Handbook UWS 2014 - 2016

Table of contents - part 1

1 UNESCO-IHE

1.1 Introduction

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

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

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

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

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

1.2 MSc Degree Programmes

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

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

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

1.3 Research and PhD Programmes

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

The PhD programme has a nominal duration of 4 years and can be carried out either in Delft or in a sandwich construction.

The PhD degrees are awarded by UNESCO-IHE together with a Dutch university. Candidates should preferably hold a UNESCO-IHE MSc degree, but an equivalent degree from another reputed university may also be acceptable.

1.4 Organisation

The Rectorate of the Institute consists of a Rector, a vice rector Academic Affairs and a Business Director. The organisation is structured into departments, which are further subdivided into various sections. Within the organisation structure, three academic departments are distinguished:

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

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

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

2 Programme framework

2.1 Introduction

The Master of Science Degree Programmes

The Institute provides the following Master of Science degree programmes:

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

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

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

2.2 Academic Regulations

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

The regulations describe the precise details of how examinations are assessed and marked, the procedures and rules for re-examinations, procedures for appeal, and which results are required for awarding the Master of Science degree.

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

2.3 Structure of the Programmes

The programme specialisations which are offered solely in Delft 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 focusing 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. he or she does not act contrary to statutory obligations;

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

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

2.3 The Head of the Central Services department may, on behalf of the Rectorate, issue instructions and directions for the purpose of ensuring the smooth and proper use and functioning of buildings and grounds of 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

Plagiarism is classified as a serious act of fraud in the examination regulations of UNESCO-IHE and is among the most egregious forms of academic misconduct. Any participant found by the Examination Board to have plagiarized will be given a failing mark on the plagiarized assignment (including theses).

In order to better understand what constitutes plagiarism and how to avoid it, you are directed to the following online resources. (see at the end of the paragraph)

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.

New text about plagiarism will follow…

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

Harvard Guide to using sources

- http://isites.harvard.edu/icb/icb.do?keyword=k70847&pageid=icb.page357682

Purdue University Writing Lab

- http://owl.english.purdue.edu/

University of Princeton Academic Integrity Site

- http://www.princeton.edu/pr/pub/integrity/pages/plagiarism/

Princeton University about Academic Integrity

- http://www.princeton.edu/pr/pub/integrity/pages/intro/index.htm

University of Teesside Plagiarism Guidance

- http://dissc.tees.ac.uk/Plagiarism/Plag-4.htm

4. UWS programme

4.1 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.

4.2 Learning objectives UWS programme

The overall objective of the UWS programme is to educate the students to adequately evaluate, design, develop and manage the (urban) water cycle, thereby contributing to sustainable development. After successful completion of the programme, UWS graduates will have achieved the following learning outcomes:

Knowledge and understanding

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

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

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

Applying knowledge and understanding

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

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

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

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

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

Making judgements

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

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

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

Communication

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

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

Learning skills

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

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

4.3 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.

4.4 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;

4.5 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

4.6 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.

Delft, October 2014

UNESCO-IHE
Institute for Water Education

Education and Examination Regulations for cohort 2014– 2016

For the Master Programmes in:

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

and
the short and online courses which are part of these programmes

Approved by the Academic Board of UNESCO-IHE, 25092014

Table of Contents

1 General Information

Article 1 Scope of the regulations

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

a. Urban Water and Sanitation
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 For the following 4 joint specialisations of the master programmes mentioned under art 1.1 and 3.1, separate examination regulations apply as these lead to a joint Master degree issued jointly by the UNESCO-IHE and the partner institutes:

- Urban Water Engineering and Management (UWEM);
- Limnology and Wetland Management (LWM);
- International Master of Science in Environmental Technology and Engineering (IMETE);
- Environmental Technology for Sustainable Development (ETSuD).

1.3 In case a joint specialisation (see art. 3.1) leads to a double or multiple degrees, the rules and regulations of the partner institute will be applicable for those parts of the programme organised and implemented by the partner.

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*);
Blind marking:	the student information is hidden from the examiner while they are marking the examination;
Consent agreement:	a negotiated agreement of examining committee members to an examination which resolves the disputed issues;
Double (multiple) degree programme:	a master programme leading to multiple degrees;
ECTS:	the European Credit Transfer and Accumulation System: a standard for comparing the study attainment and performance of students of higher education across the European Union and other collaborating European countries;
ECTS transfer:	the procedure of granting credits to a student for studies completed at another institute;
Examination board:	the committee as stipulated in article 7.12 of the Act;
Fraud:	a deception deliberately practiced in order to secure unfair or unlawful gain;

Mentor:	staff member involved in the daily direction of a student during the MSc thesis research phase;
Module:	a self-contained programme unit with specified learning objectives, as stipulated in article 7.3 of the Act;
Module sheet:	a document describing a.o. the learning objectives, content, didactic methods and assessments. Modules sheets are part of the programme handbook;
Observer:	a person who is present at an oral examination in order to monitor and listen to what happens;
Online short course:	a module offered as an online non-degree course;
Peer review:	is the evaluation of work by one or more people of similar competence to the producers of the work (peers);
Plagiarism:	The practice of taking someone else's work or ideas and passing them off as one's own;
Practical:	a practical educational activity as stipulated in article 7.13, paragraph 2, clause d of the Act, taking one of the following forms: • the writing of a report or thesis; • producing a report, study assignment or design; • conducting a test or experiment; • performing an oral presentation; • participating in groupwork, fieldwork or a fieldtrip; • conducting a research assignment; or • participation in other educational activities that aim to develop specific skills;
Programme assessment:	the formal evaluation of the student performance before graduation (in the Act: *examen*);
Module assessment:	an examination consisting of a number of different parts (e.g. assignments, written or oral exams, presentations);
Examination:	an assessment for a part of the module;
Programme handbook:	a reference document for a specific programme containing generic and programme specific information, that students need to know throughout their programme;
Rector:	the rector of the Institute;
Short course:	a module offered as a face-to face non-degree course;
Student:	a person who is registered in a study programme and sits examinations;
Supervisor:	professor responsible for the work of student during the MSc thesis research phase.

Article 3 Master Programme and specialisations

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

1. Urban Water and Sanitation programme:

Specialisation	Location	Type of degree
1. Water Supply Engineering	UNESCO-IHE	UNESCO-IHE degree
	UNESCO-IHE and Kwame Nkrumah University of Science and Technology, Ghana	Double degree
	UNESCO-IHE and Universidad de Valle, Cali, Colombia	Double degree
2. Sanitary Engineering	UNESCO-IHE	UNESCO-IHE degree
	UNESCO-IHE and Kwame Nkrumah University of Science and Technology, Ghana	Double degree
	UNESCO-IHE and Universdad de Valle, Cali, Colombia	Double degree
3. Urban Water Engineering and Management	UNESCO-IHE and Asian Institute of Technology,Thailand	Joint degree

2. Environmental Science programme:

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

3. Water Management programme:

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

4. Water Science and Engineering programme:

Specialisation	Location	Type of degree
1. Hydrology and Water Resources	UNESCO-IHE	UNESCO-IHE degree
	UNESCO-IHE and Hohai University, China P.R.	UNESCO-IHE degree
2. Hydraulic Engineering - River Basin Development	UNESCO-IHE	UNESCO-IHE degree
	UNESCO-IHE and Sriwijaija University, Palembang, Indonesia	Double degree
3. Coastal Engineering and Port Development	UNESCO-IHE	UNESCO-IHE degree
	UNESCO-IHE and Hohai University, China P.R.	UNESCO-IHE degree
	UNESCO-IHE and Sriwijaija University, Palembang, Indonesia	Double degree
4. Land and Water development	UNESCO-IHE	UNESCO-IHE degree
	UNESCO-IHE and Sriwijaija University, Palembang, Indonesia	Double degree
	UNESCO-IHE and Asian Institute of Technology Thailand	Double degree
	UNESCO-IHE and University of Nebraska -Lincoln, USA	Double degree
5. Hydroinformatics- Modelling and information systems for water management	UNESCO-IHE	UNESCO-IHE degree
	UNESCO-IHE and Hohai University, China P.R.;	UNESCO-IHE degree
	UNESCO-IHE and Universidad del Valle, Colombia	UNESCO-IHE degree
6. Ecohydrology (Erasmus Mundus programme);	UNESCO-IHE and University of Algarve, University of Lodz, University of Kiel, National University of La Plata	Multiple degree
7. Flood Risk Management (Erasmus Mundus programme).	UNESCO-IHE and Technische Universität Dresden, Universitat Politècnica de Catalunya - CIMNE, University of Ljubljana	Multiple degree

Article 4 Aim of the programmes and courses

4.1 The aim of the master programmes is for students to acquire 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 master programme graduates are listed in Appendix A.

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

Article 5 Full-time/part-time

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

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

Article 6 Programme assessment

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

6.2 The programme assessment is passed if all designated module assessments of the programme curriculum have been successfully completed as stipulated in article 7.10a, paragraph 1 of the Act.

6.3 Students of short courses or online courses are eligible to sit for the module assessment of the course they are registered for.

2 Content of the Programme

Article 7 Composition of the specialisations and joint specialisations

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

7.2 The learning objectives of the modules, the content and assessment methods are described in the module descriptions of the handbooks.

Article 8 Participation

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

3 Examinations

Article 9 Quality assurance of examinations

9.1 An examination has to test whether a student has met the learning objectives.

9.2 Module coordinators are responsible for organising module assessments and for compiling the written examinations.

9.3 The programme committees are responsible for approving the student assessment methodologies as proposed by the module coordinators.

9.4 The Examination Board annually approves the planned examinations of the taught modules, and later deviations from that plan, as described in the module sheets and proposed by the programme committees.

9.5 All written examinations have to be peer reviewed, before being used.

9.6 The programme or specialisation coordinators are responsible for checking the module examination for clarity, completeness and consistency.

Article 10 Periods and frequency of examinations

10.1 Sequence of the module assessments will take place according to the order as described the programme handbook.

10.2 Students can sit each module assessment only two times per academic year.

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

10.4 Written and oral examinations for short and online course participants are held immediately at the end of the module. When a module is not immediately followed by an examination week, separate examinations will be drafted by the examiners for these participants.

10.5 In case of an oral and written examination for an online course, the student has to provide proof of identity to the examiner.

10.6 Students are not allowed to re-sit (constituent parts of) module assessments for which a pass has been obtained.

10.7 Written and oral re-examinations take place during the next examination period as 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.

10.8 Students are not allowed to sit for further module assessments during the programme period they are registered for, if they failed three (3) different module re-examinations for the first 13 modules of the programme.

Article 11 The nature of the examinations

11.1 A module is assessed through (a combination of) written and/or oral examinations, assignments and presentations as described in the module descriptions of the programme handbook.

11.2 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 is allowed, provided that all examination work of the first part(s) is collected by the invigilators.

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

11.4 Students have to be seated in 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.

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

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

11.7 Re-examination proceeds by re-examining one or more failed constituent module examination parts as described in the assessment part of the module sheet, as would be necessary to achieve a successful examination result.

11.8 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.

11.9 MSc thesis proposal examination.
The MSc thesis proposal examination is an oral examination, organised during the week following module 14. The examination consists of a presentation of the proposal, and a discussion with the examining committee. The committee consists of the supervisor and the mentor of the student.

Article 12 Oral examinations

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

12.2 Oral examinations are non-public, unless stated otherwise in the module sheet.

Article 13 Exemptions and transfer of credit points

13.1 Exemptions to sit module assessments 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.

13.2 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 14 Absence from examinations

14.1 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 personal circumstances beyond control of the student which should be supported by written evidence as far as possible.

14.2 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.

14.3 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 15 Fraud

15.1 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.

15.2 Plagiarism is a serious act of fraud.

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

15.4 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.

4 Results of Examinations

Article 16 Assessment and notice of examination results

16.1 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 pass.
The following grading scale is used:

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

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

16.3 The mark for a module assessment 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. The minimum grade for each of the constituent parts should be 5.0.

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

16.5 The examiner shall assess a written examination or assignment within a period of 14 days after the date of the examination.

16.6 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.

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

16.8 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

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

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

Article 17 Period of validity

17.1 The result of a module assessment, when successful, is valid for an unlimited period of time.

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

Article 18 Right to inspection of assessments

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

18.2 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.

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

Article 19 Study progress and study advice

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

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

5 Thesis Examination

Article 20 Organisation of thesis examination

20.1 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 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.

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

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

20.4 Students can sit the thesis examination only if all other module assessments of the programme have been successfully completed.

20.5 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.

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

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

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

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

20.10 The maximum duration of the MSc research phase is 6 months for a full time study. In case of force majeure as supported by proving documents, 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.

6 Assessment criteria, degrees and certificates

Article 21 Assessment of the programme

21.1 The student has fulfilled the requirements for the programme assessment if (s)he has:

SINGLE DEGREES:

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

JOINT DEGREES:

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

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

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

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

DOUBLE / MULTIPLE DEGREES:

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

- For the double degree programmes in Water Supply Engineering, Sanitary Engineering, and Environmental Science and Technology conducted with Universidad del Valle:
  - Obtained a GPA of 3.5 or higher for the course work done at Univalle; and
  - Successfully completed all module assessments at UNESCO-IHE; and
  - Achieved a pass for the thesis examination; and

- Obtained a minimum of 113,36 ECTS.

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

- For the double degree programme in Land and Water development, conducted with Sriwijaija University:
  - Successfully completed all module assessments of the programme; and
  - Obtained a minimum of 106 ECTS.

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

DOUBLE / MULTIPLE DEGREES (Erasmus Mundus programmes):

- For the multiple degree programme on Flood Risk Management:
  - Successfully completed all assessments 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 multiple degree programme in Ecohydrology:
  - Successfully completed all assessments 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.

21.2 The student has fulfilled the requirements for the short or online course examination if he/she successfully completed the assessment of the course, i.e. the outcome of the assessment is a pass.

21.3 The student has successfully completed the programme examination or short / online course examination when the examination board takes a decision to that effect.

Article 22 Awarding of degrees and certificates

22.1 Master of Science degree.
Students who have successfully completed the programme assessment will be awarded the Master of Science degree at the next scheduled degree awarding ceremony. The degree is signed by the Chairman of the Examination Board, the Rector of the Institute and the Academic Registrar. In addition to the degree certificate, the

graduate receives a degree supplement stating the results achieved and credit points for each component of the programme.

22.2 Certificate.
Students who have successfully completed the short or online course assessment will be awarded a Certificate. The Certificate is signed by the Rector of the Institute, the Course coordinator and the Academic Registrar. In addition to this Certificate the graduate receives a supplement stating the result achieved and credit points.

22.3 Students who fail to meet the master programme assessment 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.

22.4 If a student within 4 years after termination re-registers and meets (after examination(s)) the requirements of a MSc degree, he /she is obliged to return the certificate as mentioned under art 26.1.

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

22.6 With reference to art 26.1, if a student re-registers within 4 years with the aim to obtain a MSc degree, he has to redo in full all failed and missed modules and to take part in all examinations and re-examinations. Re-registration is only possible for the next academic period.

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

Article 23 Criteria for MSc degree with distinction

23.1 The Master of Science degree can be awarded with distinction by the Examination Board if:

For single degree programmes:
- the candidate obtained a mark of 8.5 or higher for the thesis examination, and an arithmetic average mark at UNESCO-IHE of 8.0 or higher for all module assessments that are assessed on a numerical scale, conform article 2.1., and
- a recommendation of the chair of the examining committee.

For double / multiple degree programmes where student sits for the thesis examination at UNESCO-IHE:
- the candidate obtained a mark of 8.5 or higher for the thesis examination, and

- an arithmetic average mark at UNESCO-IHE of 8.0 or higher for all module assessments that are assessed on a numerical scale, conform article 2.1.
- and a recommendation of the chair of the examining committee.

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

For double / multiple degree programmes where student sits for the thesis examination at a partner institute:

- the candidate obtained an arithmetic average mark at UNESCO-IHE of 8.0 or higher for all module assessments that are assessed on a numerical scale, conform article 2.1.
- and a recommendation from the professor responsible for the specialisation concerned.

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

7 Appeals

Article 24 Grounds for appeal

24.1 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.
   e. a serious non-solved conflict has arisen between the supervisor and /or the mentor.

Article 25 Procedure for appeal

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

25.2 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.

25.3 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.

8 Final Articles

Article 26 Amendments

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

26.2 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 27 Unforeseen situations

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

Article 28 Publication

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

Article 29 Period of application

29.1 These regulations take effect for the cohort 2014– 2016. Approved by the Academic Board of UNESCO-IHE on 25 September 2014.

Appendix A Qualifications of Graduates

1. Urban Water and Sanitation Programme

1.1 Sanitary Engineering

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

Knowledge and 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.

1.2 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 distribution processes 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.

1.3 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.

2. Environmental Science Programme

2.1 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.

2.2 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.

2.3 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.

3. Water Management Programme

3.1 Water 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 management at various spatial and temporal scales

Methods, techniques & tools

5. 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.

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

Analysis, synthesis & integration

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

Research

8. 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

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

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

11. 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.

Two or more additional learning objectives will be added depending on the study profile of the student.

3.2 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.

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

2. Have the academic attitude and learning skills to enhance and keep up-to-date the acquired knowledge and application skills in a largely independent manner.

3.3 Water Conflict Management

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

Knowledge & 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.

3.4 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

3.5 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.

4. Water Science and Engineering Programme

4.1 Hydraulic Engineering and River Basin Development

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

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.

4.2 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.

4.3 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.

4.4 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.

4.5 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.

4.6 Integrated River,Lowland and Coastal Development and Management Planning (joint specialization with Sriwijaija University)

After successful completion of the programme graduates will :

1. Have in-depth understanding and specific knowledge of the current concepts and theories to support a sustainable hydraulic development of integrated river, lowland and coastal with different types of land use;
2. Have in-depth understanding and specific knowledge of the multi-disciplinary involvement in the integrated river, lowland and coastal sector with the wider aspects of society, economy and the environment;
3. Depending on their chosen specialization, master the respective major different hydraulic and environmental engineering aspects and methodologies;
4. Be able to contribute to the planning, design, development and implementation (action plan for the realisation) of the hydraulic infrastructure for integrated river, lowland and coastal development and management schemes. Depending on their chosen specialization it can be river, coastal or irrigation infrastructure;
5. Have knowledge of contemporary research questions and the relevant literature in the field of integrated river lowland and coastal development;
6. Be able to advise developers, system managers and water users on the operation and maintenance aspects of the water management and river or sea flood protection schemes in the lowland;
7. Be able to formulate and conduct hydraulic and environmental engineering research, plan development and designs in the field of integrated river lowland and coastal development, experiments and tests for both practical and scientific purposes, either independently or within a team-based framework;
8. 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;
9. 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;
10. Be able to formulate and evaluate a concept with its alternatives for integrated river lowland and coastal 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 development and/or management plans;

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

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

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

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.

4.8 Learning objectives of the Advanced Water Management for Food Production Programspecializations, (joint specialisation with Nebraska)

Upon completion of the Advanced Water Management for Food Production Program specializations, the graduates should:

1. have in-depth understanding and specific knowledge of the latest concepts and theories of irrigation, drainage, flood protection, land reclamation and consolidation technologies for food production;

2. the cross-sectoral linkages comprehending wider aspects of society, economy and the environment;

3. 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;

4. be able to identify and cross-evaluate alternative land and water development options for areas under different land uses and assess their feasibility; technologically, economically, and environmentally;

5. be able to engage in or advise developers, system managers and water users on the participatory development and management, including operation and maintenance of the irrigation, drainage and flood protection schemes;

6. to be able to identify and develop available water resources for food production;

7. to be able to enhance the of on-farm irrigation systems through better design and management;

8. understand and formulate water management methodologies to enhance crop production with limited water supplies;

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

10. be able to formulate research questions, articulate research methodologies, develop study plans, and adequately communicate research results and conclusions in written and oral forms to a wide variety of audience.

4.9 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.

4.10 Flood Risk management

After successful completion of the programme graduates will have:

1. a broad and cross-boundary scientific knowledge on flood risk management;
2. a comprehensive knowledge base and understanding of the current theory and practice relating to flooding and flood management;
3. the fundamental knowledge leading to the understanding of socio-economic issue related to flooding;
4. a broad scientific knowledge about conservation, restoration and management measures to overcome challenges imposed on water by humans and by climate change, and;
5. an extended knowledge on a basin-wide approach to flood risk management.

The acquired competencies (application of knowledge) include the ability to:

1. analyse the reciprocal relationships between the physical system, the institutional framework and the socio-economic environment, identifying future social and climatic pressures and needs and the consequent trends in system management;
2. apply specific practical skills, such as identifying the major physical processes in a given river basin or coastal zone and their interaction with the associated assets and receptors;
3. identify the links between all issues related to flooding in order to apply an integrated approach using the best tools to support decision making for the sustainable management of floods;
4. review scientific literature and carry out independent research (such as writing a state of the art paper based on research and practice literature);
5. apply sophisticated hydroinformatics and modelling tools and best practices to address the problems of flood risk management;
6. occupy an independent and responsible position as a flood risk professional;
7. communicate his/her knowledge and research results to the scientific and non-scientific communities (such as presenting papers/posters to scientific congresses, general lectures to policy makers and interested non-specialists);
8. acquire independently further knowledge and techniques, and
9. operate in a team.

Appendix B Examination Procedures

GENERAL RULES

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

WRITTEN EXAMINATIONS

PROCESS:

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

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

Communication: During the examination, students are not allowed to exchange materials or to communicate with other students. If something is unclear, students have to inform the invigilator, who will contact the programme coordinator, the examiner or 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 display their student card on their table.

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

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

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

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

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

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

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

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

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

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

ASSIGNMENT REPORTS AND INDIVIDUAL DISCUSSIONS

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

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

THESIS PROPOSAL

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.

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

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

Appendix D MSc modules: names, credits & assessment methods

1. Urban Water and Sanitation programme

Water supply engineering

Code	Module Name	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)
UWS/01	Hydrology, Water supply and water demand management and GI	5	75		25			
UWS/02	Chemistry and public health	5	30+65		35			
UWS/03	EPT, Microbiology and Integrated Urban Water	5	70		30			
UWS/WSE/04	Surface water treatment I	5	60		20		20	
UWS/WSE/05	Surface water treatment II	5	80				20	
UWS/WSE/06	Groundwater treatment and resources	5	70		15		15	
UWS/WSE/UWEM/07	Water transport and distribution	5	60		40			
UWS/WSE/08	Advanced water treatment and reuse	5	70		20		10	
UWS/09	International fieldtrip and fieldwork	5			100			
UWS/SE/UWEM/10	Industrial effluents treatment and residuals	5	60		25			15
WSE/HI/10b/e	Urban water systems	5	40		60			
UWS/WSE/UWEM/10	Water treatment processes and plants	5	60		40			
UWS/SE/11	Faecal sludge management	5	85		15			
UWS/WSE/11a	Advanced water transport and distribution	5	60		40			
UWS/WSE/11b	Decentralised water supply and sanitation	5	60		30	10		
UWS/12	Summer courses	1						
UWS/13	Groupwork Sint Maarten	5			80	20		
UWS/14	MSc research methodology and proposal development	9		100				
UWS/15	MSc thesis research and thesis writing	36		100				

Sanitary engineering

Code	Module Name	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)
UWS/01	Hydrology, Water supply and water demand management and GI	5	75		25			
UWS/02	Chemistry and public health	5	65		35			
UWS/03	EPT, Microbiology and Integrated Urban Water	5	70		30			
UWS/SE/UWEM/04	Urban drainage and sewerage	5	60		40			
UWS/SE/05	Conventional wastewater treatment	5	80		20			
UWS/SE/06	Resource oriented wastewater treatment and sanitation	5	80		20			
UWS/SE/07	Wastewater treatment plants design and engineering	5	50	25	25			
UWS/SE/08	Modelling of wastewater treatment processes and plants	5	60		40			
UWS/09	International fieldtrip and fieldwork	5			100			
UWS/SE/UWEM/10	Industrial effluents treatment and residuals	5	60		25			15
WSE/HI/10b/e	Urban water systems	5	40		60			
UWS/WSE/UWEM/10	Water treatment processes and plants	5	60		40			
UWS/SE/11	Faecal sludge management	5	85		15			
UWS/WSE/11a	Advanced water transport and distribution	5	60		40			
UWS/WSE/11b	Decentralised water supply and sanitation	5	60		30	10		
UWS/12	Summer courses	1						
UWS/13	Groupwork Sint Maarten	5			80	20		
UWS/14	MSc research methodology and proposal development	9		100				
UWS/15	MSc thesis research and thesis writing	36		100				

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

Location	Code		ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)
KNUST	KN1	Module (KN) 1 Introduction to Environmental Sanitation	5	70		30			
	KN2	Module (KN) 2 Mathematical and research methods	4	70		30			
	KN3	Module (KN) 3 Environmental science and process technology	6	70		30			
	KN4	Module (KN) 4 Environmental quality	3	70		30			
	KN5	Module (KN) 5 water supply	2	70		30			
U-IHE	UWS/SE/06	Resource oriented wastewater treatment and sanitation	5	80		20			
	UWS/SE/07	Wastewater treatment plants design and engineering	5	50	25	25			
	UWS/SE/08	Modelling of wastewater treatment processes and plants	5	60		40			
	OR								
	UWS/WSE/06	Groundwater treatment and resources	5	70		15		15	
	UWS/WSE/UWEM/07	Water transport and distribution	5	60		40			
	UWS/WSE/08	Advanced water treatment and reuse	5	70		20		10	
	UWS/09	International fieldtrip and fieldwork	5			100			
	UWS/SE/UWEM/10	Industrial effluents treatment and residuals	5	60		25			15
	WSE/HI/10b/e	Urban water systems	5	40		60			
	UWS/WSE/UWEM/10	Water treatment processes and plants	5	60		40			
	UWS/SE/11	Faecal sludge management	5	85		15			
	UWS/WSE/11a	Advanced water transport and distribution	5	60		40			
	UWS/WSE/11b	Decentralised water supply and sanitation	5	60		30	10		
	UWS/12	Summer courses	1						
	UWS/13	Groupwork Sint Maarten	5			80	20		
	UWS/14	MSc research methodology and proposal development	9		100				
U-IHE / KI	UWS/15	MSc thesis research and thesis writing	36		100				

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

Location	Code	Module Name	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)
Univalle	C1	C1 Chemistry of Environmental Pollution	5,13	50		20		30	
	C2	C2 Environmental Pollution Microbiology	5,13	x		x	x	x	
	C3	C3 Fundamentals of Environmental Processes	5,13	60		20		20	20
	C4	C4 Environmental and Development	5,13	35		30	35		
	C5	C5 Engineering Research Introduction	3,42			100		20	
U-IHE	UWS/WSE/04	Surface water treatment I	5	60		20		20	
	UWS/WSE/05	Surface water treatment II	5	80				20	
	UWS/WSE/06	Groundwater treatment and resources	5	70		15		15	
	UWS/WSE/UWEM/07	Water transport and distribution	5	60		40			
	UWS/WSE/08	Advanced water treatment and reuse	5	70		20		10	
	UWS/SE/UWEM/04	Urban drainage and sewerage	5	60		40			
	UWS/SE/05	Conventional wastewater treatment	5	85		15			
	UWS/SE/06	Resource oriented wastewater treatment and sanitation	5	80		20			
	UWS/SE/07	Wastewater treatment plants design and engineering	5	50	25	25			
	UWS/SE/08	Modelling of wastewater treatment processes and plants	5	60		40			
	UWS/09	International fieldtrip and fieldwork	5			100			
	UWS/SE/UWEM/10	Industrial effluents treatment and residuals	5	60		25			15
	WSE/HI/10b/e	Urban water systems	5	40		60			
	UWS/WSE/UWEM/10	Water treatment processes and plants	5	60		40			
	UWS/SE/11	Faecal sludge management	5	85		15			
	UWS/WSE/11a	Advanced water transport and distribution	5	60		40			
	UWS/WSE/11b	Decentralised water supply and sanitation	5	60		30	10		
	UWS/12	Summer courses	1						
	UWS/13	Groupwork Sint Maarten	5			80	20		
Univalle	C9	Engineering research I (4 UVC)	6,84						
	C10	Engineering Research II (8 UVC)	13,68						
		MSc thesis (14 UVC)	23,94						

The programme components, credits, and the nature of the examinations in the specialisation **Urban Water Engineering and Management** with **AIT** are:

Location	Code	Module Name	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)
AIT		Watershed hydrology	3 (7.5)	x		x			
		Drinking water treatment	3 (7.5)	x					
		Wastewater treatment	3 (7.5)	x		x			
		Integrated water resources management	3 (7.5)	x		x			
U-IHE	UWS/SE/UWEM/04	Urban drainage and sewerage	2 (5.0)	60		40			
	UWS/UWEM/05	Asset management	2 (5.0)		60	40			
	WSM/06	Managing water organisations	2 (5.0)			100			
	UWS/WSE/UWEM/07	Water transport and distribution	2 (5.0)	60		40			
	WSE/HI/08B/E	Urban flood management and disaster risk mitigation	2 (5.0)	40		60			
	UWS/09	International fieldtrip and fieldwork	2 (5.0)			100			
	UWS/SE/UWEM/10	Industrial effluents treatment and residuals	2 (5.0)	60		25			15
	WSE/HI/10b/e	Urban water systems	2 (5.0)	40		60			
	UWS/WSE/UWEM/10	Water treatment processes and plants	2 (5.0)	60		40			
		Total coursework	26 (65)						
	UWS/UWEM/11	MSc thesis proposal preparation	2.8 (7.0)			x	x		
AIT		MSc thesis work	19.2 (48)			x	x		
		Grand total (coursework + thesis)	48 (120)						

2. Environmental Science programme

Environmental Science and Technology

Code	Module Name	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
ES0123	Week 1 + Introduction to environmental science	15	70		30				
ES04	Integrated project environmental science	5	70		30				
ES05T	Industrial Resource Management & Cleaner Production	5	60		35	5			
ES06TM	Environmental systems analysis	5	40		40	20			
ES07T	Environmental engineering	5	50		25 +25				
ES08T	Environmental monitoring and modelling	5	70		15		15		
ES09TMW	Foreign fieldtrip and fieldwork ES	5			50	50			
ES10TWL	Aquatic ecosystems: processes and applications	5			80+10	10			
	Electives:								
ES11T	Solid waste management	5	60		35	5			
ES11MW	Watershed and river basin management	5	70		30				
ES11X	IWRM as a tool for adaptation to climate change	5	70		30				
ES11L	Wetlands for livelihoods and conservation	5	40		40	20			
ES12	Summer courses	1			100				
ES13TMW	Groupwork ES	5			100				
ES14	MSc research methodology and proposal development	9			100				
ES15	MSc research	36			100				

Environmental Policy Making

Code	Module Name	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
ES0123	Week 1 + Introduction to environmental science	15	70		30				
ES04	Integrated project environmental science	5	70		30				
WM05	Water and environmental law	5							
ES06TM	Environmental systems analysis	5	40		40	20			
ES07M	Water and environmental policy making	5	70		30				
ES08MW	Environmental planning and implementation	5	55		30+15				
ES09TMW	Foreign fieldtrip and fieldwork ES	5			50	50			100
ES10M	Environmental assessment for water related policies and develo	5	70		30				
	Electives:								
ES11T	Solid waste management	5	60		35	5			
ES11MW	MW: Watershed and river basin management	5	70		30				
ES11X	IWRM as a tool for adaptation to climate change	5	70		30				
ES11LM	Wetlands for livelihoods and conservation	5	40		40	20			
ES12	Summer courses	1			100				
ES13TMW	Groupwork ES	5			100				
ES14	MSc research methodology and proposal development	9			100				
ES15	MSc research	36			100				

Water Quality Management

Code	Module Name	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
ES0123	Week 1 + Introduction to environmental science	15	70		30				
ES04	Integrated project environmental science	5	70		30				
WM05	Water and environmental law	5	60		40				
ES06W	Water quality assessment	5	60		15+15		10		
ES07W	Wetlands for water quality	5	60		40				
ES08MW	Environmental planning and implementation	5	55		30+15				
ES09TMW	Foreign fieldtrip and fieldwork ES	5			50	50			100
ES10TWL	Aquatic ecosystems: processes and applications	5			80+10	10			
	Electives:								
ES11T	Solid waste management	5	60		35	5			
ES11MW	Watershed and river basin management	5	70		30				
ES11X	IWRM as a tool for adaptation to climate change	5	70		30				
ES11L	Wetlands for livelihoods and conservation	5	40		40	20			
ES12	Summer courses	1			100				
ES13TMW	Groupwork ES	5			100				
ES14	MSc research methodology and proposal development	9			100				
ES15	MSc research	36			100				

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

Location	Code	Module Name	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
Univalle	C1	C1 Chemistry of Environmental Pollution	5,13	50		20		30		
	C2	C2 Environmental Pollution Microbiology	5,13	x		x	x	x		
	C3	C3 Fundamentals of Environmental Processes	5,13	60		20		20	20	
	C4	C4 Environmental and Development	5,13	35		30	35			
	C5	C5 Engineering Research Introduction	3,42			100		20		
U-IHE	ES04	Integrated project environmental science	5	70		30				
	ES05T	Industrial Resource Management & Cleaner Production	5	60		35	5			
	ES06TM	Environmental systems analysis	5	40		40	20			
	ES07T	Environmental engineering	5	50		25 +25				
	ES08T	Environmental monitoring and modelling	5	70		15		15		
	ES09TMW	Foreign fieldtrip and fieldwork ES	5			50	50			100
	ES10TWL	Aquatic ecosystems: processes and applications	5			80+10	10			
		Electives:								
	ES11T	Solid waste management	5	60		35	5			
	ES11MW	Watershed and river basin management	5	70		30				
	ES11X	IWRM as a tool for adaptation to climate change	5	70		30				
	ES11L	Wetlands for livelihoods and conservation	5	40		40	20			
	ES12	Summer courses	5			100				
	ES13TMW	Groupwork ES	5			100				
Univalle		MSc thesis (14 UVC)	23,94							

The programme components, credits, and the nature of the examinations in the specialisation **Environmental Technology for Sustainable Development** with **AIT** are:

Location	Code	Module Name	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
AIT		Environmental chemistry and laboratory	3 (7.5)	x		x				
		Environmental quality management	3 (7.5)	x		x				
		Any two course out of:								
		- Air pollution and management	6 (15.0)	x		x				
		- Solid waste management								
		- Environmental impact assessment								
		- Industrial waste abatement and management								
U-IHE	ES05T	Industrial Resource Management & Cleaner Production	2 (5.0)	60		35	5			
	ES06TM	Environmental systems analysis	2 (5.0)	40		40	20			
	ES07W	Wetlands for water quality	2 (5.0)	60		40				
	ES08T	Environmental monitoring and modelling	2 (5.0)	70		15		15		
	ES09TMW	Foreign fieldtrip and fieldwork ES	5			50	50			100
	ES10TWL	Aquatic ecosystems: processes and applications	2 (5.0)			80+10	10			
	ES11ETSuD	MSc research proposal development	2.8 (7.0)				100			
	ES12	Summer courses	2 (5.0)			100				
		Total coursework	26 (65)							
AIT		Elective	2 (5.0)	x		x				
		MSc thesis proposal preparation	2.8 (7.0)			x	x			
		MSc thesis work	19.2 (48)			x	x			
		Grand total (coursework + thesis)	50 (125)							

The programme components, credits, and the nature of the examinations in the specialisation **Environmental Technology and Engineering** with **Prague and Ghent** are:

1 General Courses		**71**	**ECTS**
U-IHE	I002048	Introduction in Environmental Science I [en]	5
	I002049	Introduction to Environmental Science II [en]	5
	I002050	Introduction to Environmental Science III [en]	5
	I002051	Integrated Project Environmental Science [en]	5
Prague	I001978	Environmental Microbiology [en]	4
	I001977	Environmental Engineering [en]	4
	I001856	Wastewater Treatment [en]	5
	I001857	Sludge Management [en]	2
	I001976	Atmosphere Protection Technology [en]	3
	I001859	Waste Management and Treatment [en]	4
	I001860	Elective Project [en]	5
	I001980	Laboratory Training in Environmental Technology [en]	3
Ghent	I001861	Scientific Skills [en]	6
	I001512	Clean Technology [en]	3
	I001862	Environmental Fate and Management of Heavy Metals and Metalloi	5
	I001873	Microbial Re-use Technology [en]	3
	I001863	Summer School Environmental Technology and Engineering [en]	4

2 Elective Courses		**19**	**ECTS**
U-IHE	I001865	Basic Dutch for Foreigners [en]	2.0
Prague	I001864	Basics of Czech [en]	2.0
Ghent	I000675	Advanced Waste Gas Treatment [en]	3.0
	I001368	Applied Isotopes [en]	5.0
	I001549	Applied Statistics [en]	5.0
	I001974	Ecological Risk Assessment [en]	7.0
	I001522	Environmental Constructions [en]	5.0
	I001349	Environmental Ecology [en]	7.0
	I001439	Environmental Noise [en]	3.0
	I000256	Geostatistics [en]	5.0
	I000260	Life Cycle Assessment [en]	3.0
	I001554	Membrane Processes in Environmental Technology [en]	3.0
	I001755	Modeling and Control of Waste Water Treatment Plants [en]	3.0
	I001563	Quality of Groundwater Resources [en]	5.0
	I001872	Soil Degradation [en]	3.0
	I000846	Soil Water Management [en]	3.0
	I000447	Urban and Indoor Air Pollution [en]	5.0
	I001979	Internship [en]	6.0
	I001571	Environmental Legislation [en]	3.0
	I001973	Basics of Control Engineering and Process Engineering [en]	4.0
U-IHE	I001867	Cleaner Production and the Water Cycle [en]	5.0
	I001868	Constructed Wetlands for Wastewater Treatment [en]	5.0
	I001869	Ecological Sanitation [en]	5.0
	I001981	Modelling Sanitation Systems [en]	5.0
3 Master Dissertation			**30.0**

The programme components, credits, and the nature of the examinations in the specialisation **Limnology and Water Management** with **Boku and Egerton** are:

Code	Module Name	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab report (%)	Home work (%)	Integrated in modules (%)
LWM1	Basics in Limnology	9							
LWM2	Ecology of Aquatic Organisms	6							
LWM3	Basics in Applied Limnology	6							
LWM4	Aquatic Ecosystem Management	4							
LWM5	Scientific Working	3							
ES05bL	Lake Ecology	5,6	60		10	20	10		
ES06L	Stream & River Ecology	5,6	60			20	20		
ES07L	Tropical wetlands for Water Quality	5,6	60		10	20			10
ES08L	Fisheries & Aquaculture	5,6	60			20			10+10
ES09L	Data Analysis and Modeling for Aquatic Ecosystems	5,6	40		40	20			
ES10TWL	Aquatic Ecosystems: Processes and Applications	5,6			80+10	10			
ES11LM	Wetlands for livelihoods and conservation	5	40		40	20			
ES12	Summer courses	1			100				
ES13TMW	Group-work	5,6			100				
ES14	MSc research methodology and proposal development	9			100				
ES 15	LWM15: Research plan, logistics, site assessment, application & s	13,4							
	MSc-Thesis								
	LWM16: M.Sc. Research and Thesis writing	30							
	TOTAL	120							

3. Water Science and Engineering programme

River Basin Development

Code	Module Name	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
WSE/01/c	Week 1 + Introduction to Water Science and Engineering	5	25+25+10		20 (x2)				
WSE/02/c	Hydrology and hydraulics	5	35 (x2)		30				
WSE/RBD/03/s	River basin hydraulics, geotechnics and remote sensing	5	25+25+25		25				
WSE/RBD/04/s	River morphodynamics	5	80		20				
WSE/RBD/05s	Data collection and analysis	5	40+20		20+20				
WSE/RBD/06/s	River Basin Development and EIA	5	40+20		10+10+20				
WSE/RBD/07/s	River structures	5		100					
WSE/RBD/08A/e	River training and rehabilitation	5	80		20				
WSE/09/c	Fieldtrip and fieldwork WSE	5						100	
WSE/RBD/10/e	Storage and hydropower	5	45+45		10				
WSE/RBD/11/e	Modelling and operation of river systems	5	30+30		40				
WSE/12/C	Summer courses / research methodology for WSE	1			100				
WSE/13/c	Groupwork WSE	5				100			
WSE/14/c	MSc research proposal development for WSE	9			100				
WSE/15	MSc research	36			100				

Coastal Engineering and Port Development

Code	Module Name	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
WSE/01/c	Week 1 + Introduction to Water Science and Engineering	5	25+25+10		20 (x2)				
WSE/02/c	Hydrology and hydraulics	5	35 (x2)		30				
WSE/CEPD/03/s	Introduction to coastal science and engineering	5	10	50+30	10				
WSE/CEPD/04s	Coastal systems	5	60	20	20				
WSE/CEPD/05/s	Port planning and infrastructure design	5			30+70				
WSE/CEPD/06/s	Coastal and port structures	5			100				
WSE/CEPD/07/s	Environmental aspects of coasts and ports	5	15+15+15+15		40				
WSE/CEPD/08A/e	Management of coasts and ports (International Port Seminar)	5				100			
WSE/CEPD/08B/e	Management of coasts and ports (ICZM)	5		100					
WSE/09/c	Fieldtrip and fieldwork WSE	5						100	
WSE/CEPD/10/e	Geotechnical engineering and dredging	5		60	40				
WSE/CEPD/11/e	Flood protection in lowland areas	5	20	40	40				
WSE/12/C	Summer courses / research methodology for WSE	1			100				
WSE/13/c	Groupwork WSE	5				100			
WSE/14/c	MSc research proposal development for WSE	9			100				
WSE/15	MSc research	36			100				

Land and Water Development

Code	Module Name	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
WSE/01/c	Week 1 + Introduction to Water Science and Engineering	5	25+25+10		20 (x2)				
WSE/02/c	Hydrology and hydraulics	5	35 (x2)		30				
WSE/LWD/03/s	Principles and practices of land and water development	5		15	70 + 15				
WSE/LWD/04/s	Design aspects of irrigation and drainage systems	5	30		20+25+25				
WSE/LWD/05s	Water management systems and agronomy	5	35		10+30+25				
WSE/LWD/06/s	Socio-economic and environmental aspects of irrigation and drai	5			25+20+30+25				
WSE/LWD/07/s	Service oriented management of irrigation systems	5		40	35+25				
WSE/LWD/08/e	Conveyance systems	5	30		15+30+25				
WSE/09/c	Fieldtrip and fieldwork WSE	5						100	
WSE/LWD/10/e	Irrigation and drainage structures	5			45+30+25				
WSE/LWD/11/e	Innovative approaches and practices	5			40+60				
WSE/12/C	Summer courses / research methodology for WSE	1			100				
WSE/13/c	Groupwork WSE	5				100			
WSE/14/c	MSc research proposal development for WSE	9			100				
WSE/15	MSc research	36			100				

Hydroinformatics

Code	Module Name	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
WSE/01/c	Week 1 + Introduction to Water Science and Engineering	5	25+25+10		20 (x2)				
WSE/02/c	Hydrology and hydraulics	5	35 (x2)		30				
WSE/HI/03/s	Hydroinformatics: modelling and information systems for water	5	40		15+15+30				
WSE/HI/04/s	Modelling theory and Computational Hydraulics	5	25+25+30		20				
WSE/HI/05s	Modelling and information systems development	5	20		30+20+30				
WSE/HI/06/s	Computational Intelligence and Operational water management	5	25+30		10+15+20				
WSE/HI/07/s	River basin modelling	5	100						
WSE/HI/08A/e	River Flood Analysis and Modelling	5	50		25+25				
WSE/HI/08B/e	Urban flood management and disaster risk mitigation	5	40		60				
WSE/09/c	Fieldtrip and fieldwork WSE	5						100	
WSE/HI/10A/e	Flood risk management	5	60		40				
WSE/HI/10B/e	Urban water systems	5	40		30+30				
WSE/HI/11/e	Hydroinformatics for decision support	5			40+30+30				
WSE/12/C	Summer courses / research methodology for WSE	1			100				
WSE/13/c	Groupwork WSE	5				100			
WSE/14/c	MSc research proposal development for WSE	9			100				
WSE/15	MSc research	36			100				

Hydrology and Water Resources

Code	Module Name	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
WSE/01/c	Week 1 + Introduction to Water Science and Engineering	5	25+25+10		20 (x2)				
WSE/02/c	Hydrology and hydraulics	5	35 (x2)		30				
WSE/HWR/03/s	Hydrogeology	5	25+25+20		10+10+10				
WSE/HWR/04/s	Surface hydrology	5	70		30				
WSE/HWR/05/s	Water quality	5	50+25		25				
WSE/HWR/06/s	Tracer hydrology and flow systems analysis	5	50+50						
WSE/HWR/07A/s	Hydrological data collection and processing	5	60				40		
WSE/HWR/07B/s	Groundwater data collection and interpretation	5	25+35+15		10+15				
WSE/HWR/08/e	Integrated hydrological and river modelling	5			50+35	15			
WSE/09/c	Fieldtrip and fieldwork WSE	5						100	
WSE/HWR/10B/e	Applied groundwater modelling	5			70+30				
WSE/11	Water resilient cities	5		50		50			
WSE/12/C	Summer courses / research methodology for WSE	1			100				
WSE/13/c	Groupwork WSE	5				100			
WSE/14/c	MSc research proposal development for WSE	9			100				
WSE/15	MSc research	36			100				

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

Location	Code	Module Name	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
AIT		Watershed Hydrology	7,5	30+40		30				
		Hydrodynamics	7,5	40+50		10				
		Irrigation and Drainage Engineering	7,5	30+40		30				
		Integrated Water Resources Management	7,5	20+30		50				
U-IHE	WSE/LWD/04/s	Design aspects of irrigation and drainage systems	5	30		20+25+25				
	WSE/LWD/05s	Water management systems and agronomy	5	35		10+30+25				
	WSE/LWD/06/s	Socio-economic and environmental aspects of irrigation and drai	5			25+20+30+25				
	WSE/LWD/07/s	Service oriented management of irrigation systems	5	40		60				
	WSE/LWD/08/e	Conveyance systems	5	30+25		15+30				
	WSE/09/c	Fieldtrip and fieldwork WSE	5						100	
	WSE/LWD/10/e	Irrigation and drainage structures	5			45+30+25				
	WSE/LWD/11/e	Innovative approaches and practices	5			40+60				
	WSE/12/C	Summer courses / research methodology for WSE	1			100				
	WSE/13/c	Groupwork WSE	5				100			
	WSE/14/c	MSc research proposal development for WSE	9			100				
AIT		MSc research work	36							
			121							

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

Location	Code	Module Name	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
Sriwijaija	1	Ecostatistics (PL611)	3							
	2	Lowland environmental science (PL612)	2							
	3	Environmental values & ethics (PL613)	2							
	4	Environmental law (PL614)	2							
	5	Environmental sociology (PL615)	2							
	6	Resource economics (PL626)	2							
	7	Research methods (PL627)	2							
	8	Environmental management system (PL636)	2							
	9	Integrated aspects of lowland management	3							
	10	Managing, organization and change in lowland schemes	3							
	11	Lowland hydrology	2							
	12	Soil and water data collection, monitoring and evaluation	2							
U-IHE	WSE/01/c	Week 1 + Introduction to Water Science and Engineering	5	25+25+10		20 (x2)				
	WSE/02/c	Hydrology and hydraulics	5	35 (x2)		30				
	WSE/LWD/03/s	Principles and practices of land and water development	5		15	70 + 15				
	WSE/LWD/04/s	Design aspects of irrigation and drainage systems	5	30		20+25+25				
	WSE/LWD/05s	Water management systems and agronomy	5	35		10+30+25				
	WSE/LWD/06/s	Socio-economic and environmental aspects of irrigation and drai	5			25+20+30+25				
	WSE/LWD/07/s	Service oriented management of irrigation systems	5	40		60				
	WSE/LWD/08/e	Conveyance systems	5	30+25		15+30				
	WSE/09/c	Fieldtrip and fieldwork WSE	5						100	
Sriwijaija		Fieldtrips	3							
		Groupwork	5							
		MSc thesis work	12							
U-IHE		MSc thesis writing	24				100			

The programme components, credits, and the nature of the examinations in the specialisation **Coastal Engineering and Port Development *with Sriwijajija University*** are:

Location	Code	Module Name	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
Sriwijaija	1	Ecostatistics (PL611)	3							
	2	Lowland environmental science (PL612)	2							
	3	Environmental values & ethics (PL613)	2							
	4	Environmental law (PL614)	2							
	5	Environmental sociology (PL615)	2							
	6	Resource economics (PL626)	2							
	7	Research methods (PL627)	2							
	8	Environmental management system (PL636)	2							
	9	Integrated aspects of lowland management	3							
	10	Managing, organization and change in lowland schemes	3							
	11	Lowland hydrology	2							
	12	Soil and water data collection, monitoring and evaluation	2							
U-IHE	WSE/CEPD/03/s	Introduction to coastal science and engineering	5	10	50+30	10				
	WSE/CEPD/04s	Coastal systems	5	60	20	20				
	WSE/CEPD/05/s	Port planning and infrastructure design	5			30+70				
	WSE/CEPD/06/s	Coastal and port structures	5			100				
	WSE/CEPD/07/s	Environmental aspects of coasts and ports	5	15+15+15+15		40				
	WSE/CEPD/08B/e	Management of coasts and ports (ICZM)	5		100					
	WSE/09/c	Fieldtrip and fieldwork WSE	5						100	
Sriwijaija		Fieldtrips	3							
		Groupwork	5							
		MSc thesis work	12							
U-IHE		MSc thesis writing	24				100			

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

Location	Code	Module Name	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
Sriwijaija	1	Ecostatistics (PL611)	3							
	2	Lowland environmental science (PL612)	2							
	3	Environmental values & ethics (PL613)	2							
	4	Environmental law (PL614)	2							
	5	Environmental sociology (PL615)	2							
	6	Resource economics (PL626)	2							
	7	Research methods (PL627)	2							
	8	Environmental management system (PL636)	2							
	9	Integrated aspects of lowland management	3							
	10	Managing, organization and change in lowland schemes	3							
	11	Lowland hydrology	2							
	12	Soil and water data collection, monitoring and evaluation	2							
U-IHE	WSE/RBD/03/s	River basin hydraulics, geotechnics and remote sensing	5	25+25+25		25				
	WSE/RBD/04/s	River morphodynamics	5	80		20				
	WSE/RBD/05s	Data collection and analysis	5	40+20		20+20				
	WSE/RBD/06/s	River Basin Development and EIA	5	40+20		10+10+20				
	WSE/RBD/07/s	River structures	5		100					
	WSE/RBD/08A/e	River training and rehabilitation	5	80		20				
	WSE/09/c	Fieldtrip and fieldwork WSE	5						100	
Sriwijaija		Fieldtrips	3							
		Groupwork	5							
		MSc thesis work	12							
U-IHE		MSc thesis writing	24				100			

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

Location	Code	Module Name	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
TU-Dresden		Flood Risk Management I	10	50		30 +20				
		Flood Risk Management II								
		Meteorology and Hydrology	5	100						
		GIS and Remote Sensing								
		Climate change	5	50			50			
		Hydraulic Engineering	5	100						
		Hydromechanics								
		Ecology	5	75			25			
		Statistics	5	100						
		Geodesy		100						
U-IHE	WSE/HI/06/s	Computational Intelligence and Operational water management	5	25+30		10+15+20				
	WSE/HI/07/s	River basin modelling	5	100						
	WSE/HI/08A/e	River Flood Analysis and Modelling	5	50		25+25				
	WSE/HI/08B/e	Urban flood management and disaster risk mitigation	5	40		60				
	WSE/09/c	International Fieldtrip (12 days)	5						100	
	WSE/HI/10A/e	Flood risk management	5	60		40				
	WSE/HI/11/e	Hydroinformatics for decision support	5			40+30+30				
	ES11MW	Watershed and river basin management	5	70		30				
UPC		Implications of global warming on floods and droughts	3		40	10+20+30				
		Coastal flooding: impacts, conflicts and risks	7	100						
		Debris flow and flash floods: risk, vulnerability, hazard and resili	6	40		55				5
		Applications of radar-based rainfall observations and forecasts in	3	100						
UL		Spatial planning for flood protection and resilience	5	20		40+40				
		Socio-economic and institutional framework of floods	5	25		10+20+45				
TUD/IHE/UPC/UL		MSc thesis work	30							

The programme components, credits, and the nature of the examinations in the specialisation ***Ecohydrology.***

Ecohydrology Programme Components

First Semester (Period P1a: University of Algarve or P1b: University of Lodz):
30 ECTS, 20 SWS,

Period P1a: University of Algarve integrative period – compulsory modules:
24 ECTS have to be collected:

Course	Course Name	Teaching form	SWS	Credits	Evaluation
UALG 101	Dynamics of Aquatic Ecosystems	L/P/E/OT	15/10/10/4	6	Written 100%
UALG 102	Estuarine and wetland processes	L/P/TP/E/	15/15/10 /10	6	Written 100%
UALG 103	Hydrogeology and Aquifer Management	TP/OT/S	35/5/10	6	Written 100%
UALG 104	Introduction to Ecohydrology	L/P/E/OT	15/15/10/	6	Written 100%

Period P1a: University of Algarve - elective modules
6 ECTS have to be collected from the full curriculum of courses offered.

Period P1b: University of Lodz – compulsory modules
24 ECTS have to be collected:

Course	Course Name	Teaching form	SWS	Credits	Evaluation
ULO 101	Ecohydrology	L/P	1/3	6	Oral 100%
ULO 102	Environmental Modelling and Statistics	L/P	1/1	3	Oral 100%
ULO 103	Ecotoxicology	L/P	2/2	5	Oral 100%
ULO 104	Emviromental/Landscape Planning	L/P	2/2	5	Oral 100%
ULO 105	Environmental Protection Politics	L/P	2/1	5	Oral 100%

Period P1b: University of Lodz – elective modules
6 ECTS have to be collected:

ULO 106	Estuarine and coastal ecohydrology	L/OT	1/1	5	Oral 100%
ULO 107	Ecological Risk Assessment	L/P	1/2	5	
ULO 109	Fish-based Assessment & River Restoration	L/P	0,7/0,6	2	
ULO 111	Long-term Ecological Research	L/P	0,7/0,6	2	
ULO 112	International Water Resources	L	0,7	1	
ULO 113	Polish Language			2	

Second Semester (Period P2a: University of Algarve or P2b: University of Lodz and Period 3: University de la Plata):
30 ECTS, 20 SWS,

Period P2a: University of Algarve, compulsory modules
18 ECTS have to be collected:

Course	Course Name	Teaching form	SWS	Credits	Evaluation
UALG 201	Biogeochemical Processes and Global Changes	L/TP/E/W	15/10/10/5/2	6	Written 100%
UALG 202	Modelling marine and coastal processes	L/TP/OT	25 /30/5	6	Written 100%
UALG 203	Techniques of marine intervention	L/TP/P/E/W	20/10/ 5/10	6	Written 100%

Period P2a: University of Algarve, elective modules
12 ECTS have to be collected from the full curriculum of courses offered.

Period P2b: University of Lodz, compulsory modules
12 ECTS have to be collected:

Course	Course Name	Teaching form	SWS	Credits	Evaluation
ULO 201	Applied Aquatic Ecology	L/P	1/1	4	Oral 100%
ULO 202	Phytotechnologies & Phytoremediation	L/P	1/2	5	Oral 100%
ULO 203	Wetlands & Land-Water Ecotones	L/P	1/1	3	Oral 100%

Period P2b: University of Lodz, elective modules
8 ECTS have to be collected:

ULO 204	Environmental GIS	L/P	1/1	3	Oral 100%
ULO 205	Applied Hydrology	L/P	1/1	4	Oral 100%
ULO 206	Ecohydrology Application in Urban Areas	L/P	1/1	4	oral 100%
ULO 208	Ecohydrology for Sustainable Fisheries & Aquaculture	L/P	0,7/1	3	Oral 100%
ULO 209	Watershed Pollution control	L/P	0,7/1	3	Oral 100%
ULO 210	Hydroacustic in Fisheries & Ecology	L/P	0,7/1,3	4	Oral 100%
ULO 211	Trophic Relationships in Reservoirs	L/P	0,7/1	3	Oral 100%
ULO 212	Free elective: the topic is based on the scholar mobility in the Ecohyd consortium			5	

Period P3: University de la Plata, compulsory modules
10 ECTS have to be collected:

Course	Course Name	Teaching form	SWS	Credits	Evaluation
ULP 301	Environmental Hydrology and Water Resource Management	L/P/E	1/1/1	2	Written 100%
ULP 302	Aquatic Biogeochemistry	OT/P	1/1	3	Written 100%
ULP 303	Field trip	OT/P/E	1/1/1	3	Written 100%
ULP 304	Spanish language			2	

Third Semester (Period 4: UNESCO - IHE):

Period P4: 30 ECTS, 20 SWS

Period 4 UNESCO - IHE – compulsory courses
10 ECTS have to be collected:

Course	Course Name	Teaching form	SWS	Credits	Evaluation
IHE 401	MSc research proposal development for WSE (WSE/14/c)	P	NA	5	Presentation (100%)
IHE 402	Hydrology and Hydraulics (WSE/02/c)	L/P	78	5	Assignment (30%) Written (70%)

Period 4 UNESCO - IHE – free elective courses
20 ECTS (four modules) may be selected from the full course offering of IHE. Selected modules should address topics related to the proposed thesis research and must be approved by the mentor and UNESCO-IHE program coordinator.

Third Semester (Period 4: CAU Kiel):

Period P4: 30 ECTS, 20 SWS

Period 4 CAU Kiel – compulsory courses
12 ECTS have to be collected:

Course	Course Name	Teaching form	SWS	Credits	Evaluation
CAU 401 S 133	The Ecosystem Approach and Spatial Concepts to Manage Natural Resources (EM 3.2.2)	S	4	6	Oral 100%
CAU 402 S 142	Integrated Management of River Basins (EM 3.1.3)	L/E/S	2/1/1	6	Presentation 100%

Period 4 Christian-Albrechts-University of Kiel – elective courses
18 ECTS have to be collected:

Course	Course Name	Teaching form	SWS	Credits	Evaluation
CAU 403 S 143	Integrated Management of Wetlands (EM 3.1.4)	L/E/S	2/2/1	6	Report 100%

CAU 404 S 127	Integrated Management of Coastal Zones (EM 3.1.2)	S/E	3,5/0,5	6	Report 100%
CAU 405 S 135	Principles in Hydrology and Climatology	L/L/E	2/1/1	6	Written 100%
CAU 406 S 144 + S 145	Hydrological and hydraulic modelling	L/P	2/2	6	Report 100%
CAU 407	Free elective from the overall CAU offer confirmation by the exam board			6	
CAU 408	Thesis plan – obligatory for students doing the thesis not at CAU			6	Project 100%

Fourth Semester (Period 5):

Master Thesis (30ECTS):

Christian-Albrechts-University of Kiel
or University of Algarve
or University of Lodz
or UNESCO IHE Delft

Explanations:

Course:	Course Identification Code
Course name:	Title of the course
Teaching form:	Kind of teaching L= Lecture S= Seminar P= Practice TO=Theoretical-practical OT=Tutorial W= Workshop E= Excursion
SWS:	Hours of teaching (face to face)
Evaluations:	= Prüfungsleistungen
Oral exam	= Mündliche Prüfung
Written Examination	= Schriftliche Prüfung
Presentation	= Vortrag
Exercise	= Hausaufgabe
Project	= Protokoll
Report	= Hausarbeit

Michael McClain
Chair oft he WSE Programme Committee

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

	Code	Module Name	UNL credits/ ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
UNESCO-IHE	WSE/01/c	Week 1 + Introduction to Water Science and Engineering	3 (5)	25+25+10		20 (x2)				
	WSE/02/c	Hydrology and hydraulics	3 (5)	35 (x2)		30				
	WSE/LWD/03/s	Principles and practices of land and water development	3 (5)		15	70 + 15				
	WSE/LWD/04/s	Design aspects of irrigation and drainage systems	3 (5)	30		20+25+25				
	WSE/LWD/05s	Water management systems and agronomy	3 (5)	35		10+30+25				
	WSE/LWD/06/s	Socio-economic and environmental aspects of irrigation and drai	3 (5)			25+20+30+25				
	WSE/LWD/07/s	Service oriented management of irrigation systems	3 (5)		70	30				
	WSE/LWD/08/e	Conveyance systems	3 (5)			30+15+30+25				
University of Nebraska, Lincoln, USA		Field Course: Measurement Techniques in Hydrology and Irrigati	3 (5)							
		Research Methodology & Thesis Research Proposal	2 (14)							
		Plant-Water Relations	3 (5)							
		Groundwater Geology	3 (5)							
		Advanced Irrigation and Drainage Systems Engineering	3 (5)							
		Advanced Irrigation Management	3 (5)							
		Water Law, Planning and Policy	3 (5)							
		Masters Research Project	4 (28)			100				

4. Water Management programme

Water Resources Management

Code	Module Name	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
WM/1	Week 1 + principles of integrated water resources management	5	50		25+25				
WM/2	The water resources system	5	70		30				
WM/3	Water governance	5	50		20+30				
WM/4	Water economics	5	70		30				
WM/5	Water and environmental law	5	70		30				
WM/WRM/6	Water resources assessment	5	65		35				
WM/WRM/7	Water systems modelling	5	60			40			
WM/WRM/WCM/8	Water resources planning	5	65		35				
WM/9	International fieldwork	5			30	40+30			
WM/WRM/WCM/10	Institutional analysis	5			10+10+10+70				
ES/11/X	IWRM as a tool for adaptation to climate change	5	70			30			
WM/12	Summer course	1			100				
WM/13	IWRM Groupwork	5			65+35				
WM/14	MSc proposal +Research and academic skills development	9		100					
WM/15	MSc thesis research and thesis writing	36		100					

Water Conflict Management

Code	Module Name	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
WM/1	Week 1 + principles of integrated water resources management	5	50		25+25				
WM/2	The water resources system	5	70		30				
WM/3	Water governance	5	50		20+30				
WM/4	Water economics	5	70		30				
WM/5	Water and environmental law	5	70		30				
WM/WCM/6	Mediation for water conflict management	5	50		40				10
WM/WCM/7	Advanced mediation for water conflict management	5	40		50				10
WM/WRM/WCM/8	Water resources planning	5	65		35				
WM/9	International fieldwork	5			30	30+30			
WM/WRM/WCM/10	Institutional analysis	5			10+10+10+70				
WM/WSM/WCM/11	Urban water governance	5		50	20+30				
WM/12	Summer course	1			100				
WM/13	IWRM Groupwork	5			65+35				
WM/14	Research and academic skills development WM	9		100					
WM/15	MSc thesis research and thesis writing	36		100					

Water Services Management

Code	Module Name	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
WM/1	Week 1 + principles of integrated water resources management	5	50		25+25				
WM/2	The water resources system	5	70		30				
WM/3	Water governance	5	50		20+30				
WM/4	Water economics	5	70		30				
WM/5	Water and environmental law	5	70		30				
WM/WSM/6	Managing water organisations	5		60	20+20				
WM/WSM/7	Water supply and sanitation systems	5	70		30				
WM/WSM/8	Financial management in the water sector	5	65		20+15				
WM/9	International fieldwork	5			30	30+30			
WM/WSM/10	Partnerships in the Water Sector	5	70		30				
WM/WSM/WCM/11	Urban water governance	5		50	20+30				
WM/12	Summer course	1							
WM/13	IWRM Groupwork	5			65+35				
WM/14	Research and academic skills development WM	9		100					
WM/15	MSc thesis research and thesis writing	36		100					

Water Quality Management

Code	Module Name	ECTS	Written exam (%)	Oral exam (%)	Assignments (%)	Oral presentation (%)	Lab Report (%)	Home work (%)	Integrated in modules (%)
WM/1	Week 1 + principles of integrated water resources management	5	50		25+25				
WM/2	The water resources system	5	70		30				
WM/3	Water governance	5	50		20+30				
WM/4	Water economics	5	70		30				
WM/5	Water and environmental law	5	70		30				
ES/6/W	Water quality assessment	5	70		20		10		
ES/07/T	Environmental engineering	5	50		25+25				
ES/07/W	Wetlands for water quality	5	60		40				
ES/08/MW	Environmental planning and implementation	5	70		30				
WM/9	International fieldwork	5			30	30+30			
ES/10/TWL	Aquatic ecosystems: processes and applications	5	80		10	10			
ES/11/MW	Watershed and river basin management	5	70		30				
WM/12	Summer course	1			100				
WM/13	IWRM Groupwork	5			65+35				
WM/14	Research and academic skills development WM	9		100					
WM/15	MSc thesis research and thesis writing	36		100					

Appendix E MSc thesis marking guidelines

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

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

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

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

UNESCO-IHE - Academic Calendar 2014/2016

YEAR 1																			
	2014											2015							
	October			November				December				January				February			
Week	42	43	44	45	46	47	48	49	50	51	52	01	02	03	04	05	06	07	08
Mon	13	20	27	03	10	17	24	01	08	15	22	29	05	12	19	26	02	09	16
Tue	14	21	28	04	11	18	25	02	09	16	23	30	06	13	20	27	03	10	17
Wed	15	22	29	05	12	19	26	03	10	17	24	31	07	14	21	28	04	11	18
Thu	16	23	30	06	13	20	27	04	11	18	25	01	08	15	22	29	05	12	19
Fri	17	24	31	07	14	21	28	05	12	19	26	02	09	16	23	30	06	13	20
Sat	18	25	01	08	15	22	29	06	13	20	27	03	10	17	24	31	07	14	21
Sun	19	26	02	09	16	23	30	07	14	21	28	04	11	18	25	01	08	15	22
		(2x5 ECTS)							(2x5 ECTS)									(2x5 ECTS)	
		Module 1			Module 2				Module 3					Module 4				Module 5	

YEAR 1																		
	2015												fieldtrip			..		
	March					April				May					June			
Week	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Mon	23	02	09	16	23	30	06	13	20	27	04	11	18	25	01	08	15	22
Tue	24	03	10	17	24	31	07	14	21	28	05	12	19	26	02	09	16	23
Wed	25	04	11	18	25	01	08	15	22	29	06	13	20	27	03	10	17	24
Thu	26	05	12	19	26	02	09	16	23	30	07	14	21	28	04	11	18	25
Fri	27	06	13	20	27	03	10	17	24	01	08	15	22	29	05	12	19	26
Sat	28	07	14	21	28	04	11	18	25	02	09	16	23	30	06	13	20	27
Sun	01	08	15	22	29	05	12	19	26	03	10	17	24	31	07	14	21	28
						(2x5 ECTS)							(1x5 ECTS)			(2x5 ECTS)		
		Module 6				Module 7			Module 8				Module 9			Module 10		

YEAR 1																
	..					Groupwork			..							
	July				August					September				October		
Week	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
Mon	29	06	13	20	27	03	10	17	24	31	07	14	21	28	05	12
Tue	30	07	14	21	28	04	11	18	25	01	08	15	22	29	06	13
Wed	01	08	15	22	29	05	12	19	26	02	09	16	23	30	07	14
Thu	02	09	16	23	30	06	13	20	27	03	10	17	24	01	08	15
Fri	03	10	17	24	31	07	14	21	28	04	11	18	25	02	09	16
Sat	04	11	18	25	01	08	15	22	29	05	12	19	26	03	10	17
Sun	05	12	19	26	02	09	16	23	30	06	13	20	27	04	11	18
					1	(1x5 ECTS)				..	(2+7 ECTS)					
	Module 11				M12	Module 13				..	Module 14					

YEAR 2																												
	2015										2016																	
	October	November				December					January					February				March				April				
Week	43	44	45	46	47	48	49	50	51	52	53	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17
Mon	19	26	02	09	16	23	30	07	14	21	28	04	11	18	25	01	08	15	22	29	07	14	21	28	04	11	18	25
Tue	20	27	03	10	17	24	01	08	15	22	29	05	12	19	26	02	09	16	23	01	08	15	22	29	05	12	19	26
Wed	21	28	04	11	18	25	02	09	16	23	30	06	13	20	27	03	10	17	24	02	09	16	23	30	06	13	20	27
Thu	22	29	05	12	19	26	03	10	17	24	31	07	14	21	28	04	11	18	25	03	10	17	24	31	07	14	21	28
Fri	23	30	06	13	20	27	04	11	18	25	01	08	15	22	29	05	12	19	26	04	11	18	25	01	08	15	22	29
Sat	24	31	07	14	21	28	05	12	19	26	02	09	16	23	30	06	13	20	27	05	12	19	26	02	09	16	23	30
Sun	25	01	08	15	22	29	06	13	20	27	03	10	17	24	31	07	14	21	28	06	13	20	27	03	10	17	24	01

Legend

- = Lecture period
- = Examination days
- = MSC thesis writing
- = Holiday/free time
- = Opening acad. year
- = Diploma awarding
- = Summer course

Chistmas: 25/26 Dec 2014
Good Friday: 3 April 2015
Easter: 5/6 April 2015
Kingsday: 27 April 2015
Liberationday: 5 May 2015
Ascencion: 14 May 2015
Pentecost: 24/25 May 2015
Chistmas: 25/26 Dec 2015
Good Friday: 25 March 2016
Easter: 27/28 March 2016

UWS Programme Overview 2014-2016

			WSE Water Supply Engineering	SE Sanitary Engineering	UWEM Urban Water Engineering and Management
	1	……-19/10 20/10-26/10	Week ONE Introduction (ALL)		at AIT *(August 2013 onwards)* watershed hydrlogy, drinking water treatment, Wastewater treatment and integrated water resource management
	1	27/10-02/11 03/11-09/11	Hydrology, Water supply and water demand management and GIS (UWS/01)		
	2	10/11-16/11 17/11-23/11 24/11-30/11	Chemistry and public health (UWS/02)		
	..	01/12-07/12	Examination Week		
	3	08/12-14/12 15/12-21/12	EPT, Microbiology and Integrated Urban Water Management (UWS/03)		
	..	22/12-28/12 29/12-04/01	Free Period		
	3	05/01-11/01	(UWS/03) *continue*.		
Students Univalle Enter	4	12/01-18/01 19/01-25/01 26/01-01/02	Surface water treatment I (UWS/WSE/04)	Urban drainage and sewerage (UWS/SE/UWEM/04)	
	..	02/02-08/02	Examination Week		
	5	09/02-15/02 16/02-22/02 23/02-01/03	Surface water treatment II (UWS/WSE/05)	Conventional wastewater treatment (UWS/SE/05)	Asset management (UWS/UWEM/05)
Students KNUST Enter	6	02/03-08/03 09/03-15/03 16/03-22/03	Groundwater treatment and resources (UWS/WSE/06)	Resource oriented wastewater treatment and sanitation (UWS/SE/06)	Managing water organisations (=> WSM06)
	..	23/03-29/03	Examination Week		
	7	30/03-05/04 06/04-12/04 13/04-19/04	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	20/04-26/04 27/04-03/05 04/04-10/05	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)
	..	11/05-17/05	Examination Week		
	9	18/05-24/05 25/05-31/05 01/06-07/06	International fieldtrip and fieldwork (UWS/09)		
	10	08/06-14/06 15/06-21/12 22/06-28/06	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 (2014-2016)			
	11	29/06-05/07 06/07-12/07 13/07-19/07	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 preparatory course and thesis research proposal (UWS/13)
	..	20/07-26/07	Examination Week		at AIT
	12	27/07-02/08	Summer course (UWS/12)		
	13	03/08-09/08 10/08-16/12 17/08-23/08	Groupwork Sint Maarten (UWS/13)		
	..	24/08-30/08	Examination Week		
	..	31/08-06/09	Free		
Univalle and KNUST leave	14	07/09-13/09 14/09-20/09 21/09-27/09 28/09-04/10 05/10-11/10	MSc preparatory course and thesis research proposal (UWS/14)		
	..	12/10-18/10	Examination Week		
	15	19/10/15 …. …… …… …… …. 10/04/16	MSc thesis research work(6 months) (UWS/15)		
	..	11/04-17/04 18/04-24/04	Final Examination Week(s) - Diploma awarding 26/04/2016		

MASTERS PROGRAMME UWS 2014-2016 - PART 2

Table of Contents

URBAN WATER AND SANITATION

MASTERS PROGRAMME

Academic Year: 2014-2016
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**

2014/2016-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: **2014-2016**
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, assignment.

Lecturing Material

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

Assessment

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

2014/2016-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	**8**	**6**	**2**				**10**	**32**	Prof. dr. A.M. de Roda-Husman
	Total	**20**	**6**	**12**	**4**			**36**	**86**	
MSc module - UNESCO-IHE										

URBAN WATER AND SANITATION

MASTERS PROGRAMME

Academic Year: 2014-2016
Specialization: Core Programme
Module Coordinator: Steen, N.P. van der

Module Sheet

Module Name EPT, Microbiology and Integrated Urban Water	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**

2014/2016-UWS/03: EPT, Microbiology and Integrated Urban Water											
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	20		4				24	64	dr. N.P. van der Steen
2	Microbiology	12		16				28	52	dr. J. van de Vossenberg, dr. H. van Bruggen
3	Intro IUWM and Technical report assignment	1	20					1	23	dr. N.P. van der Steen
4	IUWM Technical Writing	4						4	12	W.J. Sturrock, Adv Dip Ed
5	IUWM Systems analysis and the Urban Water System	4		6				10	18	dr. N.P. van der Steen
6	IUWM Material flows, Water and Energy	2		3				5	9	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	20	29				84	214	
MSc module - UNESCO-IHE										

URBAN WATER AND SANITATION

MASTERS PROGRAMME

Academic Year: 2014-2016
Specialization: WSE
Module Coordinator: Kennedy, M.D.

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) --**

2014/2016-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: 2014-2016
Specialization: Core Programme
Module Coordinator: Hammond, M.

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

2014/2016-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: 2014-2016
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 UWS 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, natural systems, 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.

Natural systems
Theory of bank filtration and aquifer recharge

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 --**

2014/2016-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**	B. Martijn, MSc
	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: 2014-2016
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 --

2014/2016-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: 2014-2016
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.**

2014/2016-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: **2014-2016**
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 --**

2014/2016-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: 2014-2016
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 --**

2014/2016-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										

WATER MANAGEMENT

MASTERS PROGRAMME

Academic Year: 2014-2016
Specialization: Core Programme
Module Coordinator: Schwartz, K.H.

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 supply and sanitation organisations (including regulators).	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..

- Relate academic debates concerning water supply and sanitation provisioning to the management of water organizations
- Explain the position and strategy of a water organization in relation to its institutional environment.
- Diagnose challenges for a water organization in relation to its context and develop strategic plans accordingly, including the management of change.
- Apply leadership and influence skills in managing organizations
- The course is built up of three blocks. The first block focuses on understanding the water services sector in which a water organization develops. During this block the regulatory and policy context of water organizations is elaborated upon. During the second block, the module focuses on specific elements of organizational management. This includes strategic management, change management, human resources management and customer management. The third part of the modules focuses on management skills of the individual. In particular the topic of leadership is examined

Topics and Learning Activities

The Water Supply and Sanitation Sector
Policy analysis, Regulatory Models, Public Sector Reform,

Water Organisations at Work
Strategic Management, Performance Analysis (including benchmarking), Human Resources Management, Customer Management (billing/collection and commercial losses)

Management Skills in a Water Organization
Leadership and managing teams

Lecturing Material

• Students will be provided a list of articles that are required reading. It should be noted that students are expected to read and understand a considerable number of articles during this module. In addition, the module will make use of power point presentation, case studies and a simulation game.

Assessment

• 60%: Oral Exam -- Based on an extensive case study of a water utility and its context, the students will develop a strategy plan for that organization based on the topics learned in the module
• 20%: Assignment -- Research assignment: Students will develop a small research project based on a given research question. The students will develop these assignments by undertaking interviews with Dutch water organizations
• 20%: Assignment -- Students will have to develop and reflect on strategic plans in the different phases of a simulation game

2014/2016-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)
	Sector overview	**3**						**3**	**9**	Schwartz
	Performance	**1**		**2**				**3**	**5**	Schwartz
	Policy Analysis	**3**						**3**	**9**	Schwartz
	Regulatory Models									Guest lecturer
	Public Sector Reform	**3**						**3**	**9**	Schwartz
	Strategic Management	**3**						**3**	**9**	Schwartz
	Water Utility Simulation Game	**1**	**7**					**1**	**10**	Tutusaus/Schwartz
	Benchmarking	**1**						**1**	**3**	Tutusaus
	Benchmarking Game			**4**				**4**	**4**	Tutusaus
	Change Management	**3**						**3**	**9**	Mels
	Human Resources Management	**3**						**3**	**9**	Guest Lecturer
	Customer Management	**3**						**3**	**9**	Blokland
	Water Utility Research Assignment	**1**	**23**					**1**	**26**	Tutusaus/Schwartz
	Leadership and Influence	**6**						**6**	**18**	Guest Lecturer
	Introduction Exam	**1**						**1**	**3**	Tutusaus
	Total	**32**	**30**	**6**				**38**	**132**	
MSc module - UNESCO-IHE										

URBAN WATER AND SANITATION

MASTERS PROGRAMME

Academic Year: 2014-2016
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.

2014/2016-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: 2014-2016
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 --**

2014/2016-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: 2014-2016
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 --**

2014/2016-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: 2014-2016
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.
- explain the modeling of MBR systems, simulate existing models using BioWIn, 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.

Modelling membrane bioreactors using BioWin

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);
BioWin modelling. (Exercise)
• Practical guide for activated sludge modelling, UNESCO-IHE lecture notes series, S.Meijer/D.Brdjanovic

Assessment

• 25%: Assignment -- Assessment of application skills: Modelling of an activated sludge WWTP using BioWin
• 15%: Assignment -- Assessment of application skills: Modelling of an anaerobic sludge digester using BioWin
• 60%: Written Exam (closed book) -- Assessment of theoretical knowledge and application skills

2014/2016-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 (BioWin)	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: **2014-2016**
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 --**

2014/2016-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: 2014-2016
Specialization: Core Programme
Module Coordinator: Slokar, Y.M.

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 --**

2014/2016-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: 2014-2016
Specialization: MWI-SE, MWI-UWEM
Module Coordinator: Garcia Hernandez, H.A.

Module Sheet

Module Name Industrial effluents treatment and residuals	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**

2014/2016-UWS/SE/UWEM/10: Industrial effluents treatment and residuals											
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: **2014-2016**
Specialization: **WSE**
Module Coordinator: **Sharma, S.K.**

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) --**

2014/2016-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										

URBAN WATER AND SANITATION

MASTERS PROGRAMME

Academic Year: 2014-2016
Specialization: Core Programme
Module Coordinator: Hammond, M.

Module Sheet

Module Name Urban water systems	Module Code UWS/UWEM/10	Credits 5

Target Group	Prerequisites
Programme target group	Urban Drainage I (recommended, but not essential)

Learning Objectives

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

- gain a sound overall understanding of processes that are necessary for analysis and planning of urban water systems.
- gain an understanding of processes that are necessary for modelling, analysis and planning of water distribution systems.
- gain an understanding of processes that are necessary for modelling, analysis and planning of sewerage and drainage systems.
- conduct modelling of Urban drainage Networks: Use advanced simulation software for urban drainage systems, including surcharge, sewer overflow, water quality issues; analyse model output and desire if some part of the system shall be changed; recommend possible solutions to improve the function of a drainage system to prevent flooding and pollution of receiving waters
- gain an understanding of processes that are necessary for modelling, analysis and planning of wastewater treatment plants.
- gain an understanding of impacts from urban water systems on receiving environment.

Topics and Learning Activities

Water distribution systems
Learning Activities:
Lecture, Exercise, Workshop

Urban Drainage
Learning Activities:
Lecture, Exercise, Workshop

Water Quality for Urban Drainage
Learning Activities:
Lecture, Exercise, Workshop

Wastewater treatment
Learning Activities:
Lecture, Exercise, Workshop

Lecturing Material

- Lecture notes (provided by each lecturer)

Workshop material (including the case study date)
Additional material provided on the module web site.

Assessment

- **40%: Written Exam (closed book) --**
- **60%: Assignment -- Computer workshops, Homework, Class work, participation**

2014/2016-UWS/UWEM/10: 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)
	Urban Water Systems Theory and Workshops (Water Distribution, Drainage, Wa	**20**	**10**	**20**				**40**	**90**	Z. Vojinovic, N. Trifunovic, D. Savic, O. Mark, I. Nopens
	Hydrology for Urban Drainage	**4**						**4**	**12**	P.D.A. Pathirana, PhD, MSc
	Water Quality for Urban Drainage	**2**	**4**					**2**	**10**	Z. Vojinovic, PhD, MSc, O.Mark., PhD, MSc
	Impacts on Receiving Environment	**1**	**3**					**1**	**6**	A. van Griensven, A. Mynett, McClain,
	Total	**27**	**17**	**20**				**47**	**118**	
MSc module - UNESCO-IHE										

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

Academic Year: 2014-2016
Specialization: Limnology and Wetland Management
Module Coordinator: Hes, E.M.A.

Module Sheet

Module Name Wetlands for livelihoods and conservation	Module Code ES11LM	Credits 5

Target Group	Prerequisites
Programme target group	Programme prerequisites

Learning Objectives

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

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

Topics and Learning Activities

Ecosystem functions and services

Learning Activities:
lectures, field-work and data analysis

Climate change as a driver of change in wetland management planning

Learning Activities:
lectures and exercises

Objective Oriented Planning

Developing a wetland management plan according to the guidelines of the Ramsar Convention

Learning Activities:
lectures, field-work and case study

Stakeholder analysis and participatory approaches

Learning Activities:
lectures, field-work, case study and role play

Lecturing Material

- Case study descriptions
- PowerPoint presentations
- Selected scientific and other publications

Assessment

- **40%: Written Exam (closed book) --**
- **40%: Assignment -- Individual report and performance**
- **20%: Presentation -- Groupwork presentation**

2014/2016-ES11LM: Wetlands for livelihoods and conservation											
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)
	Ecosystem functions and services	8		4		16		28	44	
	Climate change as a driver of change in wetland management planning	8		4				12	28	
	Objective Oriented Planning	2		16		16		34	38	
	Stakeholder analysis and participatory approaches	2		14		8		24	28	
	Examination		2						2	
	Total	20	2	38		40		98	140	
MSc module - UNESCO-IHE										

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

Academic Year: 2014-2016
Specialization: Water Resources Management & Water Quality Management
Module Coordinator: Jiang, Y.

Module Sheet

Module Name Watershed and river basin management	Module Code ES11MW	Credits 5

Target Group	Prerequisites
Young and mid-career professionals (scientists, decision-makers) with a background in water management, environmental management, and / or watershed management.	Affinity with hydrology, development economics, agronomy or geography (preferably a relevant water science or engineering related bachelorâ€™s degree or equivalent) and preferably experience in watershed and / or river basin management. Good command of English.

Learning Objectives

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

- describe the main natural and anthropogenic interactions at a watershed scale; and how they can be aggregated to rive basin scale
- describe the role of water in sustaining different land uses, including ecosystems
- understand the watershed planning and management approaches, specifically in terms of soil and water management
- explain temporal and spatial scales issues in hydrology
- characterize the fundamental economic issues in watersheds and river basins and the role of economic valuation of acquatic ecosystem services in watershed and river basin management

Topics and Learning Activities

Introduction

This section introduces watershed and river basin management

Learning Activities:

Lecture, group exercise/workshop

Biophysical processes and anthropogenic interactions

This section overviews biophysical processes and interactions with human activitiies in watersheds and river basins, covering soil & water management, watershed hydrology and human interventions, environmental flow, and grounwater management

Learning Activities:

Lecture, group exercise/workshop

Watershed and river basin planning

This section describes the planning process of watershed and river basin management, including technical and participatior tools to support planning processes

Learning Activities:

Lecture, group exercise/workshop

Watershed economics

This section introduces and characterises the fundamental economic issues in watersheds and river basins, explain the relevance and role of economics and economic valuation in watershed and river basin management

Learning Activities:

Lecture, group exercise/workshop

Watershed and river basin management

This section synthesizes the institutional aspects in watershed and river basin management, explains transboundary interdependencies and cooperation, and presents a case study of watershed and river basin management in the real world

Learning Activities:

Lecture, group exercise/workshop

Role play- ShaRiva

This group excercise uses hydrological simulation as a decision support tool to help understand the interdependency of different stakeholders and the importance of communication and cooperation to effective watershed and river basin management

Learning Activities:

group excercise

Field trip

Lecturing Material

- Lecture Notes
- Role play reading materials
- Lecture powerpoint slides
- Additional reading materials

Assessment

- **70%: Written Exam (closed book) --**
- **30%: Assignment --**

2014/2016-ES11MW: Watershed and river basin 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**	Jiang
2	**Biophysical processes and anthropogenic interactions**									
2.1	Soil & Water Management	4		4				8	16	Van der Zaag
2.2	Watershed hydrology and human interventions	4		4				8	16	Ilyas
2.3	Environmental flow allocation	4		4				8	16	McClain
2.4	Groundwater Management	4		4				8	16	Guest Lecturer
3	**Watershed economics**									
3.1	Economic issues in watersheds and river basins	2						2	6	Jiang
3.2	Payment for watershed services	2		4				6	10	Jiang
3.3	Game theory	4		4				8	16	Gues lecturer
4	**Watershed and river basin planning and management**									
4.1	Planning process	2		2				4	8	Evers
4.2	Watershed and river basin management	4						4	12	Evers
4.3	Case study			4				4	4	Guest lecturer
5	**Role-play SHA-RIVA**		**12**						**12**	Ilyas
6	**Field trip**					**5**		**5**	**5**	Jiang
	Exam		**3**						**3**	
	Total	**31**	**15**	**30**		**5**		**66**	**143**	
MSc module - UNESCO-IHE										

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

Academic Year: 2014-2016
Specialization: Core Programme
Module Coordinator: Siebel, M.A.

Module Sheet

Module Name Solid waste management	Module Code ES11T	Credits 5

Target Group	Prerequisites
Engineers, academicians, staff from Non-Government Organizations, Community-based Organizations, politicians, health officials, students, scientists, local, regional or national government officials, etc., involved or interested in the management of solid waste.	1) Involved in or familiar with one or more of the key elements of solid waste management, or 2) having studied the topic in a formal educational setting, or 3) having a university engineering degree.

Learning Objectives

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

- suggest options for waste reduction at source so as to reduce quantities of waste generated;
- choose from an array of options to turn waste into economic goods;
- suggest treatment/disposal methods for waste from which the value has been taken out and to make basic calculations related to the conceptual design thereof;
- assess the impact of waste and waste management on other environmental compartments;
- roughly assess financial consequences of proposed management aspects in SWM;
- conceptually develop a solid waste management scheme for an urban area.

Topics and Learning Activities

1) Introduction & Stakeholders
what is solid waste? what are the key problems (social, financial, environmental)? who are involved?
Learning Activities:
lecture, group activity/learning from each other, role play

2) Generation, collection & separation
How/why is SW generated? how can generation be reduced? what are collection schemes & means, what means waste separation? at what point in the process? what are advantages? how can separation/reuse be stimulated?
Learning Activities:
lecture, group activity/learning from each other, exercise, role play,

3) Biological processes, composting, digestion
Aerobic and anaerobic conversion of waste organics, process characteristics, fields of application, impacts on waste reduction
Learning Activities:
lecture, calculation exercise, laboratory experiment

4) Landfill technology, CDM, MBT and Incineration
What are main waste management technolgies? in more or in less developed countries? design elements, application areas? GHG issues
Learning Activities:
lecture, group activity/learning from each other, calculation exercise

5) Transboundary issues in SWM
What is Basel Convention? what is transboundary waste transport, processing and storage? What are environmental, social, economic aspects thereof?
Learning Activities:
lecture, group activity/learning from each other, role play,

6) Prevention & Recycling
How can waste generation be reduced? what are policy, economic tools? How can generated waste quickest be brought into the economic cycle?
Learning Activities:
lecture, group activity/learning from each other, calculation exercise

7) SWM planning and financing
How can all possible SWM pieces be put together to design a waste management system for a build-up area that is financially, socially and environmentally sustainable?
Learning Activities:

group activity/learning from each other, exercise, role play

Lecturing Material

• 1) PPT's; reviewed paper; BOOK: Waste Technology and Management; BOOK: Vital waste statistics
• 2) PPT's; reviewed paper; BOOK: From waste to resource; BOOK: Solid Waste Management in World Cities
• 3) PPT's; reviewed paper; BOOK: Waste Technology and Management; Video: Anaerobic degradation processes
• 4) PPT's; reviewed paper; BOOK: Waste Technology and Management; Video Bioreactor Landfill; UNEP SWM Landfill chapter
• 5) PPT's; reviewed paper; BOOK: Waste Technology and Management
• 6) PPT's; reviewed paper; BOOK: Waste Technology and Management
• 7) papers on planning practice

Assessment

• 60%: Written Exam (open book) -- MOODLE multiple choice
• 35%: Assignment -- All assignments together
• 5%: Presentation -- Participation in class or fora

2014/2016-ES11T: Solid waste 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	6						6	18	Siebel
2	Waste prevention	4						4	12	Dijk
3	Exercise household waste generation			9				9	9	Siebel
4	Waste collection/ source separation	3						3	9	
5	Composting and biogas	6						6	18	Valencia
6	Excursion					4		4	4	Siebel
7	Informal sector	4						4	12	Rotter
8	Material cycles			4				4	4	Rotter
9	Landfill processes	3						3	9	Valencia
10	Landfill technology	3						3	9	Valencia
11	Mechanical biological treatment	4						4	12	Rotter
12	Lab landfill			3				3	3	Rotter
13	Integrated planning			8				8	8	Siebel
14	Presentations			2				2	2	Siebel
15	Assignments		13						13	
16	Exam		2						2	
	Total	33	15	26		4		63	144	
MSc module - UNESCO-IHE										

MASTERS PROGRAMME

Academic Year: 2014-2016
Specialization: Core Programme
Module Coordinator: Ruijter van Steveninck, E.D. de

Module Sheet

Module Name IWRM as a tool for adaptation to climate change	Module Code ES11X	Credits 5

Target Group	Prerequisites
Programme target group (Participants in the programmes at IHE) and qualified short course participants.	Programme prerequisites (BSc in a topic appropriate to UNESCO-IHE programme) and basic knowledge of water management.

Learning Objectives

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

- describe the expected impacts of climate change on water resources and water use sectors in relation to (other) human activities
- identify the consequences of the predicted impacts of climate change and climate variability for integrated water resources management
- integrate climatic change conditions at different time and spatial scales into (risk) management in the water sector
- justify decisions on adaption to the impacts of climate change under uncertainty

Topics and Learning Activities

Principles of Integrated Water Resources Management
Introduction into the concept of IWRM
Learning Activities:
Lecture and discussion

Climate change and impacts
The climate system and the causes of climate change and variability. Impacts of climate change on the hydrological cycle, the environment and on water use sectors. Country presentations by participants
Learning Activities:
Lectures and exercises

Vulnerability and adaptation under uncertainty
What determines vulnerability to CC. Adaptation measures and strategies how to adapt under a high level of uncertainty. Economic aspect of climate change. Integrating IWRM and climate change
Learning Activities:
Lecture, exercise and fieldtrip

Institutional aspects and stakeholder participation
The importance of involving stakeholders in water management and CC adaptation and strategies on involving stakeholders
Learning Activities:
Lecture,exercise and role play

Multi sector/multicriteria decision making
Modelling effects of CC on water resources using Climateland as a case study
Learning Activities:
Lecture and computer/modelling exercise

Lecturing Material

- Lecture notes, power point presentations, background materials

Assessment

- **30%: Presentation --**
- **70%: Written exam (closed book) --**

2014/2016-ES11X: IWRM as a tool for adaptation to climate change											
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	**IWRM, climate change and the hydrological cycle**	**6**						**6**	**18**	de Ruyter, van Dorland, Maskey
2	**Â Climate change: impacts and adaptation**	**17**		**6**				**23**	**57**	de Ruyter, van der Meulen, de Fraiture, Pathirana, Popes
3	**Vulnerability and adaptation under uncertainty**	**6**		**6**				**12**	**24**	Bresser, deRuyter
4	**Institutional aspects and stakeholder participation**			**6**				**6**	**6**	Kemerink
5	**Multi sector/multicriteria decision making**			**24**				**24**	**24**	Venneker/Wenninger
6	**Oral presentations**			**6**				**6**	**6**	
7	**Field trip**					**6**		**6**	**6**	Gersonius, van der Meulen
8	**Examination**			**3**				**3**	**3**	
	Total	**29**		**51**		**6**		**86**	**144**	
MSc module - UNESCO-IHE										

URBAN WATER AND SANITATION

MASTERS PROGRAMME

Academic Year: 2014-2016
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 - climate, hard ware, a vast number of stakeholders, willingness to pay, space to store and treat, groundwater pollution, different toilet types - a proper and well-functioning faecal sludge management system is hard to achieve. In this module we will address a holistic approach on FSM. There will be a focus on technology; however, technology cannot be seen separately from planning and management aspects; therefore, non-technical aspects will also be addressed in this module.

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 --**

2014/2016-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: 2014-2016
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)**
- **28%: Assignment -- Report on four short assignments regarding advanced water distribution modelling done in WaterGEMS software: (1) Network design using GA optimiser, (2) Network criticality analysis, (3) Water quality analysis, and (4) Water hammer analysis.**
- **12%: Assignment -- GIS assignment on the exercise using ArcGIS.**

2014/2016-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: **2014-2016**
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 --**

2014/2016-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										

WATER MANAGEMENT

MASTERS PROGRAMME

Academic Year: 2014-2016
Specialization: Core Programme
Module Coordinator: Kooy, M.E.

Module Sheet

Module Name Urban water governance	Module Code WSM11	Credits 5

Target Group	Prerequisites
Young mid-career professionals who are 1) working at middle and upper level in an organization in the water sector, 2) employed in policy making institutions in the water sector, 3) working for organizations engaged in management of water resources and water services.	Mandatory: High level of ability to read and discuss academic articles and book chapters in English; willingness to engage in social science theory and new conceptual frameworks; willingness to engage in cross-disciplinary discussions and applications. Preferred: completion of the Institutional Analysis module.

Learning Objectives

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

- Articulate the relevance of current urban development debates for the provision of water supply/sanitation services.
- Identify relationships between urban governance and urban water supply/sanitation infrastructure (be able to describe how they influence and inform each other) in presented case studies.
- Apply the concept of the hydro-social cycle to analyze the intersection of social issues/processes with technical issues in urban water supply and sanitation service delivery.

Topics and Learning Activities

Introduction to urban development in the global South

Trends in urbanization; description of the urbanization process; description of current infrastructure and states of access to basic services in cities of the global South.

Learning Activities:

lecture, assigned reading

Urban development & inequality

Discussion of conditions of urban poverty; description of urban poverty measurements and trends; discussion of urban poverty, inequality and exclusion as related to urban WSS infrastructure.

Learning Activities:

lecture, assigned reading

Urban growth & slum urbanism

Discussion of urban migration; low income urban settlements; peri-urbanization and urban sprawl as related to access to water/sanitation.

Learning Activities:

lecture, assigned reading

Urban resilience

Discussion of the relationship between urbanization and climate change; climate change impacts on cities in the global South; urban resiliency planning.

Learning Activities:

lecture, assigned reading

Right to the City

social movements and urban politics; grassroots urban coalitions

Learning Activities:

lecture, assigned reading

Urban waterscapes & the hydro-social cycle

urban water supply as the inter-section of social and biophysical processes; water as a socio-natural entity

Learning Activities:

lecture, assigned reading

The modern city

Integrated urban infrastructural ideal; hydraulic paradigm and urban planning ideals

Learning Activities:

lecture, assigned reading

Lecturing Material

• Students will be provided a list of articles that are required reading.

Assessment

• 20%: Assignment -- Students will work in small groups to identify how the current key challenges for urban development, discussed in week 1, relate to access to water supply and sanitation.

• 30%: Assignment -- Students will read 2-3 journal articles per topic for week 2 and submit short written assignments.

• 50%: Assignment -- Students will write a final essay to apply the concepts learned in Week 1-2.

2014/2016-WSM11: Urban water governance											
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 development challenges in the global South	2	4					2	10	Kooy
	Urban poverty & inequality	2	4					2	10	Pouw (UvA)
	Urban growth & slum urbanism	2	4					2	10	Kooy
	Urban resilience	2	4					2	10	Kooy
	Right to the city	2	4					2	10	Rusca
	Urban waterscapes & hydro-social cycle	2	4					2	10	Smit/Kooy
	Modern city	2	4					2	10	Kooy
	The Modern city: case study	2						2	6	guest (March)
	The Splintered city	2	4					2	10	Kooy
	The Splintered city: case study	2						2	6	Kooy
	The Informal city	2	4					2	10	Schwartz/Rusca
	The Informal city: case study	2						2	6	guest
	Essay assignment		30						30	
	Total	24	66					24	138	
MSc module - UNESCO-IHE										

WATER SCIENCE AND ENGINEERING

MASTERS PROGRAMME

Academic Year: 2014-2016
Specialization: Water engineering and river basin development
Module Coordinator: Gersonius, B.

Module Sheet

Module Name Water resilient cities	Module Code WSE/11	Credits 5

Target Group	Prerequisites
All participants and external professionals dealing with urban water and flood risk management working for municipalities, water management organisation, consulting firms, educational institutions and NGOs.	BSc degree in Engineering or Social Sciences background; basic knowledge of urban water and flood risk management; good command of English.

Learning Objectives

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

- Define and assess flood and drought resilience of communities and built-up areas
- Develop short- and long-term strategies that enhance flood and drought resilience
- Explain the role of spatial planning and design philosophy in flood and drought risk management, and implement these within an overall strategy
- Analyse the need for and place of community participation and collaborative governance in enhancing flood and drought resilience

Topics and Learning Activities

Flood and drought resilience

The first week of the module introduces an approach to understand and assess flood and drought resilience of communities and built-up areas. It goes on to discuss key aspects of resilience, including the system's resistive, coping and recovery capacity. Experiences from different cities worldwide with the development of short- and long-term strategies to enhance flood and drought resilience will be addressed through formal lectures, including a field trip.

Learning Activities:

Lecture, assignment, workshop, self study.

Water Sensitive Urbanism

The second week introduces Water Sensitive Urban Design (WSUD) as a process and why it is particularly relevant to address the integrated management of the water cycle. It covers the development of WSUD and itsâ€™ contemporary meaning in exemplar cultures (Australia, UK, USA and South Africa). Also the relationship between WSUD, green infrastructure and spatial planning will be discussed, as well as how these components work together across different scale levels.

Learning Activities:

Lecture, workshop, fieldtrip, self study.

Community participation and collaborative governance

The third week of the module builds on the 2 previous weeks and explains the need for and place of community participation and collaborative governance in enhancing flood and drought resilience. Diverse topics will be addressed in a series of formal lectures, such as social/active learning, social resilience, collaborative networks and governance structures.

Learning Activities:

Lecture, workshop, self study.

Lecturing Material

- Reader with journal papers and classroom presentations

Assessment

- **50%: Oral Exam -- Topics: Flood and drought resilience; Water Sensitive Urbanism; Community participation and collaborative governance.**
- **50%: Presentation -- Topics: Flood and drought resilience; Water Sensitive Urbanism; Community participation and collaborative governance.**

2014/2016-WSE/11: Water resilient cities											
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	**Flood and drought resilience**	6	4				8	14	46	Bachhin, Gersonius, Zevenbergen
2	**Water Sensitive Urbanism**	8				8	6	22	50	Ashley, Nillisen, Veerbeek
3	**Community participation and collaborative governance**	8					6	14	42	Anema, Rijke, Pathirana
	Total	22	4			8	20	50	138	
MSc module - UNESCO-IHE										

WATER SCIENCE AND ENGINEERING

MASTERS PROGRAMME

Academic Year: 2014-2016
Specialization: Core Programme
Module Coordinator: Roelvink, J.A.

Module Sheet

Module Name Flood protection in lowland areas	Module Code WSE/HECEPD/11/e	Credits 5

Target Group	Prerequisites
	Basic knowledge of hydraulics, basic knowledge of soil mechanics

Learning Objectives

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

- carry out a basic design of dikes, revetments and closure dams
- understand concepts and advances of flood risk management with due consideration of societal aspects, including flooding issues in the floodplain and coastal zone, management of flood risk, planning aspects and a variety of non-structural measures
- understand and apply concepts and advances in tools used for coastal flood modelling and flood forecasting
- understand and apply the principles of flood frequency analysis and risk based approaches to design of hydraulic works
- understand (the practical application of) probabilistic design theory

Topics and Learning Activities

Dikes and Revetments (J. Salazar, C. Dorst)

Seadikes in The Netherlands, philosophy of dike design, definition of frequency of failure, risk analysis, design methodology for dikes, hydraulic boundary conditions, wave run-up and overtopping, geometrical design of dikes and revetments, stability for rock, artificial units, design criteria for placed block revetment, other types (bituminous, asphalt.. etc), other design considerations, geotechnical aspects related to dikes, overall stability, design of granular filter, geotextiles, geosystems, improvement and maintenance of dikes and revetments, design of bottom protection, design methodology for closures; sand closures, stone closures, caisson closures.

Learning Activities:

Lectures

Probablistic Design (P. van Gelder)

Theoretical background of probability functions, practical application of probabilistic design, various levels of probability, examples of application of probabilistic design, the use of fault trees, exercise in the application of probabilistic design in coastal engineering problems.

Learning Activities:

Lectures

Storm Impact Modelling (D. Roelvink, M. van Ormond, J. van Thiel de Vries, A. van Rooijen)

This course focuses on prediction of flooding from the sea, due to tsunamis and storms. Subjects that are treated are causes, models, effects and warning systems related to tsunamis; storm types and characteristics in different areas in the world; storm surge and extreme wave modeling; storm erosion, overtopping and inundation modeling; predictive modeling vs. (probabilistic) modeling for design purposes. Case studies based on Katrina, Ivan, Sidr and the Indian Ocean tsunami. Hands-on exercises using Delft3D and XBeach.

Learning Activities:

Lectures and Assignment

Lecturing Material

- Verhagen, H.J.: Revetments, Sea Dikes and River Levees-Lecture notes hh292/99/1
- Hassan, R.M.: handouts, Dikes and Revetments, 2002
- Groot, M.: Handouts, Geotechnical Aspects for Dikes, 2003
- Verhagen, H.J. : Design of closure of dams- Lecture notes ln0052/02
- Vrijling, J.K.: Probabilistic Design, Lecture notes ln0217/04/
- Handout: collection of tutorials and papers related to OpenEarth, Delft3D and XBeach applications.

Assessment

- **40%: Oral Exam -- Dikes and Revetments (assignment, oral discussion)**
- **40%: Assignment -- Storm impact modelling**
- **20%: Written Exam (closed book) -- Probabilistic design**

2014/2016-WSE/HECEPD/11/e: Flood protection in lowland areas											
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	**Dikes and Revetments**	**8**		**4**				**12**	**28**	C. Dorst
2	**Dikes and Revetments**	**12**						**12**	**36**	J. Salazar
3	**Probabilistic design**	**6**		**6**				**12**	**24**	P. van Gelder
4	**Storm Impact modelling**	**2**						**2**	**6**	J. A. Roelvink
5	**Storm Impact modelling**	**6**		**5**				**11**	**23**	M. van Ormondt
6	**Storm Impact modelling**	**6**		**5**				**11**	**23**	J. van Thiel de Vries
	Total	**40**		**20**				**60**	**140**	
MSc module - UNESCO-IHE										

WATER SCIENCE AND ENGINEERING

MASTERS PROGRAMME

Academic Year: 2014-2016
Specialization: Core Programme
Module Coordinator: Suryadi, F.X.

Module Sheet

Module Name Innovative approaches and practices	Module Code WSE/HELWD/11/e	Credits 5

Target Group	Prerequisites
All WSE participants and from other programmes with specific interest.	General knowledge about drip and sprinkler irrigation systems as well as GIS and remote sensing.

Learning Objectives

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

- Determine the requirements for water table and salinity control in irrigated areas; Understand the factors that influence the functioning of a drainage system; Design a subsurface drainage system
- Design surface and overhead pressure irrigation systems and understand the need for drainage in irrigated areas
- Explain the use of modern tools as RS and GIS in combination with the use of computer models
- Predict effects of different water qualities on agricultural crops, and stock farming and human health
- Determine the effects and related water management and land use zoning that are involved when living in flood prone areas
- Discuss the interactions between land use, water management and flood control in flood prone areas

Topics and Learning Activities

Introduction: Sprinkler and Drip, F. Reinders (ARC, South Africa)

Historical background, modern irrigation, definition, decision variables.
Sprinkle irrigation: The sprinkler: classification of types; hydraulics, theoretical and empirical equations, water patterns; The lateral: distribution, length, diameter, spacing between the sprinklers, uniformity; The set: decision variables, uniformity and coefficients, winds, efficiency, automation, fertigation, control; Design procedures and considerations, analysis of factors affecting uniformity, optimal design of networks using Linear Programming. Planning: data, objectives, constraints, and optimisation. Economic evaluation.
Drip irrigation: The emitter: types, hydraulics, theoretical and empirical equations; the lateral: hydraulics, length; The set: decision variables, uniformity, automation, control, fertigation.

Learning Activities:
lecture, exercise

Sub-surface Drainage, H.P. Ritzema (Wageningen University and Research)

The need for drainage: water ponding, waterlogging and salinisation. Drainage systems: components of a drainage system, surface and subsurface drainage systems. Factors related to drainage: agricultural objectives, environmental aspects, and soil and hydrological conditions. Design considerations: drainage design criteria and layout. Drainage design equations: principles and applications. Introduction, background information, and preparing the layout and design of a subsurface drainage system.

Learning Activities:
lecture, exercise

Remote Sensing for Irrigation and Drainage, Z. Vekerdy (ITC)

Introduction to the principles of remote sensing and their applications in the field of irrigation and drainage.

Learning Activities:
lecture, exercise

Reuse of Low Water Quality, P. van der Steen (UNESCO-IHE)

Sources of pollution: domestic, industrial and agricultural pollution. Types of pollution: chemical, mechanical and biological pollution. Parameters used to describe the degree of pollution: Salinity, BOD, COD, Dissolved oxygen, TSS, faecal coli, heavy metals. Reuse of water: criteria for reuse for agriculture, cattle watering and water supply. Measures for improvement of water quality: water treatment.

Learning Activities:
lecture, exercise

Land Use and Water in Flood Prone Areas, C. de Fraiture (UNESCO-IHE)

Historical and recent developments of land use and flood prone areas. The importance of land use zoning. Interactions between land use, water management and flood control.

Learning Activities:
lecture

Emerging trends in irrigation such as Flood Based Farming and Private Irrigation, C. de Fraiture (UNESCO-IHE)

Flood based farming systems, small scale private irrigation systems

Learning Activities:
lecture

Lecturing Material

- Reinders, 2010. Determining pipe sizes (hand-out).
- Reinders, 2009. Sprinkler and drip (hand-out).
- Ritzema, 2007. Subsurface drainage.
- Ritzema, 2007. Exercise Sub-surface Drainage: Case Study Pan de Azucar.
- Schultz, 2006. Opportunities and threats for lowland development. Concept for water management, flood protection and multifunctional land-use. In: Proceedings of the 9th Inter-Regional Conference on Environment-Water. EnviroWater 2006. Concepts for Watermanagement and Multifunctional Land-Uses in Lowlands, Delft, the Netherlands, 17 - 19 May, 2006.
- Schultz, 2008. Extreme weather conditions, drainage, flood management and land use. In: Proceedings of the 10th International Drainage Workshop, Helsinki, Finland and Tallinn, Estonia, 6 - 11 July 2008, Helsinki University of Technology, Helsinki, Finland.
- Schultz, 2010. Land use and water in flood prone areas.

Assessment

- **40%: Assignment -- For Sprinkler and Drip**
- **60%: Assignment -- Assignment and oral discussion for Sub-surface Drainage**

2014/2016-WSE/HELWD/11/e: Innovative approaches and practices											
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	**Sprinkler and Drip**	**8**		**8**				**16**	**32**	F.B. Reinders
2	**Subsurface Drainage**	**12**		**8**				**20**	**44**	Dr Ir H.P. Ritzema
3	**Remote Sensing for Irrigation and Drainage**	**8**		**4**				**12**	**28**	Dr. Z. Vekerdy
4	**Reuse of Low Water Quality**	**6**						**6**	**18**	N.P. van der Steen, PhD, MSc
5	**Land Use and Water in Flood Prone Areas**	**4**						**4**	**12**	Prof. C. de Fraiture, PhD, MSc
6	**Emerging trends in irrigation such as Flood Based Farming and Private Irrigatio**	**2**						**2**	**6**	Prof. C. de Fraiture, PhD, MSc
	Total	**40**		**20**				**60**	**140**	
MSc module - UNESCO-IHE										

WATER SCIENCE AND ENGINEERING

MASTERS PROGRAMME

Academic Year: 2014-2016
Specialization: HERBD
Module Coordinator: Popescu, I.I.

Module Sheet

Module Name Modelling and operation of river systems	Module Code WSE/HERBD/11/e	Credits 5

Target Group	Prerequisites
All participants in the WSE programme	Hydraulics & Basic mathematics

Learning Objectives

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

- Familiarize participants with structure of equations used to represent water phenomenas, numerical solution techniques and their representation in modelling systems and practical use of these.
- Provide participants practical experience with standard models and develop an understanding of modelling in river and lake systems
- Understand principles of reservoir control and optimisation, and develop operational rules for (multi-purpose) reservoir operation
- Develop critical assessment in assessing quality of model calibration and validation, verification and uncertainty

Topics and Learning Activities

Computational Hydraulics (I. Popescu, IHE; M. Krajcevski, USF)

The course aims to introduce numerical aspects of modelling, so that students become aware of the limitations and characteristics of hydrodynamic numerical models. The course starts with a short overview of the differential equations used in hydraulics, principles of discretisation of shallow water equations in 1D and 2D. Further the concept of Courant number, stability and accuracy, will be introduced for both implicit and explicit schemes. Emphasis will be on river and lake applications and short wave propagation.

Learning Activities:

Formal lectures, home assignments, exercises and workshops in computer lab

Model quality assessment & uncertainty (M. Werner, IHE)

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

Learning Activities:

Formal lectures, home assignments, exercises and workshops in computer lab

Reservoir control and optimisation (M.Werner, IHE)

Principles of reservoir operation rules, including standard operation policy, hedging and flood control rules. Designing reservoir operation policies using optimisation techniques such as linear and (stochastic) dynamic programming. Long term versus short term reservoir operation. Establishing objective functions for multiplie-purpose reservoirs. Planning and implementation of environmental flows.

Learning Activities:

Formal lectures, home assignments, exercises and workshops in computer lab

Modelling Applications (I. Popescu, IHE; M. Werner, IHE,; M. Mukolwe, IHE; F. Martins, U. of Algarve; L. Beevers, Hariott Watt)

Practical experience with computational numerical models will be gained by students. Modelling exercises will be in three parts; (i) Reservoir Simulation and Optimisation; (ii) River Modelling; and, (iii) Lake Modelling. The objective of this component will be the application of the theory gained in the theoretical components of the course.

Learning Activities:

Formal lectures, home assignments, exercises and workshops in computer lab

Lecturing Material

- Popescu, I., 2004: Differential Equations and Numerical Methods.UNESCO-IHE Lecture notes.
- MOHID - Hydrodynamics user manual, 2009
- Martins, F., 2011: Modelling river and lakes using MOHID. UNESCO-IHE. Lecture notes
- Handouts

Assessment

• 30%: Written Exam (closed book) -- This component reffers to the Computational Hydraulics subject.

• 30%: Written exam (closed book) -- This component reffers to the Reservoir control and optimisation subject

• 40%: Assignment -- This component is comprised of 2 components, assignments in Reservoir control and optimisation (10%) and the assignments in Modelling applications (lakes and rivers) (30%)

2014/2016-WSE/HERBD/11/e: Modelling and operation of river 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)
1	Computational Hydraulics	6		8				14	26	I. Popescu (IHE)
2	Model quality assessment & uncertainty	2		2				4	8	M. Werner (IHE)
3	Reservoir control and Optimisation	12						12	36	M. Werner (IHE)
4	Modelling Applications: reservoirs				10			10	20	M. Werner (IHE)
5	Modelling Applications: lakes	4			10			14	32	F. Martins (Algarve University)
6	Modelling Applications: rivers			4	6			10	16	I. Popescu, M. Mukolwe (IHE), L. Beevers (Herriot Watt)
	Total	24		14	26			64	138	
MSc module - UNESCO-IHE										

WATER SCIENCE AND ENGINEERING

MASTERS PROGRAMME

Academic Year: 2014-2016
Specialization: Hydroinformatics: modelling and information systems for water management
Module Coordinator: Jonoski, A.

Module Sheet

Module Name Hydroinformatics for decision support	Module Code WSE/HI/11/e	Credits 5

Target Group	Prerequisites
Participants from all Master Programmes of UNESCO-IHE	Hydrological and hydraulic modelling concepts; Basic programming skills

Learning Objectives

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

- Understand the role of system analysis in water resources planning and management
- Formulate and solve water resources problems as optimisation problems
- Distinguish and properly use different types of decision support methods for water problems
- Build simple software applications that integrate data and models across Internet
- Understand the potential of newly available data sources (e.g. remote sensing, web resources, data generated from climate and meteorological models) in advanced integrated modelling and decision support

Topics and Learning Activities

Systems analysis in water resources, D.P. Loucks (Cornell University)

Definition and role of systems analysis in engineering planning; Basic concepts; Multi-objective models and the concept of trade-offs between conflictÂ¬ing objectives; Development and use of static and dynamic stochastic simulation models of river systems.; Introduction to decision support systems and geographic information systems and their use; Exercises in multipurpose integrated river basin (or regional) water resources management modelling

Learning Activities:
Attending lectures;
Computer exercises;
Home assignment;

Decision support systems, A. Jonoski (IHE) and I. Popescu (IHE)

Introduction to decision making process; objectives and alternatives. Optimisation in decision support (single and multi-objective0. Multi-attribute decision methods and tools: formulation of decision matrix, generating and using weights, compensatory and non-compensatory decision methods. Introduction to mDSS4 decision support software; exercises and assignments with case studies implemented in mDSS4

Learning Activities:
Attending lectures;
Computer exercises;
Home assignment;

Software technologies for integration, A. Jonoski (IHE), L. Alfonso (IHE), G. Corzo (IHE), S. Seyoum (IHE)

Introduction to methods and tools for software integration of models and data: Object-oriented integration approaches.

Software integration across networks: Client-server programming, Web protocols, Technologies for integrating distributed resources: web-interfaces technologies; creating web-based and mobile phone applications with assignment exercise.

Learning Activities:
Attending lectures;
Computer exercises;
Home assignment;

Integration of weather prediction and water models, S.J. van Andel (IHE)

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

Learning Activities:
Attending lectures;
Computer workshop;

Lecturing Material

• D.P. Loucks: Lecture Notes on Water Resource Systems Modelling: Its Role in Planning and Management (chapters 2, 3, 4, 10 and 11)
• A. Jonoski: Introduction to Decision Making and Decision Support Systems (PowerPoint Slides)
• I.Popescu: Handout DSS exercises with mDSS4
• A. Jonoski: Software Technologies for Integration (PowerPoint Slides)
• A. Jonoski, S. Seyoum, G. Corzo, L. Alfonso: Handouts Software integration exercises
• S.J van Andel: Integration of weather prediction and water models (PowerPoint Slides)
• Software:- LINGO, mDSS4, AlleyCode - web editor, Apache web server with PHP, Google maps API, Eclipse + Android

Assessment

- **40%: Assignment -- Exercise report on Systems analysis in water resources**
- **30%: Assignment -- Exercise report on Decision support systems**
- **30%: Assignment -- Exercise report on Software technologies for integration**

2014/2016-WSE/HI/11/e: Hydroinformatics for decision support											
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	**Systems analysis in water resources**	**12**		**4**	**4**			**20**	**48**	D. P. Loucks
2	**Decision support systems**	**6**		**4**	**4**			**14**	**30**	A. Jonoski, I. Popescu
3	**Software technologies for integration**	**4**		**10**	**10**			**24**	**42**	A. Jonoski, G. Corzo, S. Seyoum, L. Alfonso
4	**Integration of weather prediction and water models**	**4**		**4**				**8**	**16**	S.J. van Andel
	Total	**26**		**22**	**18**			**66**	**136**	
MSc module - UNESCO-IHE										

URBAN WATER AND SANITATION

MASTERS PROGRAMME

Academic Year: 2014-2016
Specialization: Core Programme
Module Coordinator: Slokar, Y.M.

Module Sheet

Module Name MSC prep. course and MSc research proposal	Module Code UWS/UWEM/11	Credits 5

Target Group	Prerequisites
describe here your target group.	describe prerequisites..

Learning Objectives

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

- lo1

Topics and Learning Activities

Lecturing Material

Assessment

2014/2016-UWS/UWEM/11: MSC prep. course and MSc research proposal											
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)
	well									
	Total									
MSc module - UNESCO-IHE										

URBAN WATER AND SANITATION

MASTERS PROGRAMME

Academic Year: 2014-2016
Specialization: Core Programme
Module Coordinator: Education Bureau

Module Sheet

Module Name Summer course	Module Code UWS/12	Credits 1

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**

2014/2016-UWS/12: Summer course											
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: 2014-2016
Specialization: Core Programme
Module Coordinator: Ferrero, G.

Module Sheet

Module Name Groupwork Sint Maarten	Module Code UWS/13	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/her knowledge obtained during the specialisation to solve water and sanitation related issues.
- compare the complex water and sanitation issues found in a real case study with the examples from the classes
- defend his/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.
- defend the groups' findings in front of 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 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.

Groups are supported by mentors 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 can be provided on request.

• 50%: Assignment -- The first phase of the group work consists of a specialized assignment, carried out as consultants. This work will be assessed by the "client" for whom the assignment is designed.

Criteria for the evaluation of the Report:
Content:
- Did the consultants understand the local issues?
- Are the objectives from the Terms of Reference met?
- Have the consultants made reasonable assumptions to complement missing information?
- Are the calculations correct and sufficiently extensive?
- Did the group convince you as a client that this is the best solution, whenever possible in comparison to other alternatives?
Structure:
- Is the report structured in a logic way?
- Is there an executive summary?
- Are the references used included in the document?
- Are the graphics of the report fine?

Criteria for the evaluation of the Presentation:
- Is the Power Point presentation clear?
- Have the consultants summarizes in the presentation all the key messages of the report?
- Were the consultants able to answer all your questions?
- Are the consultants convinced that the solution they propose it the right way forward?
- Criteria for the evaluation of the Attitude of the group:
- Did the group work well together?
- Did they present a positive attitude (showing up in time, general interest, etc)?
- Did you have to steer them a lot, or did they show proper own initiative?

• 30%: Assignment -- The second phase of the group work is the development of a master plan with integrated solutions for the island of Sint Maarten. The report will be assessed by a panel of experts based on the following criteria:

- 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 -- The presentation of the master plan in front of the panel of experts will be assessed based on the following criteria:

- 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?

2014/2016-UWS/13: 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	2						2	6	Ferrero
	Masterclass Master Planning	2						2	6	Belt/Bodegom
	Masterclass Consultancy	4						4	12	Buijs
	Consultancy work			45				45	45	Group work mentors
	Master plan			55				55	55	Group work mentors
	Final presentations			8				8	8	Panel members
	Masterclass How to work in groups	4						4	12	Luising
	Total	12		108				120	144	
MSc module - UNESCO-IHE										

Assessment

URBAN WATER AND SANITATION

MASTERS PROGRAMME

Academic Year: 2014-2016
Specialization: Core Programme
Module Coordinator: Slokar, Y.M.

Module Sheet

Module Name MSc preparatory course and thesis research proposal	Module Code UWS/14	Credits 9

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.

2014/2016-UWS/14: MSc preparatory course and thesis research proposal											
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: 2014-2016
Specialization: SE/WSE
Module Coordinator: Salinas Rodriguez, S.G.

Module Sheet

Module Name MSc thesis research work	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.)

2014/2016-UWS/15: MSc thesis research work											
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										