periods of three weeks, in which the components of the curriculum are presented as modules. After each second module, a separate week is reserved during which the examinations for the two modules take place. The first six months of the second year are reserved for completion of the MSc thesis research work.

Within each programme, the following generic components are distinguished:

- ten taught modules of 5 credit points each;
- fieldtrips and groupwork, total 10 credit points;
- a special/research topics module of 3 credit points;
- the thesis proposal preparation of 7 credit points;
- the thesis research and examination, 36 credit points.

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 Learning Objectives

Each programme specialisation has a set of learning objectives that state the knowledge, insight and skills achieved by students who successfully complete the programme. A distinction is made between discipline-specific learning objectives, which are required by the field of study, and general academic skills, which are expected from university education graduates. The programme objectives for each specialisation are provided in the programme-specific part of the handbook.

Similarly, each component 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 usually aim to achieve a further detailed subset of the overall learning objectives.

2.6 Working 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 for a specific component of the programme, and ultimately those of the programme itself. The examination for a component 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 component of the programme will be granted the credit points for that component. 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 Exam regulations

Click here for the separate document:

See 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 act of copying or including in one's own work, without adequate acknowledgement of, intentionally or unintentionally, the work of another, for one's own benefit. It is academically fraudulent. Plagiarism, at whatever stage of a student's course, whether discovered before or after graduation, will be investigated and dealt with appropriately by UNESCO-IHE.

The guidance given below is intended to clear up any misunderstandings you may have about plagiarism. If you are still unsure about how to avoid plagiarism, having read these guidance notes, then you should approach your Programme Coordinator or the UNESCO-IHE Library reference desk for further advice.

All assessed work is looked at carefully to ascertain whether they it is genuinely your own work. You should be aware that UNESCO-IHE regards plagiarism as a serious disciplinary offence which will be penalised as appropriate.

Each assignment you submit must be an independent piece of work. This means that you should be aware of plagiarism risks and regulations but also that there should be no significant overlap between any of the pieces of work that you submit. You cannot receive credit twice for the same piece of work, and so where a piece of assessed work includes material which has already been submitted for assessment, the examiners will disregard the duplicated material when marking.

Please note the following Assessment Regulations:

1. All work submitted for assessment by students is accepted on the understanding that it is the student's own effort without falsification of any kind.

2. Students are expected to offer their own analysis and presentation of information gleaned from research, even when group exercises are carried out.

3. Where students rely on reference sources, they should indicate what these are according to the appropriate convention in their discipline.

4. In proved cases of substantial and significant copying, plagiarism or other fraud, the Rectorate has the power to reduce the classification of, or to revoke, any degree it has already awarded, and to require the degree, diploma or certificate scroll to be returned.

As incidents of plagiarism tend to be handled by UNESCO-IHE in strict confidence, most students will be unaware of the serious harm which proven plagiarism can do to a student's standing. The action taken will be permanently noted on the student's record.

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 tutor to view. Where any direct quotations are relevant and appropriately referenced, the course tutor 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

ANNEX 1

TO WHOM IT MAY CONCERN

NAME STUDENT:
……...
STUDENT NUMBER **:**
……...

Own work declaration

I confirm that all the work I shall submit during my study for assignments, reports and my master thesis shall be my own except where indicated, and that:

1. I have clearly referenced all sources;

2. I have referenced and put in inverted commas all quoted text (from books, web, etc);

3. I have given the sources of all pictures, data etc that are not my own;

4. I did not make any use of the essay(s) of any other student(s) either past or present;

5. I did not seek or use the help of any external professional agencies for the work;

6. I acknowledged in appropriate places any help that I have received from others (e.g.fellow students, technicians, statisticians, external sources);

7. I understand that any false claim for any of the above will mean that the work in question will be penalised in accordance with the UNESCO-IHE regulations;

8. I hereby grant UNESCO-IHE, and Turnitin a non-exclusive licence to make an electronic copy of the work and make it available for assessment and archiving purposes.

9. I grant in perpetuity, without restriction, royalty free to UNESCO-IHE Institute for Water Education and partner Institutes the non-exclusive right and license to reproduce, distribute, and display, in whole or in part, my master thesis in any format now known or later developed.

Copyright ownership for all documents remains with the author in accordance with Dutch and international intellectual property law. This agreement does not prohibit the author in any way from entering into a publishing contract.

Signature student:

Date:

4 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.

4.1 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. A fter 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.

4.2 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.

4.3 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:

Knowledge and understanding

1. explain the role of sanitation in urban water cycle and its relation to public health and environment;

2. understand relevant physical, chemical and biological processes and their mutual relationships within various sanitation components;

3. name wastewater quality criteria and standards, and explain their relation to public health, environment and urban water cycle;

4. classify various categories of wastewater and predict their effect on treatment process;

5. understand hydraulic concepts and their relationship to urban drainage and sewerage networks;

6. understand the principles of mathematical modelling applied in the field of sanitation;

Applying knowledge and understanding

7. develop rational approaches towards sustainable waste(water) management via pollution prevention, appropriate treatment, resources recovery and re-use on both centralized and decentralized level;

8. prepare conceptual engineering and process design of sanitation components;

9. apply modern tools for technology selection and carry out modelling of sanitation components;

10. define and critically analyse, assess and evaluate various urban drainage and sewerage schemes, and wastewater, sludge and solid waste treatment process technologies;

4.4 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:

Knowledge and understanding

1. describe the structure of drinking water supply systems, including water transport, treatment and distribution;

2. understand occurring physical, chemical and biological phenomena and their mutual relationships, within water supply systems;

3. name water quality criteria and standards, and explain their relation to public health, environment and urban water cycle;

4. distinguish between various water quality concepts and predict their effect on treatment process;

5. understand hydraulic concepts and their relationship to water transport in treatment plants, pipelines and distribution networks;

6. understand the principles of mathematical modelling applied in water supply;

Applying knowledge and understanding

7. design and to rehabilitate raw water abstraction, transport, treatment and distribution processes and systems;

8. propose methods for operation and maintenance of water supply systems;

9. evaluate options for centralised and urban systems versus decentralized and rural systems;

10. use statistical and modelling tools for simulating, prediction of performance and operation of water supply system components;

11. understand water supply engineering within a watershed context

4.5 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:

Knowledge and understanding

1. describe 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 climatic and hydrologic uncertainties and/or extremes, work within a data-constrained environment and institutional limitations;

3. understand water infrastructure/asset planning, financing and management, and utility management;

4. understand the principles of mathematical modelling applied in the field of urban water management;

5. 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 and 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. critically assess the need for continued-education and research on planning, design, maintenance and management of urban water systems;

5. apply 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.

5 Facilities

5.1 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

5.2 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.

5.3 Student Association Board

The Student Association Board (SAB) is composed of representatives who are elected by the students in annual elections that take place some four 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. The board also publishes its own magazine *The Informer*, in which the rich variety of contributions are entirely derived from, and produced by, the student community.

5.4 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 educational programmes. All participants will get a free UNESCO-IHE web-based e-mail box. 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.

5.5 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. Last-minute changes in schedules are indicated on the announcement board near the entrance. Two monitor screens opposite the reception desk are regularly updated with news or information on events taking place at UNESCO-IHE.

Private telephone calls can be made from card-operated phone booths located next to the reception desk. Photocopy services are available to students. There is also a facility to recharge chip-cards, which students receive from the bank to pay for small purchases without using cash. Furthermore, the building contains a meditation room, which is located on the third floor.

The restaurant provides a wide variety of reasonable-priced multicultural meals and beverages during lunchtime. The meals can be paid using the chip-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. The library, computer facilities and laboratory are described in detail below.

5.6 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.

From July 2011 until December 2011, the Library spaces are being renovated. Most of the printed collections and the reference desk have been relocated to A2 a/b on the first floor and on account of missing the reading room, the opening hours have been changed to Monday-Friday 09-15-17.30

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

5.7 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.

5.8 Study Materials

Study materials such as textbooks, lecture notes and hand-outs are provided by the Institute. Students receive the lecture notes in their personal locker before the start of the involved lecture series. Additional material can be provided by the lecturers in the form of hand-outs. Reference works are available from the Institute library or the library of the Delft University of Technology (see above).

A number of supporting materials, such as for example PowerPoint presentations or exercise materials used by the lecturers, can be accessed or downloaded from the electronic repository. Students can login to the electronic repository from any location via the Internet web page located at http://km.ihe.nl.

Students are expected to provide other materials, such as stationary, electronic calculators and language dictionaries on their own account.

5.9 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 - Academic Calendar 2013/2015

YEAR 1 (weeks 42–13)

YEAR 1																								
	2013											2014												
	October		November				December					January				February				March				
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
Mon	14	21	28	04	11	18	25	02	09	16	23	30	06	13	20	27	03	10	17	24	03	10	17	24
Tue	15	22	29	05	12	19	26	03	10	17	24	31	07	14	21	28	04	11	18	25	04	11	18	25
Wed	16	23	30	06	13	20	27	04	11	18	25	01	08	15	22	29	05	12	19	26	05	12	19	26
Thu	17	24	31	07	14	21	28	05	12	19	26	02	09	16	23	30	06	13	20	27	06	13	20	27
Fri	18	25	01	08	15	22	29	06	13	20	27	03	10	17	24	31	07	14	21	28	07	14	21	28
Sat	19	26	02	09	16	23	30	07	14	21	28	04	11	18	25	01	08	15	22	01	08	15	22	29
Sun	20	27	03	10	17	24	01	08	15	22	29	05	12	19	26	02	09	16	23	02	09	16	23	30
		(2x5 ECTS)							(2x5 ECTS)									(2x5 ECTS)						
		Module 1			Module 2				Module 3					Module 4				Module 5			Module 6			

YEAR 1 (weeks 14–42)

YEAR 1																													
	2014							fieldtrip			..										Groupwork			..						
	April				May				June					July				August				September					October		
Week	14	15	16	17	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	31	07	14	21	28	05	12	19	26	02	09	16	23	30	07	14	21	28	04	11	18	25	01	08	15	22	29	06	13
Tue	01	08	15	22	29	06	13	20	27	03	10	17	24	01	08	15	22	29	05	12	19	26	02	09	16	23	30	07	14
Wed	02	09	16	23	30	07	14	21	28	04	11	18	25	02	09	16	23	30	06	13	20	27	03	10	17	24	01	08	15
Thu	03	10	17	24	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
Fri	04	11	18	25	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
Sat	05	12	19	26	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
Sun	06	13	20	27	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
	(2x5 ECTS)							(1x5 ECTS)			(2x5 ECTS)								(1x5 ECTS)				(2x5 ECTS)						
	Module 7			Module 8				Module 9			Module 10			Module 11					Module 12				Module 13			Module 14			

YEAR 2

YEAR 2																											
	2014										2015																
	Oct	November				December					January				February				March					April			
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
Mon	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
Tue	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
Wed	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
Thu	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
Fri	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
Sat	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
Sun	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

Legend

- = Lecture period
- = Examination period
- = MSC thesis writing period
- = Holiday / free time period
- = Opening acad. year Oct 17, 2013
- = Diploma awarding:

Christmas:	25/26 Dec 2013
Good Friday:	18 Apr 2014
Easter:	20/21 April 2014
Kingsday:	**27 April** 2014 / **26**=party
Liberationday:	5 May 2014
Ascencion:	29 May 2014
Pentecost:	8/9 June 2014
Christmas:	25/26 Dec 2014
Good Friday:	3 April 2015
Easter:	5/6 April 2015

UNESCO-IHE
Institute for Water Education

Education and Examination Regulations for cohort 2013– 2015

For the Master Programmes in:

- Municipal Water and Infrastructure
- Environmental Science
- Water Management
- Water Science and Engineering

Approved by the Academic Board of UNESCO-IHE, 25 July 2013

Table of Contents

1 General Information

Article 1 Scope of the regulations

1.1 The present regulations apply to the education and examinations within the following Master programmes:

a. Municipal Water and Infrastructure
b. Environmental Science
c. Water Management
d. Water Science and Engineering

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 In case a joint specialisation (see art. 3.1) leads to a double or joint degree, the rules and regulations of the partner institute will be applicable for those parts of the programme organised and implemented by the partner. Credit transfer agreements and all details of the programme offered by the partner institute are described in the agreements between UNESCO-IHE and the partner institute.

1.3 In case during the period 2013-2015 a double degree programme will be changed into a joint degree programme, the following articles are not applicable: art. 8.1b, 11,1, 25, 26, 27

Article 2 Definition of terms

2.1 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*);
Module:	a self-contained programme unit with specified learning objectives, as stipulated in article 7.3 of the Act;
Rector:	the rector of the Institute;
ECTS:	the European Credit Transfer and Accumulation System;
Examination:	an interim study performance assessment for a component of the programme (in the Act: *tentamen*);
Constituent examination:	an examination consisting of a number of different parts (e.g. assignments, written or oral exams, presentations)
Examination board:	the committee as stipulated in article 7.12 of the Act;
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 examination: the formal evaluation of the student performance before graduation (in the Act: *examen*);

Double degree programme: is a programme where the student sequentially works for two different university degrees, at different institutions. A student may earn two different degrees simultaneously.

Joint degree programme:
- are developed and/or approved jointly by several institutions;
- students from each participating institution study parts of the programme at other institutions;
- the students' stays at the participating institutions are of comparable length;
- periods of study and exams passed at the partner institution(s) are recognised fully and automatically;
- after completion of the full programme, the student obtains one degree awarded jointly by the partner institutes..

Student: a person who is registered in a study programme and sits examinations.

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

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

Article 3 Programme and specialisations

3.1 The programmes are Master of Science programmes with the following specialisations:

Municipal Water and Infrastructure programme:

1. Water Supply Engineering:
   - at UNESCO-IHE, as well as jointly with
   - Kwame Nkrumah University of Science & Technology, Ghana, and
   - Universidad del Valle, Colombia;
2. Sanitary Engineering:
   - at UNESCO-IHE, as well as jointly with
   - Kwame Nkrumah University of Science & Technology, Ghana, and
   - Universidad del Valle, Colombia;
3. Urban Water and Management: a joint specialisation with the Asian Institute of Technology, Thailand.

Environmental Science programme:

1. Environmental Science and Technology;
   - at UNESCO-IHE, as well as jointly with
   - Universidad del Valle, Colombia;
2. Environmental Planning and Management;
3. Water Quality Management;
4. Limnology and Wetland Management: a joint specialisation with
   - BOKU - University of Natural Resources and Life Sciences, Vienna, Austria, and
   - Egerton University, Egerton, Kenya
5. Environmental Technology for Sustainable Development: a joint specialisation with the Asian Institute of Technology, Thailand;
6. Environmental Technology and Engineering (Erasmus Mundus programme).

Water Management programme:

1. Water Resources Management;
2. Water Services Management;
3. Water Quality Management; and
4. Water Conflict Management.

Water Science and Engineering programme:

1. Hydrology and Water Resources;
   - at UNESCO-IHE as well as jointly with
   - Hohai University, China P.R.;
2. Hydraulic Engineering - River Basin Development;
3. Hydraulic Engineering - Coastal Engineering and Port Development;
   - at UNESCO-IHE as well as jointly with
   - Hohai University, China P.R.;
4. Hydraulic Engineering - Land and Water development;
   - at UNESCO-IHE as well as jointly with
   - Sriwijaija University, Palembang, Indonesia;
   - Asian Institute of Technology Thailand;
   - Haramaya University, Ethiopia;
5. Hydroinformatics- Modelling and information systems for water management;
   - at UNESCO-IHE as well as jointly with
   - Hohai University, China P.R.;
   - Universidad del Valle, Colombia;
   - Ain Shams University, Egypt;
6. Ecohydrology (Erasmus Mundus programme); and
7. Flood Risk Management (Erasmus Mundus programme).

Article 4 Aim of the programme

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

4.2 The qualifications of the programme graduates are listed in Appendix A.

Article 5 Full-time/part-time

5.1 The programmes are executed on a full-time basis.

Article 6 Study load of the programme

6.1 The minimum study load of the programmes is 106 ECTS credit points, with reference to article 7.4a, paragraph 8 of the Act.

Article 7 Programme examination

7.1 Students in the programmes are eligible to sit the programme examination leading to the degree of Master of Science in the programme they are registered for.

7.2 The programme examination is passed if all designated examinations in the programme curriculum have been successfully completed (and in case of joint or double degree programmes have met the requirements of the partner institutes), as stipulated in article 7.10a, paragraph 1 of the Act.

2 Academic Admission Requirements

Article 8 Admission to the programmes

8.1 Academic admission to the programmes may be granted to applicants who provide evidence of having:

a. a university level Bachelor's degree in an appropriate field for the specialisation, as listed in Appendix B, and which has been awarded by a university of recognised standing.

b. some working experience in an environment related to the specialisation. At least three years experience is in general preferred.

c. a good command of the English language, if this is not the first language. This is measured by a minimum IELTS score of 6.0, a minimum paper-based TOEFL score of 550, or a minimum computer-based TOEFL score of 213 or a minimum internet based score of 79. For other tests, the results will be interpreted to show alignment with the Council of Europe's Common European Framework (CEF) levels C1 or C2.

8.2 Academic admission to the programmes will be granted on the basis of a decision taken to that effect by the Academic Registrar, upon advice of the appropriate programme coordinator.

3 Content of the Programme

Article 9 Composition of the specialisations and joint specialisations

9.1 The composition of each programme specialisation is described in the programme handbooks of UNESCO-IHE and the partner institutes, respectively (in case of joint or double degree programmes)

Article 10 Practicals and participation

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

4 Examinations

Article 11 Sequence of the examinations

11.1 Sequence of the examinations will take place according to the order as described the programme handbook.

Article 12 Periods and frequency of examinations

12.1 Students can sit each oral or written examination only two times per academic year, except where indicated in subsequent paragraphs.

12.2 The date and time allocations for the first sitting are announced in the programme schedules. Examinations take place during the examination periods indicated in the academic calendar.

12.3 Groupwork, fieldwork and fieldtrips are offered and assessed once per academic year.

12.4 Students are not allowed to re-sit (constituent parts of) module examinations for which a successful result has been obtained.

12.5 Written and oral re-examinations take place during the examination period following the initial examination period indicated in the academic calendar. The students involved are notified sufficiently in advance by email about the date and time allocation for re-examinations. Non or misreading emails are no excuse for not participating in an re-examination. All students will take the re-sit of a written examination at the same time.

12.6 All re-examinations have to be completed in the examination week immediately following module 12.

12.7 Notwithstanding the stipulations in article 11, paragraph 1 and article 12 paragraph 5, successful completion of the examinations is not required for sitting subsequent examinations.

12.8 Students will not be allowed to sit for further examinations and -assignments during the programme period they are registered for, if they failed three (3) or more different module re-examinations for the first 13 modules of the programme.

12.8 The maximum recorded module mark after a successful re-sit is limited to 6.0.

Article 13 The nature of the examinations

13.1 A module is assessed via (a combination of) written and/or oral examinations, assignments and presentations as indicated in the module descriptions.

13.2 In case of a combination of an oral and written examination of a module the maximum total duration of both examinations shall not exceed 3 hours.

13.3 A written examination has to take place in a period of max. 3 hours during a morning or afternoon session. In case examination work consists of two or more different parts, a break of 15 minutes during the examination is allowed, provided that all examination work of the first part(s) is collected by the invigilators.

13.4 Examinations are carried out according to the guidelines described in annex C of these regulations.

13.5 The format of the examinations for each module in each programme is described in the programme handbook.

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

13.7 Re-examination proceeds by re-examining one or more failed constituent parts, as would be necessary to achieve a successful examination result.

13.8 The credits for successful completion of fieldwork and fieldtrips are granted on the basis of active participation, unless stated otherwise in the module sheet.

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

Article 14 Oral examinations

14.1 Oral examinations involve only one student at a time. During oral examinations, a second examiner has to be present as independent observer.

14.2 The examination of the thesis research is open to public attendance and discussion. All other oral examinations are non-public, unless stated otherwise in the module sheet.

Article 15 Exemptions and transfer of credit points

15.1 Exemptions to sit examinations are generally not granted. In specific cases, the examination board may evaluate a request and conclude a decision on transfer of credit points, after receiving a favourable recommendation from the programme committee.

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

Article 16 Absence from examinations

16.1 Absence from an examination 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 a medical note stating the inability to participate; or
b. serious circumstances beyond control of the student which should be supported by written evidence as far as possible.

16.2 For cases in which the programme coordinator, in agreement with the chair of the examination board, decides that the absence is justified the student shall sit the examination as soon as is reasonably possible.

16.3 For cases in which the programme coordinator, in agreement with the chair of the examination board, decides that the absence is not justified the result 1.0 will be recorded.

Article 17 Fraud

17.1 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.

17.2 Plagiarism is a serious act of fraud.

17.3 An examiner who observes or suspects fraud during the assessment of examination work is required to submit a substantiating report to the examination board.

17.4 If the examination board, after investigation of the incident, concludes that there has been a case of fraud, the offender will be given the mark 1.0 for the examination work.

5 Results of Examinations

Article 18 Assessment and notice of examination results

18.1 Examination 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 successful result.
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

18.2 Examination assessment results (including the thesis examination) obtained at partner institutes are represented according to the descriptions in annex D of these regulations.

18.3 The mark for a constituted examination is determined by the weighted average of the results of the constituent parts. The weights for the constituent parts are stated in the module sheet.

18.4 As a rule the examiner shall assess a written examination or practical paper within a period of 14 days after the date of the examination.

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

18.6 The examiner shall determine the result of an oral examination shortly after the examination has been conducted.

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

18.8 Examiners inform the module coordinators about the results of all examinations (written and oral) via standard examination result forms. Subsequently the module coordinators inform the Education Bureau via standard forms about the final module mark.

18.9 As a rule examination results shall be collected, processed, recorded and notified to the students by the Education Bureau within a period of 21 days after submission of the examination work by the student.

18.10 For each examination, the student receives a written statement from the Education Bureau of the examination result obtained for the module and, if successful, the associated credit points granted for that module.

Article 19 Period of validity

19.1 The result of an examination, when successful, is valid for an unlimited period of time.

19.2 Notwithstanding paragraph 1 of this article, the period of validity for which the examination board takes examination results into account for the programme examination is four years.

Article 20 Right to inspection of assessments

20.1 Students may, upon their own request, peruse their assessed written examination work within ten working days after they were notified of the examination result.

20.2 Where a practical forms part of an examination, the work for that part may be returned to the students after the full assessment of the examination is completed.

20.3 Written examination work is kept in archive for a minimum of 6 years.

6 Thesis Examinations

Article 21 Organisation of thesis examinations

21.1 The thesis will be assessed by a thesis examination committee, normally consisting of three (3) members: a professor as chairperson, the mentor and an external examiner. In special circumstances the committee may consist of more than three members. In case a PhD fellow, who is mentoring MSc students in his/her own research, is proposed as member of the committee, a fourth additional staff member is compulsory. External examiners are normally from outside the institute or in incidental cases from a chair group within the institute not involved in the supervision of the research work. In case of a double degree or joint degree programme, where the MSc research work is carried out under supervision of staff members of the partnering institutes, the examination committee may consist of more than three (3) members.

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

21.3 All students have to submit the examination version of the thesis report on the same date, i.e. the second Thursday of the month of the thesis examination.

21.4 Admission to the thesis examination is granted when the supervisor, upon recommendation of the mentor, has approved the draft thesis; in other words, the draft thesis needs to be approved as ‘ready for the MSc defence’.

21.5 Students can sit the thesis examination only if all other examinations of the programme specialisation curriculum have been successfully completed.

21.6 In exceptional cases, when the outcome of the thesis examination, including the defence, was negative, the examination can be repeated once. The supervisor and mentor will detail the reasons for the failure in writing and clarify what is required to pass the exam. The student has to finalise the work without further supervision and 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.

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

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

21.9 The mark for the thesis examination is based on the following components: written MSc thesis report, presentation and discussion. The latter includes the ability of the student to answer questions from the examination committee and the audience.

21.10 The maximum duration of the MSc research phase is 6 months for a full time study. Extension of this period may be granted on request by the student and is subject to approval by the rector, upon advice from the Examination Board.

Article 22 Study progress and study advice

22.1 All study results that are required for evaluating the performance of the students, and the evaluation results are recorded on behalf of the Academic Board.

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

7 Examination Board

Article 23 Examination board procedures

23.1 The examination board is a sub-board of the Academic Board and normally meets before the monthly meeting of the Academic Board. The calendar of meetings is established and circulated at the beginning of the academic year. Additional meetings will be set or meetings can be rescheduled whenever circumstances dictate.

23.2 For each meeting, the administrative secretary will provide all required material to properly conduct the examination board's deliberations.

23.3 Decisions of the examination board are concluded by majority vote.

23.4 The mandate of the examination board is defined by its Terms of Reference.

Article 24 Assessment of the programme examination

24.1 The student has fulfilled the requirements for the programme examination if (s)he has:

- For the single UNESCO-IHE degree programmes (excluding ES-LWM):
  - Successfully completed all examinations of the programme; and
  - Obtained a minimum of 106 ECTS.

- For the joint degree Limnology and Wetland Management programme (LWM):
  - Successfully completed all examinations 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):
  - Successfully completed all examinations 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 double degree programmes conducted with the Asian Institute of Technology (AIT):
  - Obtained a GPA of 2.75 or higher for the course work done at AIT; and
  - Successfully completed all module examinations at UNESCO-IHE; and
  - Achieved a grade of, excellent, very good, good or fair for the thesis examination; and
  - Obtained a minimum of 120 ECTS (UWEM, AWELWP), or 125 ECTS (ETSuD).

- For the double degree programmes conducted with Universidad del Valle:
  - Obtained a GPA of 3.5 or higher for the course work done at Univalle; and
  - Successfully completed all module examinations at UNESCO-IHE; and
  - Achieved a pass for the thesis examination; and
  - Obtained a minimum of 120 ECTS.

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

- For the double degree programme conducted with Sriwijaija University:
  - Successfully completed all examinations of the programme; and
  - Obtained a minimum of 106 ECTS.

- For the multiple degree programme on Flood Risk Management:
  - Successfully completed all examinations 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 conducted with Haramaya University:
  - Obtained a pass mark of 2.5 or higher for the course work done at Haramaya; and
  - Successfully completed all module examinations at UNESCO-IHE; and
  - Achieved a pass for the thesis examination; and
  - Obtained a minimum of 112 ECTS.

- For the multiple degree programme in Ecohydrology:
  - Successfully completed all examinations of the programme, according to the grading rules of the University of Lodz, University of Algarve, University of Kiel, University of La Plata and UNESCO-IHE; and
  - Obtained a minimum of 120 ECTS.

24.2 The student has successfully completed the programme examination when the examination board takes a decision to that effect.

Article 25 Degree awarding

25.1 Students who have successfully completed the programme examination will be awarded the Master of Science degree at the next scheduled degree awarding ceremony.

25.2 Based on a recommendation of the MSc thesis examining committee to the Examination Board, the degree can be recommended to be awarded with distinction, if 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 other examinations in the programme that are assessed on a numerical scale, conform article 2.1.
If some credit points for the taught and thesis components are earned at a partner institute, a motivating letter from the chair of the thesis examining committee is needed that justifies the recommendation to award of a MSc degree with distinction.

Article 26 Degree certificate and supplement

26.1 As evidence of successful completion of the programme examination, the Examination Board issues a degree certificate during the awarding ceremony. The degree is signed by the Chairman of the Examination Board, the Rector of the Institute and the Academic Registrar.

26.2 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.

Article 27 Programme certificate

27.1 Students who fail to meet the programme examination 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.

27.2 Students who fail to meet the programme examination requirements and have accumulated a minimum of 45 credits will be awarded a certificate of post-graduate study in the programme for which they are registered. Registration as student will be terminated.

8 Appeals

Article 28 Grounds for appeal

28.1 Students have the right to appeal against an examination assessment or an evaluation of the examination board within a period of ten working days after notification, if

a. the performance of the student suffered through illness or other factors;
b. a material administrative error in the conduct of an examination or assessment had occurred;
c. the examination or evaluation was not conducted in accordance with the regulations; or
d. some other material irregularity had occurred.

Article 29 Procedure for appeal

29.1 A student shall first attempt to resolve the problem through the programme coordinator, with the examiner, or the chairman of the examination committee or examination board.

29.2 If the student proceeds, the appeal shall be written in a letter stating the grounds for appeal and enclosing documentation as appropriate. The letter shall be addressed to the Rector.

29.3 The Rector shall accept or reject the appeal (after consultation with the examination board) and communicate the decision to the appellant via the Academic Registrar as soon as possible but usually within a period of ten working days.

9 Final Articles

Article 30 Amendments

30.1 Amendments to these regulations are made by separate decision of the Academic Board.

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

Article 31 Unforeseen situations

31.1 Situations which are not foreseen by the present regulations will be decided on by the Academic Board, where necessary after consultation with the examination board and/or programme committees.

Article 32 Publication

32.1 The Academic Board is responsible for the timely publication of the Education and Examination Regulations, and any amendments thereof.

Article 33 Period of application

33.1 These regulations take effect for the cohort 2013– 2015. Approved by the Academic Board of UNESCO-IHE on 25 July 2013.

Appendix A Qualifications of Graduates

Municipal Water and Infrastructure Programme

Sanitary Engineering

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

Knowledge and Theory

1. Apply gained knowledge and skills in practice;

2. Understand and explain the role of sanitation in urban water cycle and its relation to public health and environment;

3. Develop rational approaches towards sustainable waste(water) management via pollution prevention, appropriate treatment, resources recovery and re-use on both centralized and decentralized level;

4. In-depth understand relevant physical, chemical and biological processes, and their mutual relationships within various sanitation components.

Methods, Techniques and Tools

5. Prepare conceptual engineering and process design of sanitation components;

6. Apply modern tools for technology selection and carry out modelling of sanitation components;

Analysis, Synthesis and Integration

7. Define and critically analyse, assess and evaluate various urban drainage and sewerage schemes, and wastewater, sludge and solid waste treatment process technologies;

8. 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;

Research

9. Identify, develop and conduct independent research including formulation of hypotheses selection and application of research methodologies, and the formulation of conclusions and recommendations;

10. Carry on desk studies, field work, and laboratory based research;

11. Contribute to the development of innovative approaches to the provision of adequate and sustainable sanitation services in developing countries and countries in transition;

General Academic Skills

12. Clearly communicate concerning both oral and written skills;

13. Continuously acquire knowledge and assimilate and implement innovative learning methods and skills in an independent manner;

14. Operate both autonomously and in a multidisciplinary and multinational environment.

Water Supply Engineering

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

Knowledge and Theory

1. Have understanding of the structure of drinking water supply systems, including water transport, treatment and distribution;

2. Have understanding of water quality criteria and standards, and their relation to public health, environment and urban water cycle;

3. Have in-depth understanding of occurring physical, chemical and biological phenomena and their mutual relationships, within water supply systems;

4. Have understanding of water quality concepts and their effect on treatment process selection;

5. Have understanding of the interaction of water quality and materials applied;

6. Have understanding of hydraulic concepts and their relationship to water transport in treatment plants, pipelines and distribution networks;

Methods, Techniques and Tools

7. to design and to rehabilitate raw water abstraction, transport, treatment and distributionprocesses and systems;

8. Understand the importance and methods for operation and maintenance of water supply systems;

9. Understand options for centralised and urban systems versus decentralized and rural systems;

Analysis, Synthesis and Integration

10. define and evaluate project alternatives on basis of chosen selection criteria;

11. use statistical and modelling tools for simulating, prediction of performance and operation of water supply system components;

12. Understand water supply engineering within a watershed context

Research

13. conduct independent research, including formulation of hypotheses, selection and application of research methodologies, and the formulation of conclusions and recommendations;

General Academic Skills

14. Posses the learning skills to acquire continual knowledge in an independent manner;

15. communicate effectively in oral and written presentations to technical and non-technical audiences.

Urban Water Engineering and Management

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

Subject knowledge and skills

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. 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;

4. understand water infrastructure/asset planning, financing and management, and utility management;

5. familiarity with the concept of integrated water resources management (IWRM) and its application to a variety of water management problems at the urban catchment scale;

Core academic skills

6. identify, articulate, analyse and solve problems of the urban water cycle and systems, integrating theory and applications;

7. collect, summarise, analyse and interpret technical data/materials in a structured form to gain knowledge on urban water system design and operation and maintenance;

8. critically recognize and assess the need for continued-education and research on planning, design, maintenance and management of urban water systems;

9. have a working knowledge of 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;

Personal skills

10. Improved skills for independent learning;

11. enhanced reporting and presentation skills;

12. improved IT skills;

13. work independently or as part of a team;

14. manage time effectively.

Environmental Science Programme

Environmental Science & Technology

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

Knowledge & theory

1. demonstrate knowledge and understanding of the physical, chemical and biological processes of the environment, of the socio-economic concepts underlying the 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;

Methods, techniques & tools

5. 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;

6. apply general methods (including statistics and modelling) in scientific and technological approaches, concepts and interventions;

7. 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;

Analysis, synthesis & integration

8. 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;

Research/General academic skills

9. 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;

10. 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;

11. 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.

Environmental Planning & Management

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

Knowledge & theory

1. to demonstrate knowledge and understanding of the physical, chemical and biological processes of the environment, of the socio-economic concepts underlying the functioning and exploitation of environmental systems, and of the complex inter-relationship between the protection and wise use of environmental resources;

2. to describe the rationale for an integrated and interdisciplinary approach for the sustainable management of water and environmental resources;

3. to 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. to name and explain principles, concepts and instruments of major national and international water and environmental legislation and common and desired institutional and management arrangements;

Methods, techniques & tools

5. to design, optimise and interpret environmental monitoring and assessment schemes (including statistics and modelling) in order to gain an understanding of problems, trends, causes and effects;

6. to 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;

7. to 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;

8. to design and facilitate consultation- and decision-making processes between stakeholders, users and their representatives, water managers, politicians and other decision-makers;

Analysis, synthesis & integration

9. to critically analyse and evaluate a range of options and alternatives for the prevention or remediation of environmental problems, under different socio-economic, cultural and legal contexts, and under often data-poor conditions;

10. to 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;

Research/General academic skills

11. to 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;

12. to communicate, debate and defend, clearly and systematically, findings and generated insights, and provide rational underpinning of these in oral and written presentations to a variety of audiences;

13. to 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;

14. to 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.

Water Quality Management

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

Knowledge & theory

1. demonstrate knowledge and understanding of the physical, chemical and biological processes of the environment, of the socio-economic concepts underlying the 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;

Methods, techniques & tools

5. 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;

6. interpret, design and optimise water quality monitoring and assessment schemes in the watershed;

7. apply experimental, statistical and modelling tools for interpreting and designing water quality management programmes;

Analysis, synthesis & integration

8. 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;

9. 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;

10. critically analyse and evaluate alternative water quality management programmes in the watershed under different socio-economic and legal contexts, often in data-poor conditions;

Research/General academic skills

11. 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;

12. 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;

13. 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.

Limnology & Wetland Ecosystems

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

1. Knowledge and understanding:

- knowledge and understanding of the physical, chemical and biological processes of the environment, of the socio-economic concepts underlying the functioning and exploitation of environmental systems, and of the complex inter-relationship between the protection and wise use of environmental resources;
- describe how hydrology, morphology and aquatic organisms relate to biochemical processes and ecological functions of inland aquatic ecosystems;
- summarise provisioning and regulating ecosystem services provided by inland surface waters and wetlands;
- identify the impacts of human activities on freshwater ecosystems in different socio-economic contexts;
- demonstrate knowledge and understanding of the international water quality guidelines;

2. Applying knowledge and understanding:

- think critically in evaluation of results, information derived from the literature and other sources, and for problem-solving of complex issues related to aquatic ecosystems;
- apply general scientific methods (including statistics and environmental modelling) for the development and application of scientific and technological approaches, concepts and interventions to address environmental problems of freshwater ecosystems;
- design sampling strategies for the cost-effective monitoring of aquatic ecosystems, that can support and inform policy objectives;
- produce a wetland management plan.

3. Making judgements:

- critically analyse and evaluate a range of options and alternatives for the prevention or remediation of environmental problems related to freshwater ecosystems, under different socio-economic and legal contexts, and under often data-poor conditions;
- evaluate anthropogenic impacts on rivers, lakes and wetlands in both temperate and tropical settings;
- evaluate the usefulness of wetlands as treatment systems of waste water;
- collate stakeholder views and integrate potentially conflicting objectives for the efficient and sustainable use of lakes, rivers and wetlands using concepts of an environmental management system, including management objectives for realistic action plans.

4. Communication:

- competence to clearly report and orally communicate results, the underpinning reasoning, knowledge and assumptions;
- work effectively in an interdisciplinary team and to present evidence-based arguments to a variety of audiences.

5. Learning skills:

- effectively plan, organise and conduct a research project that has clear aims and objectives;
- apply knowledge and scientific skills in international and multicultural teams and different socio-cultural environments;
- ability to extend and enhance the own knowledge, insight and skills in an autonomous manner;

Environmental Technology for Sustainable Development

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

Knowledge & theory

1. demonstrate knowledge and understanding of the physical, chemical and biological processes of the environment, of the socio-economic concepts underlying the 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;

Methods, techniques & tools

5. 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;

6. apply general methods (including statistics and modelling) in scientific and technological approaches, concepts and interventions;

7. 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.

Analysis, synthesis & integration

8. 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;

Research/General academic skills

9. 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;

10. 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;

11. 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.

International Master of Science in Environmental Technology and Engineering

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

Knowledge & theory

1. demonstrate knowledge and understanding of the physical, chemical and biological processes of the environment, of the socio-economic concepts underlying the 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 way polluted water, waste, gas, soils and sediments can be treated;

4. identify the way ecosystems and the atmosphere can be protected from pollution;

5. identify the way to prevent environmental pollution through resource management and application of re-use technologies;

Methods, techniques & tools

6. 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;

7. develop, design and apply technologies for the prevention and remediation of environmental pollution by searching scientific information, by conducting scientific research in the field of environmental technology and engineering and by reporting their findings by means of scientific reports and papers;

8. communicate effectively in English and transferring knowledge to both the scientific and non-scientific world through oral presentations and media communications.

Analysis, synthesis & integration

9. 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;

10. demonstrate creativity and critical, multidisciplinary thinking for problem-solving and decision-making;

11. demonstrate responsibility and own initiative;

12. demonstrate capacity to work in an international, multi-cultural team.

Research/General academic skills

13. 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;

14. 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;

15. 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.

Water Management Programme

Water Resources Management

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

Knowledge & theory

1. Be able to 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. Be able to 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. Be able to explain the key concepts for integrated, multi-disciplinary and interdisciplinary analyses of water systems and describe the challenges of such approaches.

4. Be able to describe different concepts to determine the value of water for various uses and users in (amongst others) economic and social terms and explain how these concepts can be used in water resources planning at various spatial and temporal scales

Methods, techniques & tools

5. Be able to 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.

6. Be able to 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.

7. Be able to combine different types of method and through a process of triangulation synthesize outcomes in a coherent manner.

Analysis, synthesis & integration

8. Be able to define a given water resources system, and compose the water flows across time and space, including the various water uses, and describe the interdependencies these create between the various water users.

9. Be able to critically evaluate technical and/or institutional water resources interventions (projects/ programmes/ policies/ agreements) through analysis of implications for the water resources system, its users and their interrelations at various spatial and temporal scales.

Research

10. Be able to 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.

General academic skills

11. Be able to clearly and systematically communicate, argue and defend findings in oral and written presentations to a variety of audiences.

12. Think in multidisciplinary and integrated dimensions and be able to distinguish main issues from side issues.

13. 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.

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

Knowledge & theory

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.

Methods, techniques & tools

5. design and facilitate inclusive consultation and conflict management processes, such as consensus building, public participation, negotiation and mediation between actors at different levels.

6. 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.

7. do combine different types of method and through a process of triangulation synthesize outcomes in a coherent manner.

Analysis, synthesis & integration

8. define a given water resources system, assess the different functions of the water resources system and the often competing interests of water using sectors and actors, describe the interdependencies between these, and finally assess the possibilities and limitations of cooperation.

9. 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.

Research

10. 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.

General academic skills

11. clearly and systematically communicate, argue and defend findings in oral and written presentations to a variety of audiences.

12. think in multidisciplinary and integrated dimensions and be able to distinguish main issues from side issues.

13. 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.

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

Knowledge and theory

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.

Methods, techniques and tools

5. interpret, design and optimize water quality assessment and monitoring programmes by applying experimental, statistical and modelling tools.

6. 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.

7. combine different types of method and through a process of triangulation synthesize outcomes in a coherent manner.

Analysis, synthesis and integration

8. 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.

9. 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.

Research

10. 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.

General academic skills

11. clearly and systematically communicate, argue and defend findings in oral and written presentations to a variety of audiences.

12. think in multidisciplinary and integrated dimensions and be able to distinguish main issues from side issues.

13. 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

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

Knowledge and theory

1. Be able to describe for a given water resources system the interplay between the main biophysical processes and social dynamics, in analyzing service delivery modalities.

2. Be able to 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. Be able to 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. Be able to 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).

Methods, techniques and tools

5. 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.

6. Be able to 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.

7. Be able to combine different types of method and through a process of triangulation synthesize outcomes in a coherent manner.

Analysis, synthesis and integration

8. Be able to analyze and evaluate governance processes and utility management arrangements in the water services sector, integrating technical, legal administrative, social and financial components.

9. Be able to critically evaluate technical and/or institutional interventions (projects/ programmes/ policies/ agreements) through analysis of implications for water supply and sanitation services, its users and their interrelations at various spatial and temporal scales.

Research

10. Be able to 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.

General academic skills

11. Be able to clearly and systematically communicate, argue and defend findings in oral and written presentations to a variety of audiences.

12. Think in multidisciplinary and integrated dimensions and be able to distinguish main issues from side issues.

13. 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.

Water Science and Engineering Programme

Hydraulic Engineering and River Basin Development

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

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. 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;

4. 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;

5. have knowledge of contemporary research (questions) and relevant literature in the field of hydraulic engineering and river basin development;

6. critically judge and evaluate their own work and results, as well as the information of prior research or investigations;

7. adequately communicate methodologies, results, evaluations, conclusions and recommendations in written, oral and graphical form to a wide variety of audience;

8. 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;

9. 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;

10. have acquired sufficient skills in using information and communication technology for conducting studies and analyses, in addition to presentation and communication;

11. have adopted the academic attitude and learning skills to enhance and broaden the acquired knowledge and applications in an independent manner.

Hydraulic Engineering-Coastal Engineering and Port Development

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

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. 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;

3. 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;

4. apply hydraulic and nautical, logistic and economic theories in the planning and design of coastal and ports layout and port logistics;

5. 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;

6. be equipped with various analytical and computational expertise necessary to solve problems in coastal and port engineering;

7. have the skills to undertake academic research that contributes to the better understanding of coastal and/or port engineering;

8. 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;

9. 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;

10. 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;

11. have experienced different aspects of learning which are integrated through different teaching methods and through independent study experiences;

12. possess critical thinking skills, the ability of both independent and team problem-solving and the sense of engineering creativity and design;

13. have acquired sufficient skills in using information and communication technology for conducting research, studies and analyses, in addition to presentation and communication;

14. develop a sense of professionalism and an appreciation for the obligations of a professional engineer;

15. be aware of the professional and ethical issues encountered in engineering practice.

Hydroinformatics– Modelling and Information Systems for Water Management

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

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. 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;

4. have an understanding of advanced and appropriate information and communication technologies and their application to manage information relating to water management;

5. 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;

6. have a good knowledge of the relevant literature and the contemporary research questions in the field of Hydroinformatics;

7. 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;

8. critically judge and evaluate their own work and results, as well as prior research or investigations carried out by others;

9. provide considered advice to managers and users of advanced Hydroinformatics tools;

10. appreciate and discuss the ethics and nature of the postmodern society and the role of water within it as a "right" and an "asset";

11. 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;

12. 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;

13. have adopted the academic attitude and learning skills to enhance and broaden the acquired knowledge and application skills in a largely independent manner;

14. be aware of the professional and ethical issues encountered in Hydroinformatics practice directed towards issues facing developing countries and countries in transition.

Hydrology and Water Resources

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

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. 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;

3. 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;

4. 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;

5. have a good knowledge of the relevant literature and the contemporary research questions in the field of hydrology;

6. design and conduct hydrological research and experiments for both application and scientific purposes, either independently or within a team-based framework;

7. critically judge and evaluate their own work and results, as well as prior research or investigations carried out by others;

8. adequately communicate methodologies, results, evaluations, conclusions and recommendations in oral, written and graphical form to a wide variety of audience;

9. 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

10. have adopted the academic attitude and learning skills to enhance and broaden the acquired knowledge and application skills in a largely independent manner.

Hydraulic Engineering - Land and Water Development

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

1. have in-depth understanding and specific knowledge of:
    a. the latest concepts and theories of irrigation, drainage, flood protection, land reclamation and consolidation technologies for sustainable development;
    b. the cross-sectoral linkages comprehending wider aspects of society, economy and the environment;

2. 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;

3. identify and cross-evaluate alternative land and water development options for areas under different land uses and assess their technical, economic, institutional and environmental feasibility;

4. engage in or advise developers, system managers and water users on the participatory development and management, as well as modernisation of irrigation, drainage and flood protection schemes for their planning, design, implementation, operation and maintenance, financing and performance assessment;

5. acquire knowledge and understanding of contemporary research issues in the field of land and water development;

6. 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.

Learning objectives Integrated Lowland Development and Management Planning (joint specialisation with Sriwijaija University)

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

1. have in-depth understanding and specific knowledge of:
    a. the current concepts and theories of irrigation, drainage, and land reclamation and land consolidation technology to support a sustainable development of lowlands with different types of land use;
    b. the multi-disciplinary involvement in the water sector linkages with the wider aspects of society, economy and the environment;

2. master the major hydraulic and environmental engineering aspects and hydrological methodologies, as well as applications for irrigation, drainage and flood protection schemes, including techniques for data collection, processing and analysis, and modelling techniques;

3. contribute to the planning, design, development and implementation (action plan for the realisation) of the hydraulic infrastructure for lowland development and management schemes;

4. advise developers, system managers and water users on the operation and maintenance aspects, as well as on modernisation of the water management and flood protection schemes;

5. have knowledge of contemporary research questions and the relevant literature in the field of integrated lowland development;

6. formulate and conduct hydraulic and environmental engineering research, plan development and designs in the field of integrated lowland development, experiments and tests for both practical and scientific purposes, either independently or within a team-based framework;

7. critically judge and evaluate their own work and results, as well as the information of prior research or investigations, plans and design;

8. adequately communicate methodology, research results, plans, designs, evaluations, conclusions and recommendations in written, oral and graphical form to a wide variety of audience;

9. formulate and evaluate a concept with its alternatives for integrated lowland development for areas with different type of land use and assess the technical and economic feasibility, as well as the environmental sustainability of the proposed integrated lowland development and/or management plans;

10. have adopted the academic attitude and learning skills to enhance and broaden the acquired knowledge and application skills in a largely independent manner.

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:

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;
   - the cross-sectoral linkages between land and water development and wider aspects of society, economy and the environment;

2. 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;

3. 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;

4. 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;

5. acquire knowledge and understanding of contemporary research issues in the fields of land and water development and agricultural water management;

6. 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;

7. 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;

8. develop the academic attitude and learning skills to enhance and broaden the acquired knowledge and application skills in a largely independent manner.

Learning objectives Agricultural Water Management for Arid and Semi-arid Climates (joint specialisation with Haramaya) University)

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

1. Have in-depth understanding and specific knowledge of:
   - the current concepts and theories of irrigation, drainage, and land reclamation and land consolidation technology to support a sustainable development of identified lands with different types of land use;
   - the multi-disciplinary involvement in the water sector linkages with the wider aspects of society, economy and the environment;

2. Master the major hydraulic and environmental engineering aspects and hydrological methodologies, as well as applications for irrigation, drainage and flood management schemes, including techniques for data collection, processing and analysis, and modelling techniques;

3. Be able to contribute to the planning, design, development and implementation (action plan for the realisation) of the hydraulic infrastructure for land development and management schemes;

4. Be able to advise developers, system managers and water users on the operation and maintenance aspects of the water management schemes;

5. Have knowledge of contemporary research questions and the relevant literature in the field of integrated land development;

6. Be able to formulate and conduct hydraulic, agronomic and institutional research, plan development and designs in the field of agricultural water management for arid and semi-arid climates, experiments and tests for both practical and scientific purposes, either independently or within a team-based framework;

7. Be able to critically judge and evaluate their own work and results, as well as the information of prior research or investigations, plans and design.

8. Be able to adequately communicate methodology, research results, plans, designs, evaluations, conclusions and recommendations in written, oral and graphical form to a wide variety of audience;

9. Be able to formulate and evaluate a concept with its alternatives for integrated land development for areas with different type of land use and assess the technical and economic feasibility, as well as the environmental sustainability of the proposed integrated land development and/or management plans;

10. Have adopted the academic attitude and learning skills to enhance and broaden the acquired knowledge and application skills in a largely independent manner.

Ecohydrology

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

1. demonstrate knowledge and understanding of the ecological and hydrological processes on varying spatiotemporal scales in the environment, of the socio-economic concepts underlying the functioning and exploitation of environmental systems, and of the complex inter-relationship between the protection and wise use of environmental resources;

2. 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;

3. critically analyse and evaluate a range of options and alternatives for the prevention or remediation of environmental problems, under different socio-economic, cultural contexts, and under often data-poor conditions;

4. contribute as a flexible and creative member in interdisciplinary teams in developing solutions for prevention or remediation of ecohydrological systems, 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;

5. 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;

6. 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;

7. 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.

Appendix B Eligible Bachelor's Degrees for Academic admission

SPECIALISATION	ACCEPTS APPLICANTS WITH A BSC DEGREE IN
MWI programme:	
Sanitary Engineering	civil, environmental or chemical engineering, or in microbiology
Water Supply Engineering	civil, chemical, environmental, hydraulic or mechanical engineering
Urban Water Engineering and Management	civil engineering
WSE programme:	
Hydrology and Water Resources	civil or agricultural engineering, earth sciences, environmental sciences, or physics.
Hydroinformatics	civil, agricultural or systems engineering, earth sciences, environmental sciences or physics.
Hydraulic Engineering and River Basin Development	civil engineering or related field with a hydraulic engineering background.
Hydraulic Engineering - Coastal Engineering and Port Development	civil engineering or related field with a hydraulic engineering background.
Hydraulic Engineering - Land and Water Development	civil or agricultural engineering, or a related field.
WM programme:	
Water Resources Management	engineering (civil, chemical, agricultural, irrigation or environmental), natural sciences, environmental science, agronomy, geography
Water Quality Management	engineering (civil, chemical, agricultural, irrigation or environmental), natural sciences, environmental science, chemistry, biology, ecology, agronomy, geography
Water Services Management	engineering (civil, chemical, agricultural, irrigation or environmental), natural sciences, geography, sociology, economics , law, political science, public administration, anthropology
Water Conflict Management	engineering (civil, chemical, agricultural, irrigation or environmental), natural sciences, environmental science, geography, sociology, economics , law, political science, public administration, anthropology
ES programme:	
Environmental Science and Technology	civil, chemical, agricultural or environmental engineering, natural sciences, chemistry, environmental science, agriculture, or in geology
Environmental Planning and Management	civil, chemical, agricultural or environmental engineering, natural sciences, chemistry, environmental science, agriculture, geology, geography, or in environmental economics
Water Quality Management	civil, chemical, agricultural or environmental engineering, natural sciences, chemistry, environmental science, agriculture, or in geology
Limnology and Wetland Ecosystems	civil, chemical, agricultural or environmental engineering, natural sciences, chemistry, environmental science, agriculture, or in geology

Appendix C 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.

Students are advised to arrive at an examination in time and to be outside the examination room 10 minutes before the examination is scheduled to start.

Misreading the date, time or room allocation will not be accepted as an excuse for absence from an examination or for arriving too late.

Written Examinations

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 planning officer if necessary.

Student card: Students are required to bring their UNESCO-IHE student card and are allowed to enter the examination room after a signal from the invigilators. Students will not be allowed into the room if they present themselves later than 15 minutes after the start of the examination.

Attendance list: After entering the examination room, students have to sign the 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: Each student has an allocated table with a set of answer and scratch papers with their student number printed on the cover sheet. Additional paper can be obtained from the invigilators upon request.
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).

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.

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.

THESIS PROPOSAL AND RESEARCH EXAMINATIONS

The thesis proposal is to be submitted for assessment to the responsible professor and the mentor, who will evaluate the proposal and assign a 'satisfactory' judgement if the evaluation is passed. Additionally, a presentation by the student may be part of the evaluation.

The examination of the thesis research consists of a maximum 30 minutes presentation of the thesis work by the candidate, followed by a maximum 30 minutes examination discussion with the examination committee and, possibly, the audience.

Appendix D GRADING SYSTEMS used by partner institutes

JOINT SPECIALISATION IN:

- **SANITARY ENGINEERING**
- **WATER SUPPLY ENGINEERING**
-

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**

JOINT SPECIALISATION IN:

- **UWEM**
- **AWELWP**
- **ETSuD**

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

The grade needed to have a postgraduate degree conferred upon an individual is

- achieve a final cumulative grade point average of not less than 2.75;
- achieve a grade of excellent, very good, good or fair for the thesis, research study, project or internship

JOINT SPECIALISATION IN:

- **SANITARY ENGINEERING**
- **ENVIRONMENTAL SCIENCE**
- **HYDROINFORMATICS**

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 is 3.5 or higher, and a pass is obtained for the thesis.

JOINT SPECIALISATION IN:

- **ILDMP**

Sriwijaija University

Same system as used at UNESCO-IHE

JOINT SPECIALISATION IN:

- **LWM**

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.

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
5 (nicht genügend)	F/FX	fail

ERASMUS MUNDUS PROGRAMME: 'IMETE'

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			

* UNESCO-IHE marks in the table were calculated from interpolation, with a score of 10 at Gent University equal to a 6.0 at UNESCO-IHE, a 20 at Gent University equal to a 10 at UNESCO-IHE and a 0 at Gent University equal to a 0 at UNESCO-IHE.

ERASMUS MUNDUS PROGRAMME: 'FLOOD RISK MANAGEMENT'

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.

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).

TU-Catalonia
Scale from 0-10
MH Honors (is igiven 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

ERASMUS MUNDUS PROGRAMME: 'ECOHYDROLOGY'

University of Algarve
University of Lodz
University of Kiel
University of La Plata

Grades issued by the partners are converted according the following table:

Numerical National Marks				
CAU	ULodz	IHE	UALG	ULP
1	5	9.0 – 10	20	10
1.3	4.7 – 4.9	8.6 – 8.9	19 →	9.3 – 9.9
1.7	4.4 . 4.6	8.3 - 8.5	18 → 18.9	8.5 – 9.2
2	4.1 – 4.3	8.0 - 8.2	17 → 17.9	8.0 – 8.4
2.3	3.9 – 4.2	7.7 – 7.9	16 → 16.9	7.4 – 7.9
2.7	3.5 – 3.8	7.3 - 7.6	14 → 15.9	6.5. 7.3
3	3.3- 3.4	7.0 - 7.2	12 → 13.9	6.0 – 6.4

3.3	3.1.- 3.2	6.7 - 6.9	11 → 11.9	5.4 – 5.9
3.7	2.7 – 3.0	6.3 - 6.6	10.5 → 10.9	4.5 - 5.3
4.0	2.5 – 2.6	6. 0 - 6.2	10 → 10.4	4 - 4.4
← 4.0	← 2.5	← 6.0	← 10.0	← 4.0

JOINT SPECIALISATION IN:

- **AWMASC**

University of Haramaya

Grade	Description	Grade Point	Conversion to marking on scale of 10
A	Excellent	4.00	9.1 to 10
B+	Very good	3.50	8.5 to 9.0
B	Good	3.00	7.5 to 8.5
C+	Fair	2.50	6.0 to 7.5
C	Unsatisfactory	2.00	5.0 to 6.0
F	Failure 0		< 5.00

A graduate student who scores an "F" or "C" grade may repeat the course only once.

Grades obtained on repeated courses shall be final. Previous grade or grades of "F" or "C" should be shown as canceled on the transcript to indicate that the course has been repeated; and the new grade, shall be included in the computation of the final marks,

Graduate students repeating courses in which they scored "F" and/or "C" grades must register for the courses and carry out all academic activities pertaining to the courses.

Appendix E MSc module assessment methods

Urban Water and Sanitation programme

	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)
MWI01	60		15+25			
MWI02	30+45		25			
MWI03	70		30			
MWI/WSE/04	60		20		20	
MWI/SE/UWEM/04	60		20		20	
MWI/SE/05	100		60			
MWI/UWEM/05		60	40			
MWI/WSE/05	80				20	
MWI/SE/06	80		20			
MWI/WSE/06	70		15		15	
WSM/06			100			
MWI/SE/07						
MWI/WSE/UWEM/07	60		40			
MWI/SE/08	60		25+15			
MWI/WSE/08	70		20		10	
WSE/HI/08B/e	40		60			
MWI/09			100			
MWI/SE/UWEM/10	60		25			15
WSE/HI/10B/e	40		30+30			
MWI/WSE/10	**60**		40			
MWI/SE/11	100		80	20		
MWI/WSE/11a	60		10+10+10+10			
MWI/WSE/11/b	60		30	10		
MWI/12			50+30	20		
MWI/13	60		40			
MWI/14		100				
MWI/15		100				

The programme components, credits, and the nature of the examinations in the specialisation Water Supply Engineering and Sanitary Engineering with **KNUST** are:

Name	ECTS	Examination	Assignments Role play Exercises
Module (KN) 1 Introduction to Environmental Sanitation	5	70	30
Module (KN) 2 Mathematical and research methods	4	70	30
Module (KN) 3 Environmental science and process technology	6	70	30
Module (KN) 4 Environmental quality	3	70	30
Module (KN) 5 water supply	2	70	30

The programme components, credits, and the nature of the examinations in the specialisation Sanitary and Environmental Engineering with **Univalle** are:

Name	ECTS	Examination (%)	Workshops, Lab reports, assignments (%)
C1 Chemistry of Environmental Pollution	5.13	50	20%: Workshops 30%: Lab reports
C2 Environmental Pollution Microbiology	5.13		presentation of related articles followed by open questions; written assignment; written exam; lab reports
C3 Fundamentals of Environmental Processes	5.13	60	20%: Home work and workshops 20%: Case study
C4 Environmental and Development	5.13	35	30%: Three workshops or short assignments 35%: Final assignment with presentation
C5 Engineering Research Introduction	3.42		100% Report

Environmental Science programme

	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
ES/01	75		25				
ES/02	60		25 +15				
ES/03	75		25				
ES/04	60		40				
ES/05/bL	60		10	20	10		
ES/05/TM	40		40	20			
ES/05/W	70		20		10		
ES/06/L	60			20	20		
ES/06/M	70		20			10	
ES/06/T	50		25 +25				
ES/06/W	60		40				
ES/07/L	60		10	20			10
ES/07/MW	70		30				
ES/07/T	70		20		10		
ES/08/L	60			20			10+10
ES/08/MW	100						
ES/08/T	60		35	5			
ES/09/L	40		40	20			
ES/09/TMW							100
ES/10/L	**60**			30	10		
ES/10/TWL			80+10	10			
WSM/06			100				
ES/11/L	40		40	20			
ES/11/MW	70		30				
ES/11/T	60		35	5			
ES/11/X	70		30				
ES/12/L	60		10	30			
ES/12/TMW			100				
ES/13			100				
ES/14			100				
ES/15			100				

The programme components, credits, and the nature of the examinations in the specialisation ***Environmental Science and Technology*** with Univalle are:

Name	ECTS	Examination (%)	Workshops, Lab reports, assignments (%)
C1 Chemistry of Environmental Pollution	5.13	50	20%: Workshops 30%: Lab reports
C2 Environmental Pollution Microbiology	5.13		presentation of related articles followed by open questions; written assignment; written exam; lab reports
C3 Fundamentals of Environmental Processes	5.13	60	20%: Home work and workshops 20%: Case study
C4 Environmental and Development	5.13	35	30%: Three workshops or short assignments 35%: Final assignment with presentation
C5 Engineering Research Introduction	3.42		100% Report

Water Science and Engineering programme

	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
WSE/01/c	20 (x3)		20 (x2)				
WSE/02/c	35 (x2)		30				
WSE/CEPD/03/s	10	50+30+10					
WSE/LWD/03/s		15	70 + 15				
WSE/RBD/03/s	25+25+25		25				
WSE/HI/03/s	40		15+15+30				
WSE/HWR/03/s	25+25+20		10+10+10				
WSE/CEPD/04s	60	20	20				
WSE/LWD/04/s	30		20+25+25				
WSE/RBD/04/s	80		20				
WSE/HI/04/s	35+20		15+30				
WSE/HWR/04/s	70		30				
WSE/CEPD/05/s			30+70				
WSE/LWD/05s	35		10+30+25				
WSE/RBD/05s	40+20		20+20				
WSE/HI/05s	15	35	30+20				
WSE/HWR/05/s	50+30+20						
WSE/CEPD/06/s	100						
WSE/LWD/06/s			25+20+30+25				
WSE/RBD/06/s	25+15		25+10+25				
WSE/HI/06/s	25+30		10+15+20				
WSE/HWR/06/s	50+50						
WSE/CEPD/07/s	15+15+15+15		40				
WSE/LWD/07/s		70	30				
WSE/RBD/07/s		100					
WSE/HI/07/s	100						
WSE/HWR/07A/s	60				40		
WSE/HWR/07B/s	25+35+15		10+15				
WSE/CEPD/08A/e				100			
WSE/CEPD/08B/e				100			
WSE/LWD/08/e			30+15+30+25				
WSE/RBD/08A/e	80		20				
WSE/HI/08A/e	65		35				
WSE/HI/08B/e	40		60				
WSE/HWR/08/e			50+35	15			
WSE/09/c						100	
WSE/CEPD/10/e		70	30				
WSE/LWD/10/e			45+30+25				
WSE/RBD/10/e	45+45		10				
WSE/HI/10A/e	60		40				
WSE/HI/10B/e	40		30+30				
WSE/HWR/10B/e			70+30				
WSE/11							
WSE/CEPD/11/e	20	40	40				
WSE/LWD/11/e			40+60				
WSE/RBD/11/e	30+30		40				
WSE/HI/11/e			40+30+30				
ES11MW	70		30				
WSE/12/c				100			
WSE/13/C			100				
WSE/14/c			100				
WSE/15			100				

The programme components, credits, and the nature of the examinations in the specialisation ***Land and Water Development with Haramaya University*** are:

Name	ECTS	Examination	Assignments
Course work Semester I			
1. Soil Plant Water Relations	2	Final examination – 70%.	Laboratory Reports - 30%
2. Applied Hydrology	3	Written Exam (2): 40%	Assignments: 20% Project: 40%
3. Design of Surface Irrigation Systems	3		
4. Experimental Design and Analysis	2	Final examination – 60%.	Assignments including softwares outputs – 20% Presentation (20%)
Course work Semester II:			
1. Pressurized Irrigation Systems Design	3		
2. Watershed Management	3	Mid examination – 20%; Final examination – 40%	Assignments - 40%;
3. Dams and Hydraulic Structures	3	Mid examination – 30% Final examination – 50%.	Assignments – 20%
4. Drainage and Salinity Control	3	Final examination – 60%.	Two Design Projects - 40%

The programme components, credits, and the nature of the examinations in the specialisation ***Land and Water Development with Asian Institute of Technology*** are:

Name	ECTS	Examination	Assignments
Watershed Hydrology	7.5	Mid-semester Exam (30%), Final Exam (40%) and	Assignment/Semester Paper (30%).
Hydrodynamics	7.5	Mid-semester Exam (40%), Final Exam (50%) and	Assignment (10%).
Irrigation and Drainage Engineering	7.5	Mid-Semester Exam (30%); Final Exam (40%);	Exercises/Reports (30%)
Integrated Water Resources Management	7.5	Mid-semester Exam (20%), and Final Exam (30%)	Assignment and Project Work (50%)

The programme components, credits, and the nature of the examinations in the specialisation ***Land and Water Development with Sriwijajija University*** are:

Name	ECTS	Examination	Assignments
Semester 1			
1. Environmental Science	2	Exams/ 40%	Quiz/ 15% Assignment/ 25% Oral disc. presentation / 20%
2. Resource Economics	2	Mid Exam/ 20% Final Exam/ 30%	Exerc./ 20% Quiz/ 15% Assigments/ Presentation/ 15%
3. Environmental Law	2	Exams/ 30%	Assignments/ 25% Quiz/ 20% Oral/ 25%
4. Eco-statistic	3	Exam 1/30% Exam 2/30%	Assignments/20% Quiz 1/10%

			Quiz 2/10%
5. Environmental Sociology	2	Exams/ 25%	Assignment/ 20% Oral disc/ 25% Quiz/ 20% Presentation/ 10%
6. Environmental Value and Ethics	2	Exams/ 40%	Quiz / 15% Assignments/ 25% Oral disc./ presentation 20%
7. Research methods	2	Exams/ 30%	assignment/30% Quiz / 20% Oral disc and presentation./20%
Semester 2			
1. Environmental Management System	2	Exams/ 30%	assignment/30% Quiz / 20% Oral disc and presentation./20%
2. Integrated Aspects of Lowland Management	3	Exams/ 30%	Assignment/30% Quiz / 20% Oral disc and presentation./20%
3. Managing, Organization and Change in Lowland Schemes.	3	Exams/ 30%	assignment/30% Quiz / 20% Oral disc and presentation./20%
4. Soil and Water Data Collection, Monitoring Evaluation	2	Exams/ 20%	Lab, Assignment/40% Quiz / 20% Oral disc and presentation./20%
5. Lowland Hydrology	2	Written test/ 30%	Assignments/ 20% Assignments, oral disc./ 25% Lab, Field works/ 25%

The programme components, credits, and the nature of the examinations in the specialisation ***Flood Risk Management*** are:

			Credits	Exams
Sem1	September – February (year 1)	Dresden		
	Flood Risk Management I	TUD	10	written exam (50%), the study work (30%) and the protocol of the study tour (20%).
	Flood Risk Management II	TUD		
	Meteorology and Hydrology	TUD	5	written exam
	GIS and Remote Sensing	TUD		
	Climate change	TUD	5	written exam (45 minutes), and an oral presentation
	Hydraulic Engineering	TUD	5	a written exam
	Hydromechanics	TUD		
	Ecology	TUD	5	25% oral presentation 75% written exam **or** the study work
	Statistics	TUD	5	written exam
	Geodesy	TUD		written exam, participation in at least 70% of the offered practicals
Sem 2	March – July (year 1)	Delft, Netherlands		

March	Computational Intelligence and Control Systems	IHE	5	Exercise report (10%) Written exam & exercises (45%) Written exam (25%) Exercise report (20%)
April	River Basin Modelling	IHE	5	Exercises reports on three topics (10%) (20%) (30%) participation & oral exam (40%)
end of April – end of May	*Option A*: • River flood modelling and 1D flood routing *Option B*: • Urban drainage systems and Urban flood modelling	IHE	5 5	Written exam 10% Exercise report (50%) Oral exam (40%) Written exam (10%) Exercise report (50%) Written exam (40%)
end of May – first half of June	International Fieldtrip (12 days)	IHE	5	Fieldtrip report
2nd half of June – beg. of July	Flood Risk Management III	IHE	5	Exercise reports (40%) Written exam on all subjects (60%)
July	**Hydroinformatics for Decision Support** **Watershed & River Basin Management**	IHE	5 5	Assignments (35%) Assignments (30%) Assignments (20%) Assignments (15%) Exercise reports (40%) Written exam on all subjects (60%)
August	Vacation			
Semester 3	September – January (year 2)	Barcelona, Ljubljana		
	Implications of global warming on floods and droughts	UPC	3	Exercises reports on three topics (10%) (30%) (20%) & oral exam (40%)
	Coastal flooding: impacts, conflicts and risks	UPC	7	Conventional exam and/or a case study
	Debris flow and flash floods: risk, vulnerability, hazard and resilience concepts	UPC	6	Exercises reports on five topics (55%) Participation fieldtrip (5%) & exam (40%)
	Applications of radar-based rainfall observations and forecasts in early warning systems and flood forecasting	UPC	3	Conventional exam and/or a case study
	Spatial planning for flood protection and resilience	UL	5	Written exam (20%) Written exam & exercises (40%) Written exam & exercises (40%)

	Socio-economic and institutional framework of floods	UL	5	Exercise report (10%) Written exam & exercises (45%) Written exam (25%) Exercise report (20%)
	Fieldtrips	UPC, UL		
Semester 4	February – July (year 2)	different locations		
	Masters thesis in one of the partner institutes or with the associated partners			
End of July	Joint seminar/workshop MSc defences Diploma awarding	all in one of the institutions		

The programme components, credits, and the nature of the examinations in the specialisation ***Ecohydrology*** are given in the programme handbook

Water Management programme

	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
WM/1	50		25+25				
WM/2	65		35				
WM/3	50		20+30				
WM/4	50		20	30			
WM/WCM/5	40		40				20
WM/WRM/5	65		35				
WM/WSM/5	70		30				
ES/5/W	70		20		10		
WM/WCM/6	40		40				40
WM/WRM/6	60			40			
WM/WSM/6			100				
ES/06/T	50		25+25				
ES/06/W	60		40				
WM/WRM/7	65		35				
WM/WSM/7	65		20+15				
ES/07/MW	70		30				
WM/8	60		40				
WM/9			30	30+30			
WM/WRM/10	50		15+15+20				
WM/WSM/10	70		30				
ES/10/TWL	80		10	10			
WM/WSM/11			20+30+50				
ES/11/MW	70		30				
ES/11/X	70			30			
WM/12			65+35				
WM/13A				100			
WM/13B			100				
WM/14		100					
WM/15		100					

Appendix F 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.

UWS Programme Overview 2013-2015

			WSE Water Supply Engineering	SE Sanitary Engineering	UWEM Urban Water Engineering and Management
	1	.....-20/10 21/10-27/10	Week ONE Introduction (ALL)		at AIT *(August 2013 onwards)* watershed hydrlogy, drinking water treatment, Wastewater treatment and integrated water resource mamagement
	1	28/10-03/11 04/11-10/11	Hydrology, Water supply and water demand management and GIS (UWS/01)		
	2	11/11-17/11 18/11-24/11 25/11-01/12	Public health and Chemistry (UWS/02)		
	..	02/12-08/12	Examination Week		
	3	09/12-15/12 16/12-22/12	EPT, Microbiology and Integrated Urban Water Management (UWS/03)		
	..	23/12-29/12 30/12-05/01	Free Period		
	3	06/01-12/01	(UWS/03) *continue*..		
Students Univalle Enter	4	13/01-19/01 20/01-26/01 27/01-02/02	Surface water treatment I (UWS/WSE/04)	Urban drainage and sewerage (UWS/SE/UWEM/04)	
	..	03/02-09/02	Examination Week		
	5	10/02-16/02 17/02-23/02 24/02-02/03	Surface water treatment II (UWS/WSE/05)	Conventional wastewater treatment (UWS/SE/05)	Asset management (UWS/UWEM/05)
Students KNUST Enter	6	03/03-09/03 10/03-16/03 17/03-23/03	Groundwater treatment and resources (UWS/WSE/06)	Resource oriented wastewater treatment and sanitation (UWS/SE/06)	Managing water organisations (=> WSM06)
	..	24/03-30/03	Examination Week		
	7	31/03-06/04 07/04-13/04 14/04-20/04	Water transport and distribution (UWS/WSE/UWEM/07)	Wastewater treatment plants design and engineering (UWS/SE/07)	Water transport and distribution (UWS/WSE/UWEM/07)
	8	21/04-27/04 28/04-04/05 05/04-11/05	Advanced water treatment and reuse (UWS/WSE/08)	Modeling of wastewater treatment processes and plants (UWS/SE/08)	Urban flood management and disaster risk mitigationn (=> WSE/HI/08B/e)
	..	12/05-18/05	Examination Week		
	9	19/05-25/05 26/05-01/06 02/06-08/06	International fieldtrip and fieldwork (UWS/09)		
	10	09/06-15/06 16/06-22/12 23/06-29/06	Industrial effluents treatment and residuals management - (UWS/SE/UWEM/10) - or - Water treatment processes and plants - (UWS/WSE/UWEM/10) - or - Urban water systems - (WSE/HI/10B/e) - or - A module from another Programme		
		Click HERE TO CHOOSE YOUR MODULE 10+11 (2013-2015)			
	11	30/06-06/07 07/07-13/07 14/07-20/07	Advanced water transport and distribution - (UWS/WSE/11a) - or - Decentralised water supply and sanitation - (UWS/WSE/11b) - or - Faecal sludge management - (UWS/SE//11) - or - A module from another Programme		MSc research proposal
	..	21/07-27/07	Examination Week		at AIT
	..	28/07-03/08	Free		
	12	04/08-10/08 11/08-17/12 18/08-24/08	Groupwork Sint Maarten (UWS/12)		
	..	25/08-31/08	Examination Week		
Univalle and KNUST leave	13	01/09-07/09 08/09-14/09 15/09-21/09	Week 1:Research methodologies and skills + statistics Week 2 and 3: SUMMER COURSES (UWS/13)		
	14	22/09-28/09 29/09-05/10 06/10-12/10	MSc research proposal (UWS/14)		
	..	13/10-19/10	Examination Week		
	15	20/10/14 .... 12/04/15	MSc thesis (6 months)		
	..	13/04-19/04 20/04-26/04	Final Examination Week(s)		

MASTERS PROGRAMME UWS 2013-2015 - PART 2

Table of Contents

URBAN WATER AND SANITATION

MASTERS PROGRAMME

Academic Year: 2013-2015
Specialization: Core Programme
Module Coordinator: Steen, N.P. van der

Module Sheet

Module Name Hydrology, Water supply and water demand management and GIS	Module Code UWS/01	Credits 5

Target Group	Prerequisites
Programme target group	Programme prerequisites

Learning Objectives

Upon completion of the module participants will be able to..

- identify and discuss the basic elements of hydrology, and apply hydrological principles in water and wastewater engineering.
- forecast water demand in a city, based on population forecasts, per capita use and Water Demand Management measures.
- comprehend GIS and remote sensing concepts;
  explain the basic principles underlying the GIS/model-based management of water systems; recognize the GIS-based analytical and problem-solving techniques for sustainable planning and management of urban water systems.

Topics and Learning Activities

Hydrology

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 extractions; theory of groundwater flow, flow towards wells, superposition and boundary effects, potential and stream functions, development of observations and productions wells; groundwater pollution.

Learning Activities:

Lectures, workshops.

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.

Learning Activities:

Lectures, workshops.

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 the GIS computer exercises.

Learning Activities:

Lectures and computer workshops.

Lecturing Material

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

Assessment

- **45%: Written Exam (closed book) -- Hydrology**
- **30%: Written exam (closed book) -- Water Supply and Water Demand Management**
- **25%: Assignment -- GIS**

2013/2015-UWS/01: Hydrology, Water supply and water demand management and GIS										
Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: studyload hours	Lecturer(s)
	Hydrology	**8**	**8**					**8**	**32**	dr. J.W. Wenninger, dr. T.Y. Stigter
	Water Supply and Water Demand Management	**8**						**8**	**24**	dr. S.K. Sharma
	Geographic Information Systems	**8**	**8**					**8**	**32**	dr. J. van der Kwast
	Total	**24**	**16**					**24**	**88**	
MSc module - UNESCO-IHE										

URBAN WATER AND SANITATION

MASTERS PROGRAMME
Academic Year: **2013-2015**
Specialization: **Core Programme**
Module Coordinator: **Slokar, Y.M.**

Module Sheet

Module Name Chemistry and public health	Module Code UWS/02	Credits 5

Target Group	Prerequisites
Programme target group	Programme prerequisites

Learning Objectives

Upon completion of the module participants will be able to..

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

Topics and Learning Activities

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.

Learning Activities:

Lectures, workshop, laboratory work.

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).

Learning Activities:

Lectures.

Lecturing Material

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

Assessment

- **65%: Written Exam (closed book) -- Chemistry**
- **35%: Written exam (closed book) -- Public health**

2013/2015-UWS/02: Chemistry and public health											
Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: studyload hours	Lecturer(s)
	Chemistry	**12**		**10**	**4**			**26**	**54**	Dr. Y.M. Slokar, ir. J.P. Buiteman
	Public health	**10**		**2**				**12**	**32**	Prof. dr. A.M. de Roda-Husman
	Total	**22**		**12**	**4**			**38**	**86**	
MSc module - UNESCO-IHE										

URBAN WATER AND SANITATION

MASTERS PROGRAMME

Academic Year: 2013-2015
Specialization: Core Programme
Module Coordinator: Steen, N.P. van der

Module Sheet

Module Name EPT, Microbiology and Integrated Urban Water Management	Module Code UWS/03	Credits 5

Target Group	Prerequisites
Programme target group	Programme prerequisites

Learning Objectives

Upon completion of the module participants will be able to..

- 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.
- Apply microbiological principles in water and wastewater engineering.
- To 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: The knowledge/insight level: - To describe the urban water system (cycle), its components and interrelations, and its interactions with the (aquatic) environment. - To describe the causes of urbanisation and the effect on the urban water system. - To model water flows, material flows and energy consumption of an urban water system using a water balance software tool. The application level: - To apply theoretical concepts from systems engineering to the urban water system - To apply strategic and masterplanning of the urban water system, and describe links with general urban planning. The integration level: - To develop a strategy for IUWM, making use of water demand management and pollution prevention. - To clearly and coherently present your ideas in a well-organised formal academic report.

Topics and Learning Activities

Environmental Process Technology (EPT)

Mass balance analysis, reactor models, mixing in reactors, kinetics, mathematical description of chemical and biological reactions in reactors.

Learning Activities:

Lectures, workshops.

Microbiology

In (water) microbiology will be discussed: morphology, physiology, growth kinetics, classification and ecology of bacteria, fungi, protozoa, algae, cyanobacteria and viruses; pathogenic organisms and public health; principles of microbial transformations of matter in natural and biological treatment systems; bacteriological tests in drinking water supply and waste water treatment.

Learning Activities:

Lectures, laboratories.

Integrated Urban Water Management (IUWM)

The module is centered around a writing assignment, which is about assessing, evaluating and developing a strategy for IUWM in a real city. The lectures and workshops are aimed at supporting the students in preparing the technical report by training them in a number of tools that can be used to evaluate/develop IUWM strategies.

Learning Activities:

Lectures, workshops, assignment.

Lecturing Material

Assessment

- **35%: Written Exam (closed book) -- EPT**
- **35%: Written exam (closed book) -- Microbiology**
- **30%: Assignment -- IUWM**

2013/2015-UWS/03: EPT, Microbiology and Integrated Urban Water Management										
Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: studyload hours	Lecturer(s)
1	EPT	18		4				22	58	dr. N.P. van der Steen, dr. C.M. Hooijmans
2	Microbiology	14		12				26	54	dr. H.J. Lubberding, dr. J.J.A. van Bruggen
3	Â Intro IUWM and Technical report assignment	1	21					1	24	dr. N.P. van der Steen
4	IUWM Technical Writing	4						4	12	W.J. Sturrock, Adv Dip Ed
5	Â IUWM Systems analysis and the Urban Water System	4		8				12	20	dr. N.P. van der Steen
6	IUWM Material flows, Water and Energy	2		4				6	10	dr. N.P. van der Steen
7	IUWM Strategic planning for the Urban Water System	4						4	12	dr. N.P. van der Steen
8	IUWM Masterplanning for the Urban Water System	4						4	12	prof. dr. D. Brdjanovic
9	IUWM Stakeholder participation in Urban Water	4						4	12	J.S. Kemerink, MSc
	Total	55	21	28				83	214	
MSc module - UNESCO-IHE										

URBAN WATER AND SANITATION

MASTERS PROGRAMME
Academic Year: **2013-2015**
Specialization: **WSE**
Module Coordinator: **Villacorte, L.**

Module Sheet

Module Name Surface water treatment I	Module Code UWS/WSE/04	Credits 5

Target Group	Prerequisites
Mid-career professionals dealing with technical aspects of water and wastewater treatment plants, working for municipalities, water supply agencies or consulting firms.	BSc degree in Engineering or similar technical background meeting the MSc Programme entry requirements.

Learning Objectives

Upon completion of the module participants will be able to..
- Describe the theoretical principles of the unit processes involved in conventional surface water treatment
- Link theoretical principles with practical aspects
- Determine design parameters from experimental studies

Topics and Learning Activities

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

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 rectangular horizontal sedimentation tank.

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

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, applications, design considerations, filter arrangements, modelling, optimisation). Design aspects of the different filtration types.

Laboratory session
Coagulation, sedimentation and filtration

Fieldtrip

Lecturing Material
- K. Ghebremichael, J Schippers, JP Buiteman, Coagulation/Flocculation (LN0056/07/01)
- S.K. Sharma, Sedimentation (LN 0007/07/1)
- M.W. Blokland, N. Trifunovic and S.K Sharma, Sedimentation: Workshop problems (LN0009/07/1)
- N. Graham, Filtration (LN0330/07/1);
- J.P. Buiteman and K. J. Ives Filtration Workshop Problems (LN 0023/07/1)
- L. Huisman, Rapid filtration, (LN 0022/86/1); Reference
- L. Huisman, Mechanical filtration, (EE144/85/1); Reference
- J.P. Buiteman and K.J. Ives, Filtration, workshop problems (LN 0023/04/1)
- J.P. Buiteman, K. Ghebremichael, Laboratory Process Technology (LN 0004/07/1).

Assessment

- **20%: Assignment --**
- **20%: Lab report --**
- **60%: Written Exam (closed book) --**

2013/2015-UWS/WSE/04: Surface water treatment I											
Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: studyload hours	Lecturer(s)
	Coagulation	**6**		**2**	**4**			**12**	**28**	J.P. Buiteman, MSc
	Sedimentation	**10**	**4**	**6**	**3**			**19**	**46**	S.K. Sharma, PhD
	Filtration	**12**		**6**	**4**			**22**	**50**	Prof. N.J.D. Graham, PhD; J.P. Buiteman, MSc
	Dissolved air flotation	**2**		**2**				**4**	**8**	A. Vlaski, PhD
	Fieldtrip					**4**		**4**	**4**	L. Villacorte, MSc
	Total	**30**	**4**	**16**	**11**	**4**		**61**	**136**	
MSc module - UNESCO-IHE										

URBAN WATER AND SANITATION

MASTERS PROGRAMME
Academic Year: **2013-2015**
Specialization: **Core Programme**
Module Coordinator: **Seyoum, S.D.**

Module Sheet

Module Name Urban drainage and sewerage	Module Code UWS/SE/UWEM/04	Credits 5

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

Learning Objectives

Upon completion of the module participants will be able to..

- Describe the purpose, need and importance of urban drainage and discuss the challenges of modern urban drainage.

  Describe different types of sewer systems and discuss design, construction, operation and maintenance aspects, conditions of applicability and relative advantage and disadvantage of different types of sewer systems.
- Describe the hydrological processes relevant to urban storm drainage and impacts of urbanization on hydrological processes and discuss basic concepts in catchment modelling.

  Describe basic concepts of fluid flow and discuss the principles, fundamentals and applicability of methods to analyze conduit and free surface flows.
- Critically determine and analyze 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.
- Describe type of data required and processing methods for urban drainage management and process and analyses spatial and temporal data, design standards and regulations and health safety for proper deign, simulation and operation of urban drainage systems.
- Describe the inputs, outputs and functioning of urban drainage systems, explain the standard practice in designing urban drainage systems and develop simple drainage system designs.
- Explain the elements of an urban drainage system model, construct a simple model for analysis of hydraulics of a drainage system and interpret simple model results and use them for decision making in design, renewal and upgrading of urban drainage systems.

Topics and Learning Activities

Introduction to urban drainage and sewerage and Types of drainage and sewer system
purpose, types and historical development,
system components and layout.
Learning Activities:
Lectures and exercise

Rainfall characteristics and Wet weather flows quantitative characterization
Hydrological processes relevant to urban storm drainage
rainfall and surface runoff, rainfall-runoff transformation, rainfall
frequency analysis, extreme values and design storms, waste water generation;
Learning Activities:
Lectures and exercise

Sewerage layout and design and design exercise and pumping stations
Sewer system layout, approaches to urban drainage system
design, design criteria, sewer design calculations
Learning Activities:
Lectures, design exercise and assignment

Hydraulics for urban drainage and sewerage
Basic principles, pipe flow, part-full flow, open channel flow, pumped systems;
Learning Activities:
Lectures, exercise and assignment

Data acquisition for urban drainage and sewerage studies

Types of data and methods of acquisition for urban drainage systems design and management

Learning Activities:

Lectures

Dry and wet weather flows quantitative characterization and exercise

Characterizing wet and dry weather flow for urban drainage systems design and management

Learning Activities:

Lectures, exercise and assignment

Model-based design and simulation

Modelling principles, modelling tools, application of models

Learning Activities:

Lecture, exercise and assignment

Lecturing Material

• UNESCO-IHE lecture materials and other relevant lecturing materials

Assessment

• 60%: Written Exam (closed book) -- The written exam covers the following topics; (1)Introduction to urban drainage and sewerage, (2) Rainfall characteristics and Wet weather flows quantitative, (3)Sewerage layout and design and design exercise and pumping stations, (4)Hydraulics for urban drainage and sewerage

• 20%: Assignment -- Computer workshops and Individual assignment

• 20%: Assignment -- Design Exercises

2013/2015-UWS/SE/UWEM/04: Urban drainage and sewerage											
Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: studyload hours	Lecturer(s)
	Introduction to Module	1						1	3	Seyoum
	Introduction to urban drainage and sewerage and Types of drainage and sewer s	2						2	6	Seyoum
	Rainfall characteristics	2						2	6	Pathirana
	Wet weather flows quantitative characterization	2						2	6	Pathirana
	Sewerage layout and design	4						4	12	van Duijl/Seyoum
	Dry and wet weather flows quantitative characterization and exercise	4						4	12	Brdjanovic
	Conventional sewer design exercise						6	6	18	van Duijl/Seyoum
	Hydraulics of urban drainage and sewerage	6						6	18	Seyoum
	Pumping stations and CSOs	4						4	12	van Duijl/Seyoum
	Sewer processes	6	2					6	20	Vojinovic
	Data acquisition for urban drainage and sewerage studies	4						4	12	Vojinovic
	Model-based design and simulation - introduction	4						4	12	Vojinovic
	Model-based design and simulation exercise			4				4	4	Seyoum
	Fieldtrip					4		4	4	
	Total	39	2	4		4	6	53	145	
MSc module - UNESCO-IHE										

URBAN WATER AND SANITATION

MASTERS PROGRAMME

Academic Year: 2013-2015
Specialization: Water supply engineering
Module Coordinator: Ferrero, G.

Module Sheet

Module Name Surface water treatment II	Module Code UWS/WSE/05	Credits 5

Target Group	Prerequisites
Students of the MWI master programme. Professionals in water treatment, consulting agencies, ministries and equipment suppliers.	Participants should meet the general UNESCO-IHE admission criteria, and possess a BSc degree in chemical, environmental, or civil engineering.

Learning Objectives

Upon completion of the module participants will be able to..

- Understand the principles of disinfection, ion exchange, softening, adsorption and activated carbon filtration processes
- Link theoretical principles with practical aspects
- Select appropriate processes depending on the nature of impurities to be removed and the intended use of the treated water

Topics and Learning Activities

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

Adsorption
Theoretical background of adsorptive processes.

Activated carbon
Granular and powdered activated carbon, modelling and design.

Chemical softening
Principles of chemical softening and sludge blanket softening; design and operation of pellet-softening and membrane softening plants.

Ion exchange
Ion exchange resins (selectivity, column operation, regeneration of resins and applications).

Lecturing Material

- Schippers, J.C., Kruithof, J.C., Martijn, B.J. Disinfection of Drinking Water (LN0461/13/1)
- Buiteman, J.P. Ion exchange and chemical softening (LN0449/13/1)
- Buiteman, J.P. Surface Water Treatment Laboratory manual - part 2 - (LN0469/13/1)
- Orlandini,E. Application of activated carbon in water treatment
- Amy, G.L. Organic matter characterization

Assessment

- **80%: Written Exam (closed book) --**
- **20%: Lab report --**

2013/2015-UWS/WSE/05: Surface water treatment II											
Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: studyload hours	Lecturer(s)
	Public water supply	**2**						**2**	**6**	Prof. J. Schippers (to be confirmed)
	Drinking water quality	**2**		**2**				**4**	**8**	Prof. G-J. Medema, PhD (to be confirmed)
	Surface water collection and storage	**4**		**2**				**6**	**14**	J.P. Buiteman, MSc
	Disinfection	**10**		**4**	**8**			**22**	**50**	G. Ferrero, PhD
	UV Disinfection	**2**		**2**				**4**	**8**	J. Kruithof, PhD
	Adsorption	**4**		**2**				**6**	**14**	S. Sharma, PhD
	Activated carbon	**4**			**4**			**8**	**20**	S. Sharma, PhD / J.P. Buiteman, MSc
	Chemical softening and Ion exchange	**4**		**2**	**4**			**10**	**22**	J.P. Buiteman, MSc
	Fieldtrip					**4**		**4**	**4**	G. Ferrero, PhD
	Total	**32**		**14**	**16**	**4**		**66**	**146**	
MSc module - UNESCO-IHE										

URBAN WATER AND SANITATION

MASTERS PROGRAMME

Academic Year: 2013-2015
Specialization: Core Programme
Module Coordinator: Lopez Vazquez, C.M.

Module Sheet

Module Name Conventional wastewater treatment	Module Code UWS/SE/05	Credits 5

Target Group	Prerequisites
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.	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

Upon completion of the module participants will be able to..

- 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.
- discuss the physical, chemical, and biological processes applied for sewage purification and the complex interactions among them occurring in wastewater treatment systems.
- 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) as a function of environmental, operating and wastewater conditions and characteristics.
- discuss the principles, fundamentals and applicability of recently developed wastewater treatment processes such as innovative nitrogen removal processes and membrane bioreactors.

Topics and Learning Activities

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 strength. Review of typical wastewater compositions as a function of their origin and procedence.

Learning Activities:

Lecture, field trip.

Primary treatment

Fundamentals and (design) principles of primary treatment systems commonly applied in wastewater treatment processes and configurations.

Learning Activities:

Lecture, field trip.

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

Fundamentals, mechanisms and design principles of the microbial processes involved in the biological removal of carbon, nitrogen and phosphorus in wastewater treatment systems. Influence of environmental, operating and wastewater conditions and characteristics on the biological processes. Guidance for the selection of relevant parameters for the design (following a stochiometrically-based steady-state model), operation and control of treatment systems.

Learning Activities:

Lecture, exercise lab, field trip.

Final settling

Design, operating and practical aspects that affect the solid-liquid separation processes that occur in secondary settling tanks in (activated sludge) wastewater treatment systems.

Learning Activities:

Lecture, exercise lab, field trip.

Innovative nitrogen removal processes

Overview of the principles, fundamentales, characteristics, and operating and control aspects of the SHARON, ANAMMOX, combined SHARON-ANNAMOX and BABE processes. Guidance for the selection of the most appropriate and feasible side-stream process according to local and operating needs and conditions. Review of recent case-studies.

Learning Activities:

Lecture, field trip.

Membrane bioreactors

Principles, characteristics and fundamentals of membrane bioreactors (MBR) applied in municipal wastewater treatment facilities. Review and discussion of the latest (full-scale) case-studies and recent developments.

Learning Activities:

Lecture.

Lecturing Material

• M. Henze, MCM van Loosdrecht, G. Ekama and D. Brdjanovic: Biological Wastewater Treatment: Principles, Modelling and design. IWA Publishing (2008).

• (Selected) video lectures from the Online Course on Biological Wastewater Treatment: Principles, Modelling and design (OLC-BWWT). UNESCO-IHE, Institute for Water Education. Delft, The Netherlands. http://www.unesco-ihe.org/Education/Short-courses/Online-courses

Assessment

- **80%: Written Exam (closed book) --**
- **20%: Assignment --**

2013/2015-UWS/SE/05: Conventional wastewater treatment											
Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: studyload hours	Lecturer(s)
1	Wastewater chracterization and sampling	6		2				8	20	Prof. Dr. Damir Brdjanovic
2	Primary treatment	4		2				6	14	Prof. Dr. Damir Brdjanovic
3	Organic matter removal	4		4		1		9	17	Dr. Carlos M. Lopez Vazquez / Prof. George Ekama
4	Nitrification	4		4		1		9	17	Dr. Carlos M. Lopez Vazquez / Prof. George Ekama
5	Denitrification	4		4		1		9	17	Dr. Carlos M. Lopez Vazquez / Prof. George Ekama
6	Enhanced biolological phosphorus removal	4		4		1		9	17	Dr. Carlos M. Lopez Vazquez / Prof. George Ekama
7	Final settling	4		2				6	14	Dr. Carlos M. Lopez Vazquez
8	Filamentous bulking sludge			2				2	2	Eng. Dick Eikelboom / Eng. Arjan Borger
9	Side-stream nitrogen removal	4						4	12	Prof. Dr. Mark van Loosdrecht
10	Membrane bioreactors	4		2				6	14	Dr. Hector GarcÃ-a HernÃ¡ndez
	Total	38		26		4		68	144	
MSc module - UNESCO-IHE										

URBAN WATER AND SANITATION

MASTERS PROGRAMME

Academic Year: 2013-2015
Specialization: Core Programme
Module Coordinator: Pathirana, P.D.A.

Module Sheet

Module Name Asset management	Module Code UWS/UWEM/05	Credits 5

Target Group	Prerequisites
Engineers, Managers and other water professionals at the mid-carrier level. Especially relevant for those involved in the urban water context (e.g. Utilities, Urban Water management)	A first degree in Engineering, Science or a related field.

Learning Objectives

Upon completion of the module participants will be able to..

- appreciate the historical processes that made asset management approach important for urban infrastructure engineers and managers and
  describe the drivers (e.g. climate variability/change, urbanization, increasing poverty, etc...) that make asset management crucial for sustainable provision of water related infrastructure services;
- define asset management in one's own words and List and describe the essential steps of an asset management plan and provide example problems from one's own experience (professional or personal) which asset management approach would be/would have been able to solve;
- describe the techniques used in asset inventories (e.g. condition rating) and describe the importance of data for asset management process.
- Define databases and describe what a relational database is. Design a simple relational database (on paper!). List the important features of a relational database and appraise the use of data driven models in Asset Management. Describe sample approaches (e.g. ANN, Decision Trees);
- explain a decision prioritisation plan based on the analysis of significance and condition of asset components and apply hydraulic modelling to establish significance of asset components of water distribution/drainage systems;
- 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.

Topics and Learning Activities

Introduction + Overview of the course

Lecturing Material

Assessment

- **60%: Oral Exam --**
- **40%: Assignment -- All assignments. Including workshops and homework.**

2013/2015-UWS/UWEM/05: Asset management											
Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: studyload hours	Lecturer(s)
1	Introduction + Overview of the course	1						1	3	Pathirana
2	Asset Inventory	2						2	6	Gersonius
3	Data/Databases	1						1	3	Seyoum
4	Relational databases in Asset Management	2		2				4	8	Pathirana
4	Making sense of data - data mining in AM	2		4				6	10	Seyoum/Pathirana
5	Risk-based decision making in AM	2						2	6	Pathirana
7	Risk-based decision making - workshop	1		8				9	11	Pathirana
8	Condition Modelling	8						8	24	Kliener
9	Condition Modelling excercise			10				10	10	Kliener
10	Field trip					8		8	8	Pathirana
11	Advancements in Asset Management	6		2				8	20	van Heck/van der Drift/Pathirana
12	Economics of AM	2						2	6	van Dijk
13	Failure registration in AM	2						2	6	KWR water
14	Special considerations in applying AM in developing countries	2		2				4	8	Pathirana
15	Historical context of modern Asset Management	1						1	3	Pathirana
	Sustainable Water Services and AM	6						6	18	Ashley
	Total	38		28		8		74	150	
MSc module - UNESCO-IHE										

URBAN WATER AND SANITATION

MASTERS PROGRAMME

Academic Year: 2013-2015
Specialization: Core Programme
Module Coordinator: Petrusevski, B.

Module Sheet

Module Name Groundwater treatment and resources	Module Code UWS/WSE/06	Credits 5

Target Group	Prerequisites
The module specifically targets professionals in water treatment companies, consulting agencies, ministries and equipment suppliers.	Participants should meet the general UNESCO-IHE admission criteria, and possess a BSc degree in Chemical, Environmental, Civil or Sanitary Engineering.

Learning Objectives

Upon completion of the module participants will be able to..

- Assess if given (ground)water is aggressive against materials used in water a supply system and propose appropriate neutralisation technique.
- Assess overall quality of a given groundwater.
- Establish appropriate treatment approach for groundwater containing commonly occurring impurities and pollutants including iron, manganese, ammonia, fluoride, and hydrogen sulphate.
- Understand advanced groundwater treatment approaches applied in The Netherlands including direct nano filtration and ion-exchange.

Topics and Learning Activities

Water Quality & Treatment

Removal of taste and odour, aggressive characteristics of water, neutralisation of aggressive nature of water, aeration

Learning Activities:

Lectures, exercise

Groundwater quality

Relevant parameters for groundwater quality, assessment of quality of selected groundwater

Learning Activities:

Lectures, exercise

Groundwater treatment

Conventional and advanced concepts in the removal of iron, manganese, ammonia, arsenic, fluoride and hydrogen sulphate

Learning Activities:

Lectures,(comupter) exercises, assignements

Laboratory Course on Iron and Arsenic analysis and removal:

Kinetics of ferrous iron oxidation, removal of iron and arsenic, analysis of iron and arsenic

Learning Activities:

Laboratory course, assignement

Fieldtrip

Visit of a selected groundwater treatment plant in The Netherlands, Establishing a conceptual design for groundwater treatment plant based on quality of available groundwater and clients requirements

Learning Activities:

Group exercise, field visit of a groundwater treatment plant

Advance Groundwater Treatment in The Netherlands

An overview of advance groundweater treatment applied in The Netherlands including Ion Exchange for removal of organics and (direct) nano filtration

Learning Activities:

Lectures, design exercise

Lecturing Material

- J. C. Schippers, Petrusevski, S. Sharma Water Quality & Treatment; Groundwater Treatment (LNO263-12-1)
- P. Hiemstra, Design Exercise Advanced Groundwater Treatment
- W. v/d Meer, Advance Groundwater Treatment in The Netherlands
- H.J. Poepel and P.J.H. Post, Aeration and Gas Transfer- Part 1 (EE123/99/1)
- H.J. Poepel and P.J.H. Post Aeration and Gas Transfer- Part 2, Appendix- Practical Aspects of Aerators

(EE123/94/1);
• P.J.H. Post, Aeration, workshop problems (EE377/98/1)

Assessment

- **70%: Written Exam (closed book) --**
- **15%: Assignment --**
- **15%: Lab Report --**

2013/2015-UWS/WSE/06: Groundwater treatment and resources											
Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: studyload hours	Lecturer(s)
	Introduction	1		1				2	4	B. Petrusevski
	Water Quality and Treatment	6		8				14	26	B. Petrusevski, Y. Slokar
	Ground Water Quality	2		2				4	8	Petrusevski
	Groundwater Treatment	14		12	8		6	40	88	B. Petrusevski, S.Sharma, P.Hiemstra, Y. Slokar
	Advanced GWT in The Netherlands	2		2				4	8	W. v/d Meer
	Fieldtrip					6		6	6	J.van Paassen, B. Petrusevski
	Total	25		25	8	6	6	70	140	
MSc module - UNESCO-IHE										

URBAN WATER AND SANITATION

MASTERS PROGRAMME
Academic Year: **2013-2015**
Specialization: **SE**
Module Coordinator: **Ronteltap, M.**

Module Sheet

Module Name Resource oriented wastewater treatment and sanitation	Module Code UWS/SE/06	Credits 5

Target Group	Prerequisites
Participants of the MWI/SE programme and short course participants.	Preceding Sanitary Engineering Modules.

Learning Objectives

Upon completion of the module participants will be able to..

- describe the physical, chemical and microbiological processes occurring in anaerobic reactors and a number of natural systems
- critically reflect on the current sanitation systems encountered in many urban areas and to indicate ways to improve this situation in a sustainable manner;
- evaluate the possibilities for closing cycles of energy, water and nutrients
- evaluate the feasibility of the application of the technologies studied in this module in urban settings in the developing world
- carry out preliminary process design of treatment and reuse systems to assess the needs for capital, land, equipment and operation and maintenance

Topics and Learning Activities

Anaerobic Wastewater Treatment

Fundamentals about anaerobic degradation and its application in wastewater treatment.

Learning Activities:

Lectures; process design exercise; laboratory assignment; field trip

Urine Treatment

Different technologies for the treatment of urine and possible recovery routes for nutrients and energy.

Learning Activities:

Lectures and laboratory exercise.

Effluent reuse in agriculture

Waste Stabilisation Ponds; Constructed Wetlands; Soil aquifer treatment

Technology of Waste Stabilisation Ponds and their application.
Technology of Constructed Wetlands and their application.
Technology of SAT.

Learning Activities:

Lectures; process design exercise

Algae photobioreactors

Energy recovery (in view of New Sanitation)

New sanitation is about the recovery of water, nutrients and energy, i.e. seeing waste as a resource. This class will discuss new sanitation with an emphasis on energy recovery.

Learning Activities:

Lecture

Lecturing Material

- Lecture notes.
- van Loosdrecht, Ekama and Brdjanovic. Biological wastewater treatment.

Assessment

- **80%: Written Exam (closed book) --**
- **20%: Assignment --**

2013/2015-UWS/SE/06: Resource oriented wastewater treatment and sanitation											
Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: studyload hours	Lecturer(s)
	Anaerobic WWT Introduction	8						8	24	
	Anaerobic Microbiology	2						2	6	
	UASBs	6						6	18	
	Post Treatment, Bioassays, Novel Developments	4						4	12	
	Case studies anaerobic WWT			4				4	4	
	Waste Stabilisation Ponds	6			6			12	30	
	Â Field Trip					10		10	10	
	Innovative Treatment Technologies	8			6			14	36	
	WWTP as energy factory	2						2	6	
	Eefluent reuse	2						2	6	
	Total	38		4	12	10		64	152	
MSc module - UNESCO-IHE										

WATER MANAGEMENT

MASTERS PROGRAMME

Academic Year: 2013-2015
Specialization: Core Programme
Module Coordinator: Blokland, M.W.

Module Sheet

Module Name Managing water organisations	Module Code WSM06	Credits 5

Target Group	Prerequisites
Young and mid-career professionals with an interest in strategic and operational management of water organisations.	Preferably experience in the water sector. A bachelor's degree or equivalent. Basic PC-computer knowledge. Good command of English language.

Learning Objectives

Upon completion of the module participants will be able to..

- Explain the position and strategy of a water organisation in relation to its institutional environment.
- Summarize the scope , scale, structure and key work processes of organisations
- Analyze the management and decision-making processes in water organisations, including the management of change.
- Plan the use of performance analysis and benchmarking in the regulation and management of water organisations.
- Assess the processes of human resources, health and safety, management for integrity and sustainability, asset management and customer management.

Topics and Learning Activities

Water Organizations in Context

Mandate and structure, scale and scope of operations, ethics, integrity, sustainability, climate change, and reform.

Water Organisations at Work

Environment and strategy, performance and benchmarking, human resources management, health and safety, asset management, customer management.

Lecturing Material

- Reading materials.
- Discussions.
- Exercises.
- Case studies.
- Power-point presentations.
- Two field trips; one to a water supply company and one to a river basin organisation.

Assessment

- **100%: Assignment -- Essay**

2013/2015-WSM06: Managing water organisations											
Nr	**Course/Topic**	**Lecture**	**Assignment**	**Workshop Case study Role play Exercise Lab session**	**Laboratory work**	**Fieldtrip - Fieldwork**	**Design exercise**	**SUM: contact hours**	**SUM: studyload hours**	**Lecturer(s)**
1	**Introduction**									
1.1	Course and Fieldtrip Introductions			2				2	2	Blokland
1.2	Managing a Water Utility			8				8	8	To be announced
2	**Water Organisations in Context**									
2.1	Organisations Undergoing Reform			6				6	6	Schwartz
2.2	Mandate and Structure of RBOs			6				6	6	Mostert
2.3	Environment and Strategy			6				6	6	Schouten
2.4	Scale and Scope of Operations			8				8	8	Douven
3	**Water Organisations at Work**									
3.1	Effective Organisations			6				6	6	Schuurmans
3.2	Performance and Benchmarking			10				10	10	Blokland
3.3	Integrity, Sustainability			6				6	6	Mairesse, Fahsi
3.4	Health and Safety			6				6	6	Harle
3.5	Asset Management			8				8	8	van Dijk
3.6	Customer Management			6				6	6	Beltman
3.7	Human Resources Management			6				6	6	van Heijzen
4	**Fieldtrip**					**16**		**16**	**16**	Waternet Amsterdam & Drinking water utility WMD
5	**Assignment**		**43**						**43**	
	Total		**43**	**84**		**16**		**100**	**143**	
MSc module - UNESCO-IHE										

URBAN WATER AND SANITATION

MASTERS PROGRAMME

Academic Year: 2013-2015
Specialization: Water Supply Engineering, Urban Water Engineering and Management
Module Coordinator: Trifunovic, N.

Module Sheet

Module Name Water transport and distribution	Module Code UWS/WSE/UWEM/07	Credits 5

Target Group	Prerequisites
Mid-career professionals dealing with technical aspects of drinking water transport & distribution, working for water supply companies, municipal assemblies or consulting bureaus.	BSc degree in Civil Engineering or similar technical background; general PC-computer knowledge; good English command.

Learning Objectives

Upon completion of the module participants will be able to..

- 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, namely the demands, pressures, velocities and hydraulic gradients;
- 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;
- 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;
- analyse the implications of various operational modes of pumping stations and compare the investment and operational costs for various network layouts and supplying schemes;
- propose preliminary hydraulic design that will integrate economic aspects, choose adequate components, and judge technical solutions dealing with the network maintenance, rehabilitation, and expansion.

Topics and Learning Activities

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.

Learning Activities:

The core of the blended learning approach is the MS PowerPoint slideshow prepared with audio presentation, discussed during lectures accompanied by MS Excel spreadsheet hydraulic lessons; these are also available for self study i.e. solving of workshop problems. During the design exercise, network operation is analysed by using EPANET software (US Environmental Protection Agency, Ver.2). Finally, a seminar is organised to present typical operation and maintenance practices in The Netherlands.

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.

Learning Activities:

The lecture materials consist of Power Point presentations slides. Additionally, some sample questions (including calculations) and multiple choice questions have been provided to practice and to test the understanding of the subject. After going through the lectures, the participants are advised to answer the sample questions and then they can do the multiple choice questions. Furthermore, lists of additional reading materials have been provided, which will help the participants to further enrich knowledge in this field.

Lecturing Material

- N.Trifunovic - Introduction to Urban Water Distribution, Taylor & Francis, 2006, reprint 2008
- S.Sharma - Water Losses in Distribution Systems, lecture notes UNESCO-IHE 2010 (LN/0346/10/1)
- Electronic materials: slide presentations (MS PowerPoint), computer/design/laboratory assignments, computer workshop network model (EPANET Ver.2), spreadsheet hydraulic lessons (MS Excel)

Assessment

• 60%: Written Exam (open book) -- The exam inludes the part on Chapters 2 to 4 of the introductory subject and the other one on the leakage mangement and control

• 40%: Assignment -- Design exercise assignment Water Distribution, using EPANET network modelling software. Individual report should be submitted.

2013/2015-UWS/WSE/UWEM/07: Water transport and distribution											
Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: studyload hours	Lecturer(s)
1	Introduction to Water Transport and Distribution	23		11			12	46	116	N.Trifunovic, A.Pathirana, J.Vreeburg
2	Water Loss Management and Control	8						8	24	S.Sharma
	Total	31		11			12	54	140	
MSc module - UNESCO-IHE										

URBAN WATER AND SANITATION

MASTERS PROGRAMME

Academic Year: 2013-2015
Specialization: Core Programme
Module Coordinator: Lopez Vazquez, C.M.

Module Sheet

Module Name Wastewater treatment plants design and engineering	Module Code UWS/SE/07	Credits 5

Target Group	Prerequisites
MSc participants enrolled in the Municipal Water Infrastructure program from the Sanitary Engineering Specialization (MWI-SE). Wastewater professionals with background and/or proven qualifications in sanitary engineering.	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

Upon completion of the module participants will be able to..

- Select the most suitable and cost-effective wastewater treatment process technology (among the most widely applied anaerobic, aerobic, land-based and on-site systems) to treat certain wastewater stream given its composition and characteristics and taking into account the required effluent standards.
- 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).
- 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.
- 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.

Topics and Learning Activities

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.

Learning Activities:

Lecture, exercise, design exercise, case-studies.

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.

Learning Activities:

Lecture, exercise.

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.

Learning Activities:

Lecture, exercise.

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.

Learning Activities:

Lecture, exercise, case-studies.

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.

Learning Activities:

Lecture, design exercise, case-studies.

Design and Engineering of CAS and UASB wastewater treatment 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.

Learning Activities:

Lecture, exercise, case-studies, design exercise.

Design and Engineering of land-based and on-site 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.

Learning Activities:

Lecture, exercise, case-studies, design exercise.

Lecturing Material

• MOP 8: Design of Municipal Wastewater Treatment Plants. 5th Edition. ASCE Manuals and Reports on Engineering Practice No. 76.

• Franceys R, Pickford J, Reed R (1992) A Guide to the Development of on-Site Sanitation, World Health Organization. ISBN 92 4 154443 0. U.K.

Assessment

- **50%: Written Exam (closed book) --**
- **25%: Oral exam -- Based on the development of a design project.**
- **25%: Assignment --**

2013/2015-UWS/SE/07: Wastewater treatment plants design and engineering											
Nr	**Course/Topic**	**Lecture**	**Assignment**	**Workshop Case study Role play Exercise Lab session**	**Laboratory work**	**Fieldtrip - Fieldwork**	**Design exercise**	**SUM: contact hours**	**SUM: studyload hours**	**Lecturer(s)**
1	**Technology Selection.**	**4**		**2**			**2**	**8**	**20**	Prof. D. Brdjanovic/Dr. C.M. Hooijmans/DHV-RH
2	**Engineering Economics**	**4**		**2**			**2**	**8**	**20**	Dr. M. Schouten/Vitens-Evides
3	**Costing**	**4**		**2**			**2**	**8**	**20**	DHV-RH
4	**Engineering process layouts and process flow diagrams**	**2**		**2**			**2**	**6**	**14**	Prof. Damir Brdjanovic
5	**Hydraulic design.**	**2**		**2**			**2**	**6**	**14**	Dr. Solomon Seyoum/DHV-RH
6	**Design and Engineering of Conventional Activated Sludge (CAS) Systems**	**2**		**2**			**2**	**6**	**14**	Grontmij/DHV-RH
7	**Design and Engineering of Conventional UASB systems.**	**2**		**2**			**2**	**6**	**14**	Prof. Jules van Lier/Prof. Carlos Chernicharo
8	**Design and Engineering of land-based wastewater treatment systems**	**2**		**2**			**2**	**6**	**14**	Prof. M. von Sperling
9	**Design and Engineering of On-Site Sanitation Systems**	**2**		**2**			**2**	**6**	**14**	WASTE
	Total	**24**		**18**			**18**	**60**	**144**	
MSc module - UNESCO-IHE										

URBAN WATER AND SANITATION

MASTERS PROGRAMME

Academic Year: 2013-2015
Specialization: WSE
Module Coordinator: Salinas Rodriguez, S.G.

Module Sheet

Module Name Advanced water treatment and reuse	Module Code UWS/WSE/08	Credits 5

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

Learning Objectives

Upon completion of the module participants will be able to..

- DESALINATION TECHNOLOGIES
  - identify technologies for desalination;
  - explain and compare membrane-based and thermal-based desalination;
  - tell current capacity of desalination in the world;
- LOW PRESSURE MEMBRANES (UF and MF)
  - explain the basic principles of low pressure membranes;
  - identify advantages and differences in various commercial systems;
  - define and explain fouling and cleaning in low pressure membranes;
  - justify the use of low pressure membranes in membrane disinfection;
  - compare low pressure membranes with other technologies;
- REVERSE OSMOSIS
  - explain the basic principles of reverse osmosis;
  - identify and assess commercial elements and systems;
  - define and classify fouling and propose mitigation activities to control fouling in RO systems;
  - evaluate need for pre-treatment and for post-treatment in RO systems;
  - design manually and by commercial software seawater and brackish water reverse osmosis systems;
- NATURAL SYSTEMS
  - explain and design bank filtration systems;
  - describe aquifer recharge and reuse systems;
- ADVANCED OXIDATION PROCESSES
  - explain and identify advantages of various AOPs;
  - design AOPs for removal of contaminants;
- WATER REUSE
  - assess potential applications of water reuse systems;
  - define water reuse and describe various case studies

Topics and Learning Activities

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

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

Desalination
Current status of desalination in the world, thermal systems versus membrane systems

Natural systems
theory of bank filtration and aquifer recharge and reuse

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

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

Lecturing Material

• Kennedy, M.D., Salinas Rodriguez, S.G. & Schippers J.C. (2013) Low pressure membrane technology, LN0424/13/1
• Kennedy, M.D., Salinas Rodriguez, S.G. & Schippers J.C. (2011), Desalination and membrane related technology, LN0076/13/1
• Kruithof, J.C., Martijn, B (2013), Advanced oxidation processes.
• Crittenden, J. C., Trussell, R. R., Hand, D. W., Howe, K. J. & Tchobanoglous, G. (2005). Water Treatment: Principles and Design / MWH, New Jersey, Montgomery Watson Harza
• Selected papers from scientific and professional journals.

Assessment

- **70%: Written Exam (closed book) --**
- **20%: Assignment -- Computer aided RO design**
- **10%: Lab Report --**

2013/2015-UWS/WSE/08: Advanced water treatment and reuse											
Nr	**Course/Topic**	**Lecture**	**Assignment**	**Workshop Case study Role play Exercise Lab session**	**Laboratory work**	**Fieldtrip - Fieldwork**	**Design exercise**	**SUM: contact hours**	**SUM: studyload hours**	**Lecturer(s)**
	Microfiltration and Ultrafiltration	**10**		**2**	**4**			**16**	**40**	Prof. M. Kennedy, PhD / S. Salinas, PhD
	Reverse Osmosis	**8**		**6**			**4**	**18**	**42**	Prof. M. Kennedy, PhD / S. Salinas, PhD
	Desalination	**4**						**4**	**12**	Prof. M. Kennedy, PhD
	Natural systems	**4**						**4**	**12**	S. Sharma, PhD
	Advanced oxidation processes	**6**	**2**					**6**	**20**	J. Kruithof, PhD / B. Martijn, MSc
	Water reuse	**2**		**2**				**4**	**8**	S. Sharma, PhD / S. Salinas, PhD
	Fieldtrip					**6**		**6**	**6**	S. Salinas, PhD
	Total	**34**	**2**	**10**	**4**	**6**	**4**	**58**	**140**	
MSc module - UNESCO-IHE										

URBAN WATER AND SANITATION

MASTERS PROGRAMME

Academic Year: 2013-2015
Specialization: Core Programme
Module Coordinator: Hooijmans, C.M.

Module Sheet

Module Name Modelling of wastewater treatment processes and plants	Module Code UWS/SE/08	Credits 5

Target Group	Prerequisites
The module primarily targets professionals working in water and sewerage companies, consulting firms, industry, municipalities, universities and ministries.	General admission criteria IHE and a B.Sc. degree in preferably Civil Eng., Env. Eng., Microbiology, Chemistry or Chemical

Learning Objectives

Upon completion of the module participants will be able to..

- memorize the basics of wastewater treatment modelling (kinetics, stoichiometry, mass balances, hydraulics and matrix notations). Can develop a matrix for a biological model. Can use the computer software AQUASIM as a tool for modelling wastewater treatment processes. Can put a matrix in AQUASIM
- explain the nitrification and bio-P-process and the matrix of the biological models. Can put the matrix in AQUASIM and explain the outcome of the model run and the implications for wastewater treatment
- evaluate data and processes and apply it in a BioWin exercise, relates the use of BioWin as a tool for modeling activated sludge processes. Apply the theory with respect to modeling using a case study. Can put the model into BioWin and can discuss and explain the outcome of the model
- explain the modeling of anaerobic digestion. Memorize how the model works in BioWin
- explain the modeling of natural systems and the difference with activated sludge modeling. Can develop a simplified model for a pond system. Can simulate an existing model using AQUASIM and explain the results.
- explain the modeling of MBR + biofilm systems, simulate existing models using AQUASIM, explain results.

Topics and Learning Activities

Wastewater treatment modelling

Basic wastewater treatment modelling kinetics, stoichiometry, mass balances, hydraulics and matrix notations. Introduction of computer program AQUASIM as tool for modelling wastewater treatment processes.

Learning Activities:

Presentations, tutorial and AQUASIM computer exercises.

Modelling activated sludge processes: ASM approach

An overview of existing IWA models (e.g. ASM1, ASM2d), ASM3, TUD(P) models. Procedures for characterisation of wastewater and sludge. Protocol for development of calibrated activated sludge models. Case studies on modelling wastewater treatment processes using AQUASIM and BioWin.

Learning Activities:

Presentations, case studies.

Modelling of an activated sludge plant using BioWin

Optimization of an existing wwtp, supported by presentations on the approach and procedures.

Learning Activities:

Presentations, computer exercise.

Modelling anaerobic reactors using BioWin

Modelling of anaerobic reactors by applying the Anaerobic Digestion Model (ADM)

Learning Activities:

Presentations, computer exercise.

Modelling pond systems

Modelling of pond systems by modification and extension of ASM and hydraulic modelling.

Learning Activities:

Presentations, computer exercise.

Modelling membrane bioreactors using AQUASIM

Modelling following the ASM approach

Learning Activities:

Presentations, computer exercises.

Lecturing Material

• Wastewater treatment modelling: an introduction (Presentation);
Modelling Activated Sludge Processes (Book Chapter);

A General Model for Single-sludge Wastewater Treatment Systems (Paper).
• AQUASIM Modelling (Presentation);
AQUASIM (Tutorial including Exercises);
Determination of kinetic parameters of nitrification (Presentation);
Modelling Nitrification, Heterotrophic Growth and Predation in Activated Sludge (Paper).
• Modeling the carbon source, temperature and pH-effects on the Biological Phosphorus Removal Process (Presentation);
Biological P-removal modelling (Exercise);
Temperature Effects on Glycogen Accumulating Organisms (Paper).
• Modelling activated sludge wastewater treatment plants: applications (Presentation); Modelling Activated Sludge Wastewater Treatment Plants: Applications (Paper).
• Modelling activated sludge processes (Presentation);
Activated Sludge Modelling and Simulation (Paper);
Practical Protocol for Dynamic Modelling of Activated Sludge Systems (Paper).
• Data and process evaluation (Presentation);
Experience with Guidelines for Wastewater Characterization in the Netherlands (Paper);
BioWin modelling (Exercise).
• Modelling waste stabilization ponds (Presentation);
3D Model for a Secondary Facultative Pond (Paper).
• Modelling anaerobic wastewater treatment plants (Presentation)
BioWin Modelling. (Exercise)
• Modelling membrane bioreactors (Presentation);
AQUASIM modelling. (Exercise)
• Practical guide for activated sludge modelling, UNESCO-IHE lecture notes series, S.Meijer/D.Brdjanovic

Assessment

• 25%: Assignment -- Assessment of application skills: Design case activated sludge modelling using BioWin
• 15%: Assignment -- Assessment of application skills: Anaerobic sludge digester using BioWin
• 60%: Written Exam (closed book) -- Assessment of theoretical knowledge

2013/2015-UWS/SE/08: Modelling of wastewater treatment processes and plants											
Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: studyload hours	Lecturer(s)
1	Modelling introduction	2						2	6	Hooijmans
2	Set-up matrix			2				2	2	Hooijmans
3	Aquatic systems modelling (AQUASIM), BioWin introduction	7		14				21	35	Hooijmans
4	Modelling activated sludge processes	4						4	12	van Loosdrecht
5	Data and process evaluation	4						4	12	Meijer
6	Activated sludge system modelling (BioWin)		10	18				18	28	Meijer
7	MBR modelling (AQUASIM)	2		4				6	10	Garcia
8	Anaerobic reactor modelling (BioWin)	2	8	10				12	24	Spanjers
9	Modelling application examples	4						4	12	Brdjanovic
	Total	25	18	48				73	141	
MSc module - UNESCO-IHE										

WATER SCIENCE AND ENGINEERING

MASTERS PROGRAMME

Academic Year: **2013-2015**
Specialization: **Hydroinformatics: modelling and information systems for water management**
Module Coordinator: **Vojinovic, Z.**

Module Sheet

Module Name Urban flood management and disaster risk mitigation	Module Code WSE/HI/08B/e	Credits 5

Target Group	Prerequisites
Participants in WSE programmme; Participants in short course "Urban Flood Management and Disaster Risk Mitigation"	Basic knowledge of hydrology and hydraulics

Learning Objectives

Upon completion of the module participants will be able to..

- A change to proactive management of water-related disasters in urban areas requires an identification of the risk, the development of strategies to reduce that risk, and the creation of policies and programmes to put these strategies into effect.
  This course introduces current theory and practice of flood risk estimation and modelling of floods in urban areas. It provides hands-on practice with industrial standard software. The main objective of this course is to provide the most up-to-date information on the topic of urban flood modelling and disaster management and to enable participants to be more effective in applying modelling tools and techniques for urban flood management.
  Different modelling approaches are considered and they range from data driven to physically based, from conceptual to detailed 1D-2D modelling. These approaches are then embedded in the wider context of flood risk assessment and disaster management. This wider context considers everything from how the urban planning process should take place in areas with potential flood risks, to urban hydrology, climate change, flood hazards, environmental impacts, public health issues and the conceptual design of flood protection schemes.

  The first learning objective is to develop enhanced understanding of the effects of climate variability on the hydrology that affects urban areas
- Understand the structure, service provided and failures of the service for urban stormwater /drainage networks; Urban Drainage Asset Management and Optimisation, and learn how to model these systems and how to apply a typical modelling product (MOUSE, MIKE11, MIKE21 and SWMM)
- 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)
- Learn how to build safe and reliable urban drainage models and how to evaluate system performance against different standards (engineering, environmental, public health, etc.), and develop understanding of novel techniques for modelling the complex geometry and interaction between surface water (including floodplains), sub-surface flows and urban drainage infrastructure (1D and coupled 1D/2D)
- Learn how to produce different flood risk maps in a GIS environment and how to calculate different types of flood damages, and
- 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

Topics and Learning Activities

Application domains of Hydroinformatics: floods, urban systems and environment, R. K. Price (IHE), Z. Vojinovic (IHE) and A. Mynett (IHE)

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

Learning Activities:

Lectures

Climate change and its impact on hydrology, P.D.A. Pathirana(IHE)

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.

Learning Activities:

Lectures

Ethics of risk, N. Doorn

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

Learning Activities:

Lectures

Mathematical foundation of 2D urban flood modelling, I. Popescu (IHE), S. Djordjevic (UoE)

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.

Learning Activities:

Lectures

Exercise

Urban Flood Modelling and Evaluation of Flood Risks, Z. Vojinovic (IHE), O. Mark (DHI), S. Djordjevic (UoE)

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.

Learning Activities:

Lectures

Exercise

Structural and Non-structural Urban Flood Management Measures, Z. Vojinovic (IHE), O. Mark (DHI), B. Gersonius (IHE)

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.

Learning Activities:

Lectures

Exercise

Managing Urban Flood Disasters, Z. Vojinovic (IHE), D. Sakulski (UNU)

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.

Learning Activities:

Lectures

Exercise

Lecturing Material

• Vojinovic, Z. and M.B. Abbott, 2011, Flood Risk and Social Justice: From Quantitative to Qualitative Flood Risk Assessment and Mitigation, 2011, IWA Publishing

Assessment

- **40%: Written Exam (closed book) -- All Topics**
- **60%: Assignment --**

2013/2015-WSE/HI/08B/e: Urban flood management and disaster risk mitigation											
Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: studyload hours	Lecturer(s)	
	Application domains of Hydroinformatics: floods, urban systems and environme	**4**		**2**				**6**	**14**	R.K. Price, A.E. Mynett, Z. Vojinovic	
	Climate change and its impact on hydrology	**4**		**2**				**6**	**14**	P.D.A. Pathirana	
	Ethics of risk	**2**						**2**	**6**	N. Doorn	
	Introduction to 1D2D, 2D modelling	**7**		**7**				**14**	**28**	I. Popescu, S. Djordjevic	
	Urban flood modelling and evaluation of flood risks	**9**			**3**			**12**	**33**	Z. Vojinovic, O. Mark	
	Structural and non-structural measures	**4**			**2**			**6**	**16**	Z. Vojinovic, O. Mark, B. Gersonius	
	Managing urban flood disasters	**6**			**4**			**10**	**26**	D. Sakulski	
	Total	**36**		**11**	**9**			**56**	**137**		
MSc module - UNESCO-IHE											

URBAN WATER AND SANITATION

MASTERS PROGRAMME

Academic Year: 2013-2015
Specialization: Core Programme
Module Coordinator: Ferrero, G.

Module Sheet

Module Name International fieldtrip and fieldwork	Module Code UWS/09	Credits 5

Target Group	Prerequisites
Students of the SE, WSE and UWEM specialisation within the UWS programme.	Previous Modules of MWI Programme

Learning Objectives

Upon completion of the module participants will be able to..

- International Field Trip:
  To expose the participants, during a two week fieldtrip to a European country, to different international practises in the design, operation and management of water supply, wastewater, solid waste and urban civil infrastructure networks.
- Field Work:
  The fieldwork, carried out typically within the Netherlands but on location, is a one week work to make the students familiar with performing research on location, how to process real data, and to apply the newly acquired knowledge to a practical situation.

Topics and Learning Activities

International Field Trip

During the International Field Trip the participants will travel within Europe (not in the Netherlands) and visit various water and wastewater treatment plants, research institutes and water companies.

Learning Activities:

Field work, field visits, lectures, participant observation, debates, company and product demonstrations, and basic qualitative research.

Fieldwork

During the Fieldwork, the students will travel during a small number of days, together with a team of staff members including laboratory staff.

Learning Activities:

Field work, field visits, lectures, participant observation, debates, company and product demonstrations, and basic qualitative research.

Lecturing Material

- A handout is provided with relevant information on the sites to be visited

Assessment

- **100%: Assignment --**

2013/2015-UWS/09: International fieldtrip and fieldwork											
Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: studyload hours	Lecturer(s)
	International Field Trip					**93**		**93**	**93**	Â G. Ferrero, PhD
	Field Work					**47**		**47**	**47**	
	Total					**140**		**140**	**140**	
MSc module - UNESCO-IHE										

URBAN WATER AND SANITATION

MASTERS PROGRAMME
Academic Year: **2013-2015**
Specialization: **MWI-SE, MWI-UWEM**
Module Coordinator: **Garcia Hernandez, H.A.**

Module Sheet

Module Name **Industrial effluents treatment and residuals management**	**Module Code** **UWS/SE/UWEM/10**	**Credits** **5**

Target Group	**Prerequisites**
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.	MSc programme entry requirements

Learning Objectives

Upon completion of the module participants will be able to..

- Define cleaner production and explain the advantages and disadvantages of applying cleaner production activities.

  Implement cleaner production activities on a selected industrial sector.

  Describe industrial water management strategies for pollution prevention including the planning and performance of water audits, the implementation of waste minimization plans, and the adequate selection of wastewater treatment technologies

  Implement industrial water management strategies for pollution prevention on a selected industrial sector

  Define industrial effluent toxicity and identify problems associated with industrial effluent toxicity

  Illustrate how to measure industrial effluent toxicity and explain alternatives to deal with toxic effluent streams
- Define the most commonly applied wastewater treatment technologies and explain their most suitable industrial waste treatment applications as well as their advantages and disadvantages

  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

- Define sludge handle and sludge treatment and explain the needs for sludge handle and treatment activities in the context of industrial wastewater treatment

  Describe sludge handling and treatment processes such as sludge conditioning, thickening, stabilization, and dewatering

  Design sludge thickeners and anaerobic sludge digesters

  Describe sludge drying and sludge incineration processes
- Recognize wastewater treatment technologies applied to indsutrial waste treatment and analyze industrial waste schemes from case studies presented from a diverse range of industries

  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 slected industry

Topics and Learning Activities

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

Learning Activities:

Lectures including case studies and a group work

Industrial Water Management

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

Learning Activities:

Lectures including case studies and a group work

Toxicity in Industrial Wastewater

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

Learning Activities:

Lectures including case studies

Physical Chemical Processes

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

Learning Activities:

Lectures

Anaerobic Industrial Wastewater Treatment

Anaerobic High-rate Treatment of Industrial Wastewater; UASB reactors; EGSB reactors; EGSB/IC reactors; Examples

Learning Activities:

Lectures

Sludge Management and Treatment

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

Learning Activities:

Lectures and excercises

Case studies

Several case studies are presented:

Steel Industry; Tannery; Aquaculture; Industrial practices: Potato processing, sugar, tannery and yeast; Sugar, steel and water reclamation; Resource recovery; Water management/water reuse (membrane bioreactors); Shell and water; Leachate treatment; Metal surface protection by advanced wastewater treatment; Brewery industry; Sludge drying; and Sludge incineration.

Learning Activities:

Lectures

Lecturing Material

- Lecture notes posted on the e-campus webiste
- 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)

Assessment

- **15%: Homework -- Homework**
- **25%: Assignment -- Final project related to a particular industry**
- **60%: Written Exam (open book) -- Cumulative Final Exam**

2013/2015-UWS/SE/UWEM/10: Industrial effluents treatment and residuals management											
Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: studyload hours	Lecturer(s)
1	Introduction	1						1	3	Dr. H. Garcia
2	Cleaner Production	3						3	9	Dr. M.S. Moussa
3	Industrial Water Management	6						6	18	Dr. M.S. Moussa
4	Toxicity	2						2	6	Dr. M.S. Moussa
5	Case Studies (Pollution Prevention)			3				3	3	Dr. M.S. Moussa
6	Pre and Primary Treatment	4						4	12	Dr. H. Garcia
7	Secondary Treatment	2						2	6	Prof. J. van Lier
8	Physical Chemical Treatment	3						3	9	Dr. H. Garcia
9	Case Study: Aquaculture			2				2	2	Prof. D. Brdjanovic
10	Case study: Oil Industry			1				1	1	TBD
11	Case Study: Industrial Waste and Resource Recovery			2				2	2	Ir. A. Mulder
12	Case Study: Potato, Sugar, Tannery, and Water Reuse									Ir. A. Mulder
13	Case Study:Water Reuse (Dow Chemical)			1				1	1	K. Majamaa
14	Case Study: Sugar, Steel, and Water Resue			2				2	2	Appelman
15	Case Study: Wastewater Reuse (Evides)			1				1	1	JW Mulder
16	Case Study: Field Trip (Heineken)			4				4	4	Dr. H. Garcia
17	Case Study: Process Water and Reuse			2				2	2	A. Vlaski
18	Case Study: Leachate Treatment			1				1	1	D. Jaksic
19	Case Study: Metal Surface Treatment			2				2	2	D. Jaksic
20	Case Study: Brewery Industry			1				1	1	D. Jacksic
21	Sludge Management	6		3				9	21	A. Salome
22	Sludge Treatment	9		3				12	30	G. Ekama
23	Sludge Incineration			3				3	3	Brdjanovic & Salzmann
24	Sludge Drying			1				1	1	A. Kuppe
	Final Project		8						8	Dr. H Garcia
	Total	36	8	32				68	148	
MSc module - UNESCO-IHE										

URBAN WATER AND SANITATION

MASTERS PROGRAMME
Academic Year: **2013-2015**
Specialization: **WSE**
Module Coordinator: **Villacorte, L.**

Module Sheet

Module Name Water treatment processes and plants	Module Code UWS/WSE/10	Credits 5

Target Group	Prerequisites
Mid-career professionals dealing with technical aspects of water abstraction and drinking water treatment, working for municipal assemblies, water supply companies or consulting agencies.	BSc degree in Civil Engineering or similar technical background; basic PC-computer knowledge (MSWindows); good English command; basic knowledge of water treatment methods.

Learning Objectives

Upon completion of the module participants will be able to..

- to creatively apply (gained) knowledge and experience regarding water quality and conventional treatment methods in design and engineering, operation & maintenance and rehabilitation of conventional water treatment processes and plants;
- to critically analyse water quality data and to select the most attractive raw water resource;
- to design and engineer a water treatment plant (conventional and advanced water treatment plants for both ground water and surface water treatment);
- to execute plant performance studies and to evaluate results, as well as to propose improvements in order to rehabilitate a malfunctioning plant;
- to show professional knowledge and know-how for operating (process & quality control, troubleshooting) and maintaining of manually and semi-automated water treatment plants;
- in addition participants' skills will be improved through aspects such as: problem solving, decision making, oral presentations, writing reports, working in small task forces.

Topics and Learning Activities

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.

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.

Operation & Maintenance of Water Treatment Plants
Importance of adequate O&M, O&M of individual units, equipment and plants, trouble shooting, organising O&M, safety aspects, cost of O&M, O&M at plants in rural areas.

Process and Quality Control
Basics of process and quality control, water quality control during all steps of water supply system, integral quality control, organisation and cost of quality control.

Rehabilitation of Water Treatment Plants
Reasons for rehabilitation, execution of plant performance studies, proposals for process and plant improvement.

Sludge Treatment & Disposal
Treatment of backwash water and sludge from coagulation units. Disposal and re-use.

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

Lecturing Material

- J.P. Buiteman, Water Treatment Processes and Plants (LN 0087/07/2).
- J.P. Buiteman, O&M of Conventional Water Treatment Plants (LN 0094/03/1).
- J.P. Buiteman, Process and Quality Control (LN 0097/06/1).
- J.P. Buiteman, Rehabilitation of Conventional WTPs (LN 00099/06/1).
- H.M.M. Koppers, Sludge Treatment & Disposal, Part 1 (LN 0100/95/1) and Part 2 (LN 0101/95/1).
- L. Rietveld, Process modelling.

• Separate hand-outs for exercises on: Surface Water Collection and Storage, O&M, Trouble Shooting, Process & Quality Control, Rehabilitation and Sludge Treatment.

Assessment

- **40%: Assignment -- Design exercise**
- **60%: Written exam (closed book) --**

2013/2015-UWS/WSE/10: Water treatment processes and plants											
Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: studyload hours	Lecturer(s)
	Water treatment plants and processes	4		2				6	14	J.P Buiteman, MSc
	Process modelling	2		2				4	8	Prof. L. Rietveld
	Design exercise						28	28	84	S. Sharma, PhD; J.P. Buiteman, MSc; P. Hiemstra, MSc
	Operation and maintenance	2		4				6	10	J.P. Buiteman, MSc
	Process and quality control	2		2				4	8	J.P. Buiteman, MSc
	Rehabilitation	2		2				4	8	J.P. Buiteman, MSc
	Fieldtrip					8		8	8	L. Villacorte, MSc
	Total	12		12		8	28	60	140	
MSc module - UNESCO-IHE										

WATER SCIENCE AND ENGINEERING

MASTERS PROGRAMME

Academic Year: **2013-2015**
Specialization: **Hydroinformatics: modelling and information systems for water management**
Module Coordinator: **Vojinovic, Z.**

Module Sheet

Module Name Urban water systems	Module Code WSE/HI/10B/e	Credits 5

Target Group	Prerequisites
Participants in WSE programmme; Participants in short course "Urban Water Systems"	Basic knowledge of hydrology and hydraulics

Learning Objectives

Upon completion of the module participants will be able to..

- Water supply/distribution, sanitation and drainage are vital aspects for the economic and social development of all urban communities. Reliable, sustainable and affordable water management systems form the key to enhancing the quality of life of billions of people throughout the world. This module covers the essential aspects of clean water supply and distribution and wastewater disposal (sewerage, treatment and flooding), providing an understanding of how these systems work and how to use tools for simulating their performance.

  The first learning objective is to understand the complexity of urban water systems, and the interactions of their different components. Asset management and optimisation of systems
- Understand the structure, service provided and failures of the service for a) urban water distribution, b) wastewater drainage networks and c). wastewater treatment plants
- Know how to model these systems and to have used a typical modelling product (EPANET, MOUSE/SWMM and WEST++)
- Describe how to use the models to assess the performance of the systems
- Understand the processes controlling the water quality of the receiving waters from urban drainage effluents
- Know how to model water quality processes in sewer/drainage systems and impacts on receiving waters with a typical modelling product (MOUSE, MIKE 11, MIKE21, SWMM)

Topics and Learning Activities

Introduction to urban water systems, Z. Vojinovic (IHE)

General introduction to urban water systems; problems of providing potable water to large cities and collecting wastewater and storm water, especially in developing countries.

Learning Activities:

Lectures

Water distribution modelling, N. Trifunovic (IHE), D. Savic (University of Exeter)

Introduction to water distribution; services provided, end users, structure and concepts of distribution networks, modelling concepts. Water distribution modelling; familiarisation with EPANET software, use of EPANET for simple benchmark cases, application to standard problems, asset management and multi-objective optimisation of water distribution systems.

Learning Activities:

Lectures
Exercise computer lab

Wastewater and Stormwater Systems modelling, O. Mark (DHI), Z. Vojinovic (IHE)

Introduction to wastewater and stormwater collection; services provided, beneficiaries, structure and concepts of sewerage networks, composition of wastewater and stormwater flows, free-surface and pressurised pipe flows, flow measurements and instrumentation, water quality sampling, advection-dispersion, sediment transport and water quality modeling in pipe networks, real-time control, inflow and infiltration. Familiarisation with MOUSE software, operating MOUSE on standard pipe networks, process of setting up, calibrating and verifying a simple network model using flow survey data, exercises highlighting particular features of sewerage system performance and asset rehabilitation. Asset management and multi-objective optimization in systems management and rehabilitation, asset condition modelling.

Learning Activities:

Lectures
Exercise computer lab

Wastewater treatment modelling, I. Nopens (University of Ghent), P. Vanrolleghem (University of Laval)

Wastewater treatment plants; primary, secondary and tertiary levels of treatment, modelling hydraulics, primary

treatment processes, chemical and biological secondary treatment processes, modelling using WEST++; wastewater treatment plant modelling; familiarisation with WEST++, treatment works layout, modelling of individual processes, exercises on whole treatment works

Learning Activities:

Lectures

Receiving water impact modelling, A. van Griensven (IHE), A. Mynett (IHE), M. McClain (IHE) Z. Vojinovic (IHE)

Receiving water impact and sewerage rehabilitation; impact of quantity and quality of effluent flows on receiving waters, water quality objectives, classification-assessment schemes, modelling water quality in a stream, reduction of impact through sewerage rehabilitation, integrated modelling; sequential and parallel simulations of integrated models, receiving water impact modelling; using MOUSE for water quality modelling in a stream due to CSO discharges (point sources), advection, dispersion and diffusion rate equations, real-time control, exercises on different parameters.

Learning Activities:

Lectures

Lecturing Material

• R.K. Price and Vojinovic, Z., 2010, Urban Hydroinformatics: Data, Models and Decision Support for Integrated Urban Water Management, 2011, IWA Publishing

Assessment

- **40%: Written Exam (closed book) --**
- **30%: Assignment -- Water Distribution**
- **30%: Assignment -- Urban Drainage**

2013/2015-WSE/HI/10B/e: Urban water systems											
Nr	**Course/Topic**	**Lecture**	**Assignment**	**Workshop Case study Role play Exercise Lab session**	**Laboratory work**	**Fieldtrip - Fieldwork**	**Design exercise**	**SUM: contact hours**	**SUM: studyload hours**	**Lecturer(s)**
	Introduction to urban water systems	**2**						**2**	**6**	Z. Vojinovic, PhD
	Water distribution modelling	**10**			**6**			**16**	**42**	N. Trifunovic, MSc, Prof. D.A. Savic
	Wastewater and stormwater systems modelling	**8**		**4**	**8**			**20**	**44**	Dr O. Mark, Z. Vojinovic, PhD, MSc
	Wastewater treatment modelling (together with HES)	**6**		**8**				**14**	**26**	Dr Ir I. Nopens
	Receiving water impact modelling	**4**		**8**				**12**	**20**	A.B.K. van Griensven, A. Mynett, M. McClain, Z. Vojinovic
	Total	**30**		**20**	**14**			**64**	**138**	
MSc module - UNESCO-IHE										

URBAN WATER AND SANITATION

MASTERS PROGRAMME

Academic Year: 2013-2015
Specialization: Elective module
Module Coordinator: Trifunovic, N.

Module Sheet

Module Name Advanced water transport and distribution	Module Code UWS/WSE/11a	Credits 5

Target Group	Prerequisites
Engineers and scientists with keen interest in modern methods, technologies and tools used in design, operation and maintenance of water transport & distribution networks.	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

Upon completion of the module participants will be able to..

- 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;
- 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.
- recognise the GIS and remote sensing technologies, and familiarise with the GIS-based techniques for sustainable planning and management of WTD systems;
- understand the theory of transient flows, and plan the measures to prevent/control water hammer;
- select modern tools for monitoring of operation, and planning of maintenance of WTD systems.

Topics and Learning Activities

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.

Learning Activities:

Series of lectures is followed by exercise in which the case of distribution network developed during the design exercise in the module Water Transport and Distribution is tested on water quality parameters, namely the water age, source tracing and chlorine residuals, by using WaterGEMS software.

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.

Learning Activities:

Series of lectures is followed by exercise in which the case of distribution network developed during the design exercise in the module Water Transport and Distribution is optimised and tested on irregular supply and demand scenarios by using WaterGEMS software.

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.

Learning Activities:

The main learning activities are grouped around exercises and production of individual assignment. The output files produced in the exercise shall be used for hydtraulic analyses conducted by network modelling software.

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.

Learning Activities:

Series of lectures combined with software demonstrations is followed by exercise in which the case of transportation network from the design exercise Pumping Stations, developed in the module Water Transport and Distribution is teseted on water hammer using WaterGEMS software.

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.

Learning Activities:

Series of lectures is followed by a field trip to one of water supply companies in the Netherlands.

Lecturing Material

- N.Trifunovic - Introduction to Urban Water Distribution, Taylor & Francis, 2006, reprint 2008
- S.Sharma - Corrosion of Pipe Materials, lecture notes UNESCO-IHE 2009 (LN/0310/09/1)
- Electronic materials: slide presentations (MS PowerPoint), design assignments, spreadsheet hydraulic lessons (MS Excel.

Assessment

- **60%: Written Exam (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)**
- **30%: Assignment -- Report on four short assignments regarding advanced water distribution modelling done in WaterGEMS software: (1) Network design using GA optimiser (7%), (2) Network criticality analysis (7%), (3) Water quality analysis (8%), and (4) Water hammer analysis (8%).**
- **10%: Assignment -- GIS assignment on the exercise using ArcGIS.**

2013/2015-UWS/WSE/11a: Advanced water transport and distribution											
Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: studyload hours	Lecturer(s)
1	Water Quality in Distribution Networks	6					4	10	30	S.Sharma, S.Velickov, N.Trifunovic
2	Advanced Water Distribution Modelling	6		12			6	24	48	D.Savic, S.Velickov, N.Trifunovic
3	GIS in Water Distribution			4			4	8	16	Z.Vojinovic
4	Introduction to Water Hammer	6		4			4	14	34	E. Arpadzic, S.Velickov, N.Trifunovic
5	Advanced O&M Water Distribution Practices			4		8		12	12	K.van der Drift
	Total	18		24		8	18	68	140	
MSc module - UNESCO-IHE										

URBAN WATER AND SANITATION

MASTERS PROGRAMME

Academic Year: 2013-2015
Specialization: Elective Module (Open for all specializations)
Module Coordinator: Sharma, S.K.

Module Sheet

Module Name Decentralised water supply and sanitation	Module Code UWS/WSE/11b	Credits 5

Target Group	Prerequisites
Mid-career professionals, 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, consultancies.	MSc. programme entry requirements

Learning Objectives

Upon completion of the module participants will be able to..

- know different technologies/methods for small-scale water abstraction and water treatment that can be used at household or small community level
- understand the basics of sustainable sanitation technologies including nutrient reuse in agriculture (ecological sanitation), soild waste management and fecal sludge management and their implementation in small towns, peri-urban and urban poor areas of developing countries
- prepare concept design for small-scale water supply treatment and ecosan technology
- facilitate planning, financing, implementation and operation and maintenance of decentralised water supply and sanitation infrastructures based on stakeholder participation and community management

Topics and Learning Activities

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

Learning Activities:

Lecture and discussions

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)

Learning Activities:

Lectures, Workshop for calculations, Design Exercise on Multi-stage Filtration

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)

Learning Activities:

Lectures, Workshop/Discussion, Assignment, Field Trip

Management Aspects of Watsan

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)

Learning Activities:

Lectures and discussion

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.

Learning Activities:
Individual presentations and discussion

Lecturing Material

• Sharma, S. (2012) Decentralised Water Supply and Sanitation: Selected Topics UNESCO-IHE Lecture Notes LN0368/11/1
• Sharma, S. (2007) Rainwater Harvesting. UNESCO-IHE Lecture Notes LN 0357/07/1
• IRC (2002) Small Community Water Supplies. IRC TP No. 40
• Rontelap, M. (2012) Ecological Sanitation. UNESCO-IHE Lecture Notes
• Ronteltap, M. (2012) Solid Waste Management. UNESCO-IHE Lecture Notes
• van Dijk, M.P. (2012) Handouts and powerpoint presentation on (i) Institutional Arranagements and (ii) Financing and Cost Recovery Aspects

Assessment

- **60%: Written Exam (closed book) --**
- **30%: Assignment --**
- **10%: Presentation --**

2013/2015-UWS/WSE/11b: Decentralised water supply and sanitation											
Nr	**Course/Topic**	**Lecture**	**Assignment**	**Workshop Case study Role play Exercise Lab session**	**Laboratory work**	**Fieldtrip - Fieldwork**	**Design exercise**	**SUM: contact hours**	**SUM: studyload hours**	**Lecturer(s)**
1	**Introduction**									Sharma
1.1	Module introduction			1				1	1	
1.2	Introduction to decentralised water supply and sanitation	2						2	6	
2	**Decentralised Water Supply and Treatment Systems**									Sharma
2.1	Water supply systems	3						3	9	
2.2	Rain water harvesting	2		2				4	8	
2.3	Small-scale water treatment	6	6					6	24	
3	**Decentralised Sanitation Systems**									Ronteltap, Schertenleib
3.1	Ecological sanitation	6		2		4		12	24	Ronteltap
3.2	Soild waste management in small towns and urban poor areas	4						4	12	Ronteltap/Guest Lecturer
3.3	Sanitation planning and strategic tools	2		2				4	8	Schertenleib (EAWAG)
3.4	Fecal sludge management	2		4				6	10	Schertenleib (EAWAG)
4	**Management Aspects of DWSS**									Sharma, van Dijk
4.1	Participatory planning and evaluation	2		2				4	8	Guest lecturer
4.2	Institutional arrangements	2		2				4	8	van Dijk
4.3	Financing and cost recovery aspects	2		2				4	8	van Dijk
4.4	Operation and maintenance aspects	2		2				4	8	Sharma
5	**Presentation of the Participants**			**6**				**6**	**6**	Sharma
	Total	**35**	**6**	**25**		**4**		**64**	**140**	
MSc module - UNESCO-IHE										

URBAN WATER AND SANITATION

MASTERS PROGRAMME

Academic Year: 2013-2015
Specialization: Core Programme
Module Coordinator: Ronteltap, M.

Module Sheet

Module Name Faecal sludge management	Module Code UWS/SE/11	Credits 5

Target Group	Prerequisites
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.	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

Upon completion of the module participants will be able to..

- Describe the way how excreta and faecal sludge are characterised.
- Know which technologies can be applied for which type of faecal sludge (settling tanks, planted and unplanted drying beds, etc)
- Name the key stakeholders in FSM.
- Describe the relationship between sanitation and health.
- Name the challenges in emergency sanitation and know how emergency sanitation can be addressed.
- Be familiar with the latest developments in sustainable (on-site) sanitation solutions that can be applied in high density low income areas.

Topics and Learning Activities

(Overview) 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 â€“ climate, hard ware, a vast number of stakeholders, willingness to pay, space to store and treat, groundwater pollution, different toilet types â€“ 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.

Learning Activities:

The participants will be offered substantial fundamentals as well be informed with the latest insights in faecal sludge management, emergency sanitation and slum sanitation. The classes are taught by global experts in the field of FSM.

Topics in the module:

- Public Health and Sanitation

- Excreta Characterisation

- Faecal Sludge Sanitation Systems

- Non-technical aspects of FSM

- Specific circumstances

Lecturing Material

- Faecal Sludge Management Book (IWA; Editors Linda Strande, Mariska Ronteltap, Damir Brdjanovic)
- Handouts.

Assessment

- **85%: Written Exam (closed book) --**
- **15%: Assignment --**

2013/2015-UWS/SE/11: Faecal sludge management											
Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: studyload hours	Lecturer(s)
	Public Health	6						6	18	
	Black Soldier Flies	4						4	12	
	Reinventing the Toilet Challenge	2		2				4	8	
	Emergency Sanitation	6	2					6	20	
	Co treatment	2						2	6	
	Sludge characterisation	2						2	6	
	Treatment Mechanisms	12		8				20	44	
	Institutional Aspects	4						4	12	
	Financial Aspects	2		2				4	8	
	Slum sanitation	2						2	6	
	Total	42	2	12				54	140	
MSc module - UNESCO-IHE										

URBAN WATER AND SANITATION

MASTERS PROGRAMME

Academic Year: 2013-2015
Specialization: Core Programme
Module Coordinator: Ferrero, G.

Module Sheet

Module Name Groupwork Sint Maarten	Module Code UWS/12	Credits 5

Target Group	Prerequisites
Students from MWI Programme	MWI Specialisations

Learning Objectives

Upon completion of the module participants will be able to..

- apply and integrate his or her knowledge obtained during the Specialisation to solve water and sanitation related issues.
- compare the complex water and sanitation issues applied to a real case scenario with the examples from the classes
- defend his or her input in a team of specialists as well as in an interdisciplinary team.
- assess his/her own strengths and weaknesses with respect to working in a group.
- efend the groups' findings to a team of experts in the field.

Topics and Learning Activities

Didactics

Participants will work in teams. The integrated group work is based on a real-life case, the Caribbean island of Sint Maarten. Groups will identify issues and problems, identify potential solutions and related data needs, work out engineering solutions for individual problems and, at the end, define an integrated package of solutions. The final result is to be presented to a panel of experts that includes a representative of the Island Government of Sint Maarten.
Groups are supported by mentors (process) and can consult academic staff members as resource persons.

Lecturing Material

• All material is available on the Moodle platform for Module 12, containing video footage, data, interviews with Sint Maarten civil servants and inhabitants, as well as the Terms of Reference for the different phases of the group work. Additional data is provided on request.

Assessment

• 50%: Assignment -- The first part of the group work consists of a specialist exercise, carried out as consultants. This work will be assessed by the "client" for whom the assignment is designed. Assessment is based on Content and Attitude
Content:
- Are the objectives from the Terms of Reference met?
- Are the solutions presented in a clear way?
- Are the calculations correct and sufficiently extensive?
- Did the group convince the client of the best solution, whenever possible in comparison to other alternatives?

Attitude:
- Did the group work well together?
- Did the group present a positive attitude (showing up in time, general interest, etc)?
- Did the client have to steer a lot, or did the team show proper own initiative?
• 30%: Assignment -- This 30% covers the content of the report. It is assessed based on:

- Are the objectives from the Terms of Reference met?
- Are the solutions presented in a clear way?
- Did the team members identify possible conflicts?
- If yes, did they solve them in an appropriate fashion?
- Is there a logical build-up in the short, mid and long term planning?
• 20%: Presentation -- - Was the work presented well? Did the team stay within the time limit?
- Did the panel feel convinced by the group that this is indeed the way forward for Sint Maarten?
- Did the team have good answers for the questions?

2013/2015-UWS/12: Groupwork Sint Maarten											
Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: studyload hours	Lecturer(s)
	Introduction Groupwork	**2**						**2**	**6**	Ferrero
	Class on Master Planning	**4**						**4**	**12**	Marcel Belt/Kees Bodegom
	Class on Engineering Consultancy	**4**						**4**	**12**	Buijs
	Specialist Group work			**40**				**40**	**40**	Group work mentors
	Interdisciplinary Group work			**60**				**60**	**60**	Group work mentors
	Final presentations			**10**				**10**	**10**	Panel members
	Total	**10**		**110**				**120**	**140**	
MSc module - UNESCO-IHE										

URBAN WATER AND SANITATION

MASTERS PROGRAMME

Academic Year: 2013-2015
Specialization: Core Programme
Module Coordinator: Slokar, Y.M.

Module Sheet

Module Name Summer courses / research methodology for UWS	Module Code UWS/13	Credits 3

Target Group	Prerequisites
All participants of the programme	

Learning Objectives

Upon completion of the module participants will be able to..

- Discuss the latest insights, context and concepts of a contemporary issue of choice
- Able to justify his or her research in the context of UNESCO-IHE research lines, personal professional interests and preferably in local, national and regional contemporary issues.
- Apply basic statistics into research.

Topics and Learning Activities

Research methodology

Selected attention to one or several aspects of epistemology, literature review, scientific research methods, statistics, writing for publication, etc.

Learning Activities:

Presentations by and debate between staff, guest lecturers and participants on issues of research methods, epistemology, contemporary issues, etc

Summer courses

Participant will need to select 1 course out of the available Summer Courses on offer during this period (each Masters programme will offer one or more Summer Course open to all participants, as long as prerequisites are met). Topics will be presented as seminars by UNESCO-IHE staff and guest lecturers on specific contemporary themes and issues. Some examples of previous Summer Courses are:

â€¢ Water and Climate
â€¢ Environmental Flows
â€¢ Conflict Resolution
â€¢ Flood resilient planning and building

Learning Activities:

Lectures, workshops, assignments

Statistics

Statistical methods for the interpretation of scientific data are explained and applied to practical problems.

Learning Activities:

Lectures, exercise

Lecturing Material

- To be announced

Assessment

- **40%: Assignment -- Pass / fail based on attendance to research methodolgy and summer course**
- **60%: Written exam (closed book) -- Statistics**

2013/2015-UWS/13: Summer courses / research methodology for UWS											
Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: studyload hours	Lecturer(s)	
	Research methodology		**24**						**24**	various	
	Summer course			**20**				**20**	**20**	various	
	Statistics	**12**		**10**				**22**	**46**		
	Total	**12**	**24**	**30**				**42**	**90**		
MSc module - UNESCO-IHE											

URBAN WATER AND SANITATION

MASTERS PROGRAMME

Academic Year: 2013-2015
Specialization: Core Programme
Module Coordinator: Hooijmans, C.M.

Module Sheet

Module Name MSc research proposal development for UWS	Module Code UWS/14	Credits 7

Target Group	Prerequisites
All students of the Urban Water and Sanitation programme	The successful completion of at least 8 of the first 11 modules

Learning Objectives

Upon completion of the module participants will be able to..

- concisely define the intended research topic, state precise aims and objectives, describe the research methodology, argue expected relevance and justification, and identify boundary conditions and self- or externally imposed limitations;
- list available literature and replicate main arguments expounded in the literature on the specified research topic;
- demonstrate analytical problem-analysis skills and the ability to distil the strategic issues to be addressed in the research phase;
- plan the research process in weekly time-steps and indicate essential milestones, targets and indicators, required human, financial and other resources, deliverables and perceived threats and constraints at each stage of the research project;
- develop and formulate the research proposal in a clearly written, well argued and convincing report, submitted within a set deadline;
- successfully present and defend individual work, cross-reference it to and critically evaluate it in light of contemporary thinking in a specific field of study.

Topics and Learning Activities

Selection of research topic

The initial research topic of study will be selected in a consultative process with a mentor, the MSc coordinator and a professor. Research is likely to be based primarily on a review of selected literature, to a limited extent other methods of data gathering and analysis may also be applied (e.g. interviews, laboratory and field work, computer modelling, expert consultations, etc). One hour weekly meetings with the tutor form the main stay of the proposal development process. It is however expected that the MSc candidate will be self-motivated and pro-active, taking all necessary initiatives to reach the set target in a timely fashion. The resulting proposal will be presented in written form and orally defended before an audience of critical peers and a panel of staff members.

Learning Activities:

Discussion with academic staff members

Proposal drafting

Research is likely to be based primarily on a review of selected literature, to a limited extent other methods of data gathering and analysis may also be applied (e.g. interviews, laboratory and field work, computer modelling, expert consultations, etc). One hour weekly meetings with the tutor form the main stay of the proposal development process. It is however expected that the MSc candidate will be self-motivated and pro-active, taking all necessary initiatives to reach the set target in a timely fashion. The resulting proposal will be presented in written form and orally defended before an audience of critical peers and a panel of staff members.

Learning Activities:

Writing of the proposal

Proposal presentation

The resulting proposal will be presented in written form and orally defended before an audience of critical peers and a panel of staff members.

Learning Activities:

Presentation of the proposal

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Lecturing Material

- MSc thesis protocol
- How to write an MSc thesis – Wendy Sturrock

Assessment

• 100%: Oral Exam -- The MSc research proposal needs to be approved by the mentor and the professor before the student can actually start the research work. This proposal needs to be presented and defended by the student.

2013/2015-UWS/14: MSc research proposal development for UWS										
Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: studyload hours	Lecturer(s)
	MSc research proposal		196						196	
	Total		196						196	
MSc module - UNESCO-IHE										

URBAN WATER AND SANITATION

MASTERS PROGRAMME

Academic Year: 2013-2015
Specialization: SE/WSE
Module Coordinator: Hooijmans, C.M.

Module Sheet

Module Name MSc thesis research and thesis writing	Module Code UWS/15	Credits 36

Target Group	Prerequisites
UWS participants	Completion of the first 14 modules of the master programme of which at least 11 modules were approved.

Learning Objectives

Upon completion of the module participants will be able to..

- 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 of the research topic; Formulate research questions and hypotheses.
- Conduct research, independently or in a multidisciplinary team by selecting and applying appropriate research methodologies and techniques, collecting and analysing data.
- Formulate well-founded conclusions and recommendations based on a comprehensive discussion of the results.
- 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.
- 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.

Topics and Learning Activities

Lecturing Material

Assessment

• 100%: Oral Exam -- The MSc work is assessed based on the criteria described in the programme handbook (e.g., the written report, the final presentation, the defense, etc.)

2013/2015-UWS/15: MSc thesis research and thesis writing											
Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: studyload hours	Lecturer(s)
	MSc thesis research		**1008**						**1008**	Supervisor / Mentor(s)
	Total		**1008**						**1008**	
MSc module - UNESCO-IHE										