Handbook MWI 2012-2014

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 Certain modules or parts of modules may be changed, withdrawn and/or replaced by other modules.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

Table of Contents

1 UNESCO-IHE

1.1 Introduction

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

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

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

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

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

1.2 MSc Degree Programmes

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

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

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

1.3 Research and PhD Programmes

UNESCO-IHE carries out scientific research, often in co-operation with universities and research institutes in developing countries. A number of positions are available for PhD research. The PhD programme has a nominal duration of 4 years and can be carried out either in Delft or in a sandwich

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

1.4 Organisation

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

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

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

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

2 Programme framework

2.1 Introduction

The Master of Science Degree Programmes

The Institute provides the following Master of Science degree programmes:

- the master programme in Environmental Science;
- the master programme in Municipal Water and Infrastructure;
- the master programme in Water Management; and
- the master programme in Water Science and Engineering.

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

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

2.2 Academic Regulations

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

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

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

2.3 Structure of the Programmes

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

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

Within each programme, the following generic components are distinguished:

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

2.4 Curriculum Information

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

- the name and code of the subject;
- the learning objectives;
- the pre-requisite knowledge or skills;
- the study load hours and credit points;
- the lecture, exercise and examination contact hours;
- the nature and weights of the examination parts;
- the responsible lecturers/examiners;
- a concise description of the contents and working methods; and
- the required and recommended literature, and other materials.

2.5 Learning Objectives

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

Similarly, each component of the curriculum has a set of learning objectives, which detail the specific outcomes if the student completes that part of the programme. The individual subjects usually aim to achieve a further detailed subset of the overall learning objectives.

2.6 Working Methods

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

Lectures serve one or more of the following functions:

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

An exercise takes one of the following forms:

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

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

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

2.7 Examinations

Examinations serve to test if students have achieved the learning objectives for a specific component of the programme, and ultimately those of the programme itself. The examination for a component may be composed of multiple parts. For example, a combination of a written or oral test and one or more assignments to handed in separately. Examination work can also be produced by (small) groups of students working together on an assignment, e.g. the groupwork report.

Assessment of examination material is carried out by appropriate examiners, which are usually the involved lecturers. Students who successfully complete a component of the programme will be granted the credit points for that component. Fieldtrips may require active participation instead of an examination in order to receive the credit points.

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

2.8 Study Load

All scheduled education activity taking place in the presence of a lecturer or an assistant is designated as contact time. All other time spent by students in relation to the study programme is designated as independent study time.

The study load for (a part of) a programme is the cumulative contact time and independent study time that is nominally required to successfully complete that (part of the) programme. Study load is expressed in whole ECTS credit points, where one ECTS credit point is equivalent to 28 working hours.

The study load credits for a curricular activity indicate the notional time spent by an average learner to achieve the required outcomes for that activity, as specified by the learning objectives. The nominal time expenditure for a 5 ECTS credit points module is therefore 140 hours.

Where study load involves scheduled class-based activity, one lecture period is taken equal to two hours of contact time.

2.9 Planning and Scheduling

Lectures and exercises taking place inside the Institute are, in principle, scheduled into ‘periods’ of two hours each, for which the following times are available:

Period 1 08:45 – 09:30 and 09:45 – 10:30

Period 2 10:45 – 11:30 and 11:45 – 12:30

Period 3 13:45 – 14:30 and 14:45 – 15:30

Period 4 15:45 – 16:30 and 16:45 – 17:30

Throughout the academic year, the student will receive the following information and materials:

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

2.10 Participation

Active participation and attendance by students is required for all curricular activities on the schedule. 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:

Education and examination regulation cohort 2012-2014 (pdf)

3.2 Library regulations

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

The UNESCO-IHE Library Services provides access to a large number of on-line information resources and databases. Access to these resources is provided to all computer users within the premises at Westvest and through remote authentication via the UNESCO-IHE portal.

By using these on-line resources you agree with the following conditions:

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

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

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

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

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

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

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

3.3 Code of conduct

THE RECTORATE OF UNESCO-IHE

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

In accordance with article 7.57h and article 9.2, first paragraph, of the Higher Education and Scientific Research Act of the Netherlands;

Having heard the Student Association Board;

RESOLVES

To establish the following Regulations:

Article 1 Definitions

1.1 WHW

Higher Education and Scientific Research Act of the Netherlands (Staatsblad Bulletin of Acts and Decrees 1992, 593);

1.2 the Director

The director of UNESCO-IHE

1.3 the Rectorate

The director and the deputy director

1.4 Central services department

The central services department of UNESCO-IHE

1.5 Facilities

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

1.6 Buildings

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

1.7 Student

Anyone who is enrolled at UNESCO-IHE for the purpose of education provided by UNESCO-IHE

and who uses the educational and examination facilities of UNESCO-IHE for this purpose;

1.8 Visitor

Anyone who is not a student nor is employed by IHE-Delft as referred to in article 1.1 of the Collective Labour Agreement (CAO) for Dutch Universities.

Article 2 Compliance requirement for rules, guidelines and instructions

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

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

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

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

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

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

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

Article 3 Disciplinary Measures

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

a. excluding the student or visitor from the buildings and grounds of UNESCO-IHE or from one or more parts of UNESCO-IHE, with the provision that a student may only be excluded from buildings or grounds in whole or in part for a period not to exceed one year;

b. excluding the student or visitor from the use of the facilities of UNESCO-IHE;

c. fining the student if such fine has been agreed on or follows from the statute;

d. issuing a written reprimand;

e. retribution for damages to properties and or facilities.

Article 4 Exclusion Order by the Rectorate

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

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

4.3 The exclusion order will contain at least the following:

a. an indication of the buildings and/or grounds or the parts of the buildings and/or grounds of UNESCO-IHE and/or the facilities or use of the facilities of UNESCO-IHE to which the exclusion order applies;

b. the duration of the exclusion order;

c. the reasons for the exclusion order;

d. any conditions which will result in the effectuation of the exclusion order in case of non-compliance.

Article 5 Termination of the exclusion order

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

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

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

Article 6 Entry into force

These Regulations enter into force on October 1st 2007

Article 7 Method of Citation

These Regulations may be cited as “Regulations for the use of buildings, grounds and facilities by students and visitors of UNESCO-IHE”.

Approved in the rectorate meeting of September 25th 2007

4 MWI Programme

4.1 Introduction MWI programme

The Municipal Water and Infrastructure Programme educates professionals that:

- can place their profession in the wider social, economic and environmental contexts of urbanisation and
  municipal water and infrastructure services provision;
- possess the engineering and related knowledge and skills required to act as a competent professional in
  their area of chosen specialisation;
- can contribute to the development of innovative approaches to the provision of sustainable and equitable
  municipal water and infrastructure services in developing and transition countries.

The programme offers the following specialisations:

- WSE Water Supply Engineering
- SE Sanitary Engineering
- UWEM Urban Water Engineering 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 double degree programme together with AIT Bangkok.

4.2 Learning objectives MWI programme

- Place their profession in the wider social, economic and environmental contexts of urbanisation and municipal water and infrastructure services provision;
- Act as a competent professional in their area of chosen specialisation;
- Contribute to the development of innovative approaches to the provision of sustainable and equitable municipal water, sanitation, environmental and infrastructure services in developing and transition countries.

4.3 3. Specializations

Urban Water Engineering and Management
You will learn to deliver both water and wastewater services within the context of the urban water cycle, covering both technical and management aspects.

Sanitary Engineering
You will learn to design solid waste and wastewater collection and treatment systems and develop rational approaches towards sustainable waste management via cleaner production, appropriate treatment and re-use.

Water Supply Engineering
You will learn to deal with technical aspects of drinking water treatment and distribution in an integrated way, paying attention to the choice of technologies and tools, ranging from low-cost to advanced options.

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 programme graduates will be able to:

Knowledge and Theory:

- ¿ Apply gained knowledge and skills in practice
  Understand and explain the role of sanitation in urban water cycle and its relation to public health and environment
- ¿ Develop rational approaches towards sustainable waste(water) management via pollution prevention, appropriate treatment, resources recovery and re-use on both centralized and decentralized level
- ¿ In-depth understand relevant physical, chemical and biological processes, and their mutual relationships within various sanitation components.

Methods, Techniques and Tools:

- ¿ Prepare conceptual engineering and process design of sanitation components
- ¿ Apply modern tools for technology selection and carry out modelling of sanitation components

Analysis, Synthesis and Integration:

- ¿ Define and critically analyse, assess and evaluate various urban drainage and sewerage schemes, and wastewater, sludge and solid waste treatment process technologies
- ¿ 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:

- ¿ Identify, develop and conduct independent research including formulation of hypotheses selection and application of research methodologies, and the formulation of conclusions and recommendations
- ¿ Carry on desk studies, field work, and laboratory based research
- ¿ 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

- ¿ Clearly communicate concerning both oral and written skills
- ¿ Continuously acquire knowledge and assimilate and implement innovative learning methods and
  skills in an independent manner
- ¿ Operate both autonomously and in a multidisciplinary and multinational environment

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, graduates will:

Knowledge and Theory:

- Have understanding of the structure of drinking water supply systems, including water transport, treatment and distribution
- Have understanding of water quality criteria and standards, and their relation to public health, environment and urban water cycle
- Have in-depth understanding of occurring physical, chemical and biological phenomena and their mutual relationships, within water supply systems
- Have understanding of water quality concepts and their effect on treatment process selection
- Have understanding of the interaction of water quality and materials applied
- Have understanding of hydraulic concepts and their relationship to water transport in treatment plants, pipelines and distribution networks

Methods, Techniques and Tools:

- Be able to design and to rehabilitate raw water abstraction, transport, treatment and distributionprocesses and systems
- Understand the importance and methods for operation and maintenance of water supply systems
- Understand options for centralised and urban systems versus decentralized and rural systems

Analysis, Synthesis and Integration:

- Be able to define and evaluate project alternatives on basis of chosen selection criteria
- Be able to use statistical and modelling tools for simulating, prediction of performance and operation of water supply system components
- Understand water supply engineering within a watershed context

Research:

- Be able to conduct independent research, including formulation of hypotheses, selection and application of research methodologies, and the formulation of conclusions and recommendations

General Academic Skills:

- ¿
- ¿ *Posses the learning skills to acquire continual knowledge in an independent manner*

Be able to communicate effectively in oral and written presentations to technical and non-technical audiences

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.

More specifically, the learning objectives of the program will include the following:

Subject knowledge and skills:

- ¿ Understanding of the urban water cycle and its water system components, their characteristics and functioning within greater urban infrastructure systems
- ¿ Understanding of 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
- ¿ Ability to 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
- ¿ Understanding of water infrastructure/asset planning, financing and management, and utility management
- ¿ 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:

- ¿ Ability to identify, articulate, analyse and solve problems of the urban water cycle and systems, integrating theory and applications
- ¿ Collect, summarise, analyse and interpret technical data/materials in a structured form to gain knowledge on urban water system design and operation and maintenance
- ¿ Ability to critically recognize and assess the need for continued-education and research on planning, design, maintenance and management of urban water systems
- ¿ 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:

- Improved skills for independent learning
- Enhanced reporting and presentation skills
- Improved IT skills
- Ability to work independently or as part of a team
- Ability to manage time effectively

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.

6 Academic Calendar

UNESCO-IHE - Academic Calendar 2012/2014

YEAR 1	2012										
	October		November				December				
Week	42	43	44	45	46	47	48	49	50	51	52
Mon	15	22	29	05	12	19	26	03	10	17	24
Tue	16	23	30	06	13	20	27	04	11	18	25
Wed	17	24	31	07	14	21	28	05	12	19	26
Thu	18	25	01	08	15	22	29	06	13	20	27
Fri	19	26	02	09	16	23	30	07	14	21	28
Sat	20	27	03	10	17	24	01	08	15	22	29
Sun	21	28	04	11	18	25	02	09	16	23	30
			(2x5 ECTS)								
		Module 1			Module 2				Module 3		

YEAR 1	2013																			
	January				February				March					April				May		
Week	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20
Mon	31	07	14	21	28	04	11	18	25	04	11	18	25	01	08	15	22	29	06	13
Tue	01	08	15	22	29	05	12	19	26	05	12	19	26	02	09	16	23	30	07	14
Wed	02	09	16	23	30	06	13	20	27	06	13	20	27	03	10	17	24	01	08	15
Thu	03	10	17	24	31	07	14	21	28	07	14	21	28	04	11	18	25	02	09	16
Fri	04	11	18	25	01	08	15	22	01	08	15	22	29	05	12	19	26	03	10	17
Sat	05	12	19	26	02	09	16	23	02	09	16	23	30	06	13	20	27	04	11	18
Sun	06	13	20	27	03	10	17	24	03	10	17	24	31	07	14	21	28	05	12	19
	(2x5 ECTS)								(2x5 ECTS)						(2x5 ECTS)					
				Module 4				Module 5			Module 6			Module 7			Module 8			

YEAR 1	2013																					
	fieldtrip										Groupwork											
		June					July				August				September					October		
Week	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
Mon	20	27	03	10	17	24	01	08	15	22	29	05	12	19	26	02	09	16	23	30	07	14
Tue	21	28	04	11	18	25	02	09	16	23	30	06	13	20	27	03	10	17	24	01	08	15
Wed	22	29	05	12	19	26	03	10	17	24	31	07	14	21	28	04	11	18	25	02	09	16
Thu	23	30	06	13	20	27	04	11	18	25	01	08	15	22	29	05	12	19	26	03	10	17
Fri	24	31	07	14	21	28	05	12	19	26	02	09	16	23	30	06	13	20	27	04	11	18
Sat	25	01	08	15	22	29	06	13	20	27	03	10	17	24	31	07	14	21	28	05	12	19
Sun	26	02	09	16	23	30	07	14	21	28	04	11	18	25	01	08	15	22	29	06	13	20
	(1x5 ECTS)			(2x5 ECTS)								(1x5 ECTS)				(2x5 ECTS)						
	Module 9			Module 10			Module 11					Module 12				Module 13			Module 14			

YEAR 2	2013									
	Oct	November				December				
Week	43	44	45	46	47	48	49	50	51	52
Mon	21	28	04	11	18	25	02	09	16	23
Tue	22	29	05	12	19	26	03	10	17	24
Wed	23	30	06	13	20	27	04	11	18	25
Thu	24	31	07	14	21	28	05	12	19	26
Fri	25	01	08	15	22	29	06	13	20	27
Sat	26	02	09	16	23	30	07	14	21	28
Sun	27	03	10	17	24	01	08	15	22	29

YEAR 2	2014																
	January				February				March					April			
Week	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17
Mon	30	06	13	20	27	03	10	17	24	03	10	17	24	31	07	14	21
Tue	31	07	14	21	28	04	11	18	25	04	11	18	25	01	08	15	22
Wed	01	08	15	22	29	05	12	19	26	05	12	19	26	02	09	16	23
Thu	02	09	16	23	30	06	13	20	27	06	13	20	27	03	10	17	24
Fri	03	10	17	24	31	07	14	21	28	07	14	21	28	04	11	18	25
Sat	04	11	18	25	01	08	15	22	01	08	15	22	29	05	12	19	26
Sun	05	12	19	26	02	09	16	23	02	09	16	23	30	06	13	20	27

Legend
- = Lecture period
- = Examination period
- = MSC thesis writing period
- = Holiday / free time period
- = Opening acad. year 2012 Oct 18
- = Diploma awarding:

Christmas:	25/26 Dec 2012
Good Friday:	29 March 2013
Easter:	31 March/1 April 2013
Queensday:	30 April 2013
Liberationday:	5 May 2013
Ascencion:	9 May 2013
Pentecost:	19/20 May 2013
Christmas:	25/26 Dec 2013
Good Friday:	18 April 2014
Easter:	20/21 April 2014

MASTERS PROGRAMME MWI 2012-2014 - PART 2

Table of Contents

MUNICIPAL WATER AND INFRASTRUCTURE

MASTERS PROGRAMME

Academic Year: 2012-2014
Specialization: Core Programme
Module Coordinator: H.J. Lubberding, PhD, MSc

Module Sheet

Module Name Week 1, GIS, Hydrology, Chemistry	Module Code MWI/01	Credits 5

Target Group	Prerequisites
Programme target group	Programme prerequisites

Learning Objectives

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

- for objective Week 1; see separate sheet for Week 1
- for GIS the aim is to provide both an understanding and a practical introduction to the use of geographic information systems and remote sensing technologies for the analysis and solution of different water and environmental problems. Upon completion of the course, the participants will be able to:
  have a fundamental understanding of the GIS and remote sensing technologies;
  understand the basic principles underlying the GIS/model-based management of water systems;
  become aware of the GIS-based analytical and problem-solving techniques for sustainable planning and management of urban water systems.
- understand the basic elements of (water) chemistry and hydrology;
- apply chemical and hydrological principles in water and wastewater engineering;

Topics and Learning Activities

Geographic Information Systems (GIS)

See the objectives. Some attention will be also given to the complementary role of data gathering systems, spatial/temporal databases, numerical modelling and decision support systems.

Learning Activities:

Lectures, computer models.

Hydrology

The content of hydrology will be: hydrological circle, 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 extraction; theory of groundwater flow, flow towards wells, superposition and boundary effects, potential and stream functions, development of observation and production wells; groundwater pollution.

Learning Activities:

Lectures, workshops (participants present solution of problems).

Chemistry

After a brief refreshment of the basic chemical knowledge, water chemistry will deal with structure and properties of matter, chemical reactions in general, chemical calculations, reactions in aqueous solutions and at surfaces, principles of analytical chemistry and chemistry of organic compounds in water.

Learning Activities:

Lectures and laboratory work.

Lecturing Material

- Lecture notes GIS
- Lecture notes Hydrology
- Lecture + laboratory notes Chemistry

Assessment

- **60%: Written Exam (closed book)**
- **15%: Assignment**
- **25%: Assignment**

2012/2014-MWI/01: Week 1, GIS, Hydrology, Chemistry											
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)**
	Week 1		**40**						**40**	various
	Geographic Information Systems	**6**						**6**	**18**	Vojinovic
	Hydrology	**8**	**8**					**8**	**32**	Wenninger, Nonner
	Chemistry	**12**		**8**				**20**	**44**	Slokar, Buiteman
	Excursion					**8**		**8**	**8**	
	Total	**26**	**48**	**8**		**8**		**42**	**142**	
MSc module - UNESCO-IHE										

MUNICIPAL WATER AND INFRASTRUCTURE

MASTERS PROGRAMME
Academic Year: **2012-2014**
Specialization: **Core Programme**
Module Coordinator: **H.J. Lubberding, PhD, MSc**

Module Sheet

Module Name **Integrated urban water management, demography, public health**	**Module Code** **MWI/02**	**Credits** **5**

Target Group	**Prerequisites**
Programme target group	Programme prerequisites

Learning Objectives

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

- 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.
  - To forecast water demand in a city, based on population forecasts, per capita use and Water Demand Management measures

  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 analyse dynamic interactions between human development and changes in water and wastewater engineering. NEEDS ADJUSTMENT

Topics and Learning Activities

Integrated Urban Water Management

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

Human health

In human health the relation between environmental pollution and human diseases is discussed.

Learning Activities:

Lectures and group discussions, culminating in an assignment (analysis and presentation of gathered information.

Demography

In demography the components of demographic change (fertility, mortality, migration, population models) will be discussed in relation with sustainable development.

Learning Activities:

Lectures and group discussions, culminating in an assignment (analysis and presentation of gathered

information).

Lecturing Material

- IUWM Moodle Lecture Notes
- Public health lecture noters
- Demography lecture notes

Assessment

- **30%: Written Exam (closed book)**
- **45%: Written exam (closed book)**
- **25%: Assignment**

2012/2014-MWI/02: Integrated urban water management, demography, 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)**
	Intro IUWM and Technical report assignment	**1**	**21**					**1**	**24**	van der Steen
	IUWM Technical writing	**4**						**4**	**12**	Sturrock
	IUWM Systems analysis and the Urban Water System	**4**		**8**				**12**	**20**	van der Steen
	IUWM Material flows, Water and Energy	**2**		**4**				**6**	**10**	van der Steen
	IUWM Strategic planning for the Urban Water System	**4**						**4**	**12**	van der Steen
	IUWM Masterplanning for the Urban Water System	**4**						**4**	**12**	Brdjanovic
	IUWM Water supply and Water Demand Management	**8**						**8**	**24**	Sharma
	IUWM Stakeholder participation in urban water	**4**						**4**	**12**	Kemerink
	Demography	**8**	**4**					**8**	**28**	Visser
	Public Health	**8**	**8**					**8**	**32**	Hamel
	Fieldtrip					**4**		**4**	**4**	
	Total	**47**	**33**	**12**		**4**		**63**	**190**	
MSc module - UNESCO-IHE										

MUNICIPAL WATER AND INFRASTRUCTURE

MASTERS PROGRAMME

Academic Year: 2012-2014
Specialization: Core Programme
Module Coordinator: H.J. Lubberding, PhD, MSc

Module Sheet

Module Name Microbiology and environmental process technology	Module Code MWI/03	Credits 5

Target Group	Prerequisites
Programme target group	Programme prerequisites

Learning Objectives

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

- understand the basic elements of (water) microbiology and process technology;
- apply microbiological and process technological principles in water and wastewater engineering;

Topics and Learning Activities

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.

Environmental Process Technology (EPT)

In environmental process technology: mass balance analysis, reactor models, mixing in reactors, kinetics, mathematical description of chemical and biological reactions in reactors.

Learning Activities:

Lectures, workshops

Lecturing Material

Assessment

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

2012/2014-MWI/03: Microbiology and environmental process technology											
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	Microbiology	12		12				24	48	Lubberding
2	EPT	18						18	54	van der Steen
	Total	30		12				42	102	
MSc module - UNESCO-IHE										

MUNICIPAL WATER AND INFRASTRUCTURE

MASTERS PROGRAMME
Academic Year: **2012-2014**
Specialization: **WSE**
Module Coordinator: **G. Ferrero**

Module Sheet

Module Name Surface water treatment I	Module Code MWI/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)**

2012/2014-MWI/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**	G. Ferrero, PhD
	Total	**30**	**4**	**16**	**11**	**4**		**61**	**136**	
MSc module - UNESCO-IHE										

MUNICIPAL WATER AND INFRASTRUCTURE

MASTERS PROGRAMME

Academic Year: 2012-2014
Specialization: Core Programme
Module Coordinator: S.D Seymoum, MSc

Module Sheet

Module Name Urban drainage and sewerage	Module Code MWI/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 inputs, outputs and functioning of urban drainage/sewerage systems;
- Describe hydrological processes relevant to urban storm drainage, impacts of urbanization and climate change on hydrological processes and recommend various methods to mitigate adverse hydrological impacts of urbanization;
- Describe characteristics and design, construction and operation and maintenance aspects of different types of urban drainage systems;
- Describe the standard practice in designing urban drainage systems and develop simple drainage system designs;
- Describe basic concepts of urban catchment modelling, free surface flow and conduit flows;
- construct a simple model for analysis of hydraulics of a drainage system; interpret simple model results and use them for decision making in design, renewal and upgrading 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
Sewer system layout, approaches to urban drainage system
design, design criteria, sewer design calculations
Learning Activities:
Lectures, exercise and assignment

Hydraulics of drainage systems
pipe/channel flow, unsteady hydraulics, pumping stations;
Learning Activities:
Lectures, exercise and assignment

Model-based design and simulation
modelling principles, modelling tools, application
of models
Learning Activities:
Lecture, exercise and assignment

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

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

Lecturing Material

Assessment

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

2012/2014-MWI/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	Seyoum
	Dry and wet weather flows quantitative characterization and exercise	4	2	2				6	16	Brdjanovic
	Conventional sewer design exercise						8	8	24	Â Seyoum
	Hydraulics of urban drainage and sewerage	6	2					6	20	Seyoum
	Pumping stations and CSOs	4						4	12	Seyoum
	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	2		8				10	14	Vojinovic
	Fieldtrip					4		4	4	Seyoum
	Â									
	Total	35	4	10		4	8	57	147	
MSc module - UNESCO-IHE										

MUNICIPAL WATER AND INFRASTRUCTURE

MASTERS PROGRAMME

Academic Year: 2012-2014
Specialization: Core Programme
Module Coordinator: C.M. Lopez Vazquez, PhD, MSc

Module Sheet

Module Name Conventional wastewater treatment	Module Code MWI/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

• 100%: Written Exam (closed book)

2012/2014-MWI/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										

MUNICIPAL WATER AND INFRASTRUCTURE

MASTERS PROGRAMME

Academic Year: 2012-2014
Specialization: Core Programme
Module Coordinator: P.D.A. Pathirana, PhD, MSc

Module Sheet

Module Name Asset management	Module Code MWI/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**

2012/2014-MWI/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	Â 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	Â 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										

MUNICIPAL WATER AND INFRASTRUCTURE

MASTERS PROGRAMME

Academic Year: **2012-2014**
Specialization: **Water supply engineering**
Module Coordinator: **S.G. Salinas Rodriguez, PhD**

Module Sheet

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

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

Learning Objectives

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

- Understand the principles of disinfection, ion exchange, softening, adsorption and activated carbon filtration processes.
- 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

Conventional disinfection, chlorination principles and practice and an overview of disinfection by products. Break-point chlorination, advanced disinfection processes (ozone/UV).

Adsorption

Theoretical background of adsorptive processes

Activated carbon

Granular and powdered activated carbon, modelling and design

Chemical softening

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

Ion exchange

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

Lecturing Material

- P. Kelderman and G.F. Kruis, Lab. Course Aquatic Chemistry (EE353/99/1)
- Amy, G.L. Organic matter characterization
- Buiteman, J.P. Ion exchange and chemical softening
- E. Orlandini, Application of activated carbon in water treatment

Assessment

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

2012/2014-MWI/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.C. Schippers, PhD
	Drinking water quality	**2**		**2**				**4**	**8**	Prof. G-J. Medema, PHD
	Surface water collection and storage	**2**		**4**				**6**	**10**	J.P. Buiteman, MSc
	NOM characterization	**2**						**2**	**6**	S.G. Salinas Rodriguez, PhD
	Disinfection	**12**		**4**	**7**			**23**	**54**	J. Kruithof, PhD
	Adsorption	**4**		**2**				**6**	**14**	S. Sharma, PhD
	Activated carbon	**4**			**4**			**8**	**20**	S. Sharma, PhD / J.P. Buiteman, MSc
	Chemical softening and Ion exchange	**4**		**2**	**4**			**10**	**22**	J.P. Buiteman, MSc
	Fieldtrip					**2**		**2**	**2**	S.G. Salinas Rodriguez, PhD
	Total	**32**		**14**	**15**	**2**		**63**	**142**	
MSc module - UNESCO-IHE										

MUNICIPAL WATER AND INFRASTRUCTURE

MASTERS PROGRAMME

Academic Year: 2012-2014
Specialization: SE
Module Coordinator: M. Ronteltap, PhD

Module Sheet

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

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

Learning Objectives

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

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

Topics and Learning Activities

Anaerobic Wastewater Treatment

Fundamentals about anaerobic degradation and its application in wastewater treatment.

Learning Activities:

Lectures; process design exercise; laboratory assignment; field trip

Urine Treatment; Greywater Treatment

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

Different technologies for the treatment of greywater with the possibility of reusing greywater as a secondary water stream (e.g. irrigation).

Learning Activities:

Lectures and laboratory exercise.

Effluent reuse in agriculture

Waste Stabilisation Ponds; Constructed Wetlands; Soil aquifer treatment

Technology of Waste Stabilisation Ponds and their application.

Technology of Constructed Wetlands and their application.

Technology of SAT.

Learning Activities:

Lectures; process design exercise

Algae photobioreactors

Energy recovery (in view of New Sanitation)

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

Learning Activities:

Lecture

Sustainability of large WWTPs; WWTP as Energy Factory

Large WWTPs have invested significantly to turn from large energy consumers into energy producing factories. Also in nutrient and water recovery big developments were booked.

Learning Activities:

Lectures

Lecturing Material

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

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

2012/2014-MWI/SE/06: Resource oriented wastewater treatment and sanitation											
Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: studyload hours	Lecturer(s)
	General Introduction to Anaerobic WWT	2						2	6	Prof. J.B. van Lier
	Microbiology and iochemistry of anaerobic conversion processes	2						2	6	Dr. N.P. van der Steen
	Basic calculations, working with COD balances			2				2	2	Prof. J.B. van Lier
	Anaerobic Reactor Technology	2						2	6	Prof. J.B. van Lier
	Anaerobic treatment of Domestic Sewage	2						2	6	Prof. J.B. van Lier / Dr. C. Chernicharo
	Start-Up and Granulation	2						2	6	Prof. J.B. van Lier
	Post Treatment of anaerobically pretreated sewage	2						2	6	Dr. C. Chernicharo
	Bio-assays for Specific Methanogenic Activity; Biochemical Methane Potential; I	2						2	6	Prof. J.B. van Lier
	Novel Development: Anaerobic Membrane Bioreactors	2						2	6	Prof. J.B. van Lier
	Field Trip I									Dr. M. Ronteltap
	Urine Treatment	2		2				4	8	Dr. M. Ronteltap
	Greywater Treatment	2						2	6	Dr. M. Ronteltap; Dr. L. Hernandez-Leal
	Lab Resource Recovery			4				4	4	Dr. M. Ronteltap
	Waste Stabilisation Ponds	4						4	12	Dr. N.P. van der Steen
	WSP Exercise			2				2	2	Dr. N.P. van der Steen
	Constructed Wetlands	4						4	12	Dr. H. van Bruggen
	CW Exercise			2				2	2	Dr. H. van Bruggen
	Field Trip II					6		6	6	Dr. M. Ronteltap
	Sustainability of Large WWTPs	2						2	6	Prof. D. Brdjanovic
	New Sanitation: Energy Recovery			2				2	2	Prof. G. Zeeman
	WWTP as Energy Factory			2				2	2	Prof. M. van Loosdrecht; Dr. M. de Kreuk
	Resource Recovery in Hospital Waste			2				2	2	N. Wortel, MSc
	Field Trip III					2		2	2	N. Wortel, MSc
	Algae Photobioreactors	2						2	6	Dr. N.P. van der Steen
	Effluent Reuse in Agriculture	2						2	6	Prof. J.B. van Lier
	Soil Aquifer Treatment	2						2	6	Dr. S.K. Sharma
	Environmental Factors affecting Anaerobic WWT	2						2	6	Prof. J.B. van Lier
	Total	38		18		8		64	140	
MSc module - UNESCO-IHE										

MUNICIPAL WATER AND INFRASTRUCTURE

MASTERS PROGRAMME
Academic Year: **2012-2014**
Specialization: **Core Programme**
Module Coordinator: **B. Petrusevski, PhD, MSc**

Module Sheet

Module Name Groundwater treatment and resources	Module Code MWI/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**

2012/2014-MWI/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										

WATER MANAGEMENT

MASTERS PROGRAMME

Academic Year: 2012-2014
Specialization: Core Programme
Module Coordinator: M.W. Blokland, MSc

Module Sheet

Module Name Managing water organisations	Module Code WSM06	Credits 5

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

Learning Objectives

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

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

Topics and Learning Activities

Water Organizations in Context

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

Water Organisations at Work

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

Lecturing Material

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

Assessment

- **100%: Assignment**

2012/2014-WSM06: Managing water organisations											
Nr	**Course/Topic**	**Lecture**	**Assignment**	**Workshop Case study Role play Exercise Lab session**	**Laboratory work**	**Fieldtrip - Fieldwork**	**Design exercise**	**SUM: contact hours**	**SUM: studyload hours**	**Lecturer(s)**
1	**Introduction**									
1.1	Course and Fieldtrip Introductions			2				2	2	Blokland
1.2	Managing a Water Utility			8				8	8	To be announced
2	**Water Organisations in Context**									
2.1	Organisations Undergoing Reform			6				6	6	Schwartz
2.2	Mandate and Structure of RBO\\\'s			6				6	6	Mostert
2.3	Environment and Strategy			6				6	6	Schouten
2.4	Scale and Scope of Operations			8				8	8	Douven
3	**Water Organisations at Work**									
3.1	Effective Organisations			6				6	6	Schuurmans
3.2	Performance and Benchmarking			10				10	10	Blokland
3.3	Integrity, Sustainability			6				6	6	Mairesse, Fahsi
3.4	Health and Safety			6				6	6	Harle
3.5	Asset Management			8				8	8	van Dijk
3.6	Customer Management			6				6	6	Beltman
3.7	Human Resources Management			6				6	6	van Heijzen
4	**Fieldtrip**					**16**		**16**	**16**	Waternet Amsterdam & Drinking water utility WMD
5	**Assignment**		**43**						**43**	
	Total		**43**	**84**		**16**		**100**	**143**	
MSc module - UNESCO-IHE										

MUNICIPAL WATER AND INFRASTRUCTURE

MASTERS PROGRAMME

Academic Year: 2011-2013
Specialization: Core Programme
Module Coordinator: Dr. C.M. Lopez Vazquez

Module Sheet

Module Name Wastewater treatment plants design and engineering (NEW)	Module Code MWI/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, 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, demonstration of design software, 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 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.

Lecturing Material

• TBD

Assessment

2012/2014-MWI/SE/07: Wastewater treatment plants design and engineering (NEW)											
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**				**6**	**14**	Prof. D. Brdjanovic, Dr. C.M. Hooijmans
2	**Engineering Economics**	**4**		**2**				**6**	**14**	Dr. M. Schouten or Dr. M. Biljsma
3	**Costing**	**4**		**2**				**6**	**14**	TBD
4	**Engineering process layouts and process flow diagrams**	**4**		**8**				**12**	**20**	TBD
5	**Hydraulic design.**			**6**				**6**	**6**	TBD
6	**Design and Engineering of Conventional Activated Sludge (CAS) Systems**			**10**				**10**	**10**	TBD
7	**Design and Engineering of Conventional UASB systems.**	**2**		**14**				**16**	**20**	van Lier, Chernicharo, van der Steen.
8	**Design and Engineering of land-based wastewater treatment systems**	**4**		**8**				**12**	**20**	Â Prof. M. von Sperling
9	**Design and Engineering of On-Site Sanitation Systems**	**4**		**6**				**10**	**18**	TBD
	Total	**26**		**58**				**84**	**136**	
MSc module - UNESCO-IHE										

MUNICIPAL WATER AND INFRASTRUCTURE

MASTERS PROGRAMME

Academic Year: 2012-2014
Specialization: Water Supply Engineering, Urban Water Engineering and Management
Module Coordinator: N. Trifunovic, PhD, MSc

Module Sheet

Module Name Water transport and distribution	Module Code MWI/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)**
- **40%: Assignment**

2012/2014-MWI/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**	**24**		**12**			**12**	**48**	**120**	N.Trifunovic, A.Pathirana, J.Vreeburg
2	**Water Loss Management and Control**	**6**		**2**				**8**	**20**	S.Sharma
	Total	**30**		**14**			**12**	**56**	**140**	
MSc module - UNESCO-IHE										

MUNICIPAL WATER AND INFRASTRUCTURE

MASTERS PROGRAMME

Academic Year: 2012-2014
Specialization: Core Programme
Module Coordinator: C.M. Hooijmans, PhD, MSc

Module Sheet

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

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

Learning Objectives

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

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

Topics and Learning Activities

Wastewater treatment modelling

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

Learning Activities:

Presentations, tutorial and AQUASIM computer exercises.

Modelling activated sludge processes: ASM approach

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

Learning Activities:

Presentations, case studies.

Modelling of an activated sludge plant using BioWin

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

Learning Activities:

Presentations, computer exercise.

Modelling anaerobic reactors using BioWin

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

Learning Activities:

Presentations, computer exercise.

Modelling pond systems

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

Learning Activities:

Presentations, computer exercise.

Modelling membrane bioreactors using AQUASIM

Modelling following the ASM approach

Learning Activities:

Presentations, computer exercises.

Lecturing Material

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

Assessment

- **25%: Assignment**
- **15%: Assignment**
- **60%: Written Exam (closed book)**

2012/2014-MWI/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)**	**6**		**14**				**20**	**32**	Hooijmans
4	**Modelling activated sludge processes**	**4**						**4**	**12**	van Loosdrecht
5	**Data and process evaluation**	**4**						**4**	**12**	Meijer
6	**Activated sludge system modelling (BioWin)**		**10**	**18**				**18**	**28**	Meijer
7	**MBR modelling (AQUASIM)**	**2**		**4**				**6**	**10**	Garcia
8	**Anaerobic reactor modelling (BioWin)**	**2**	**8**	**10**				**12**	**24**	Spanjers
9	**Modelling application examples**	**4**						**4**	**12**	Brdjanovic
	Total	**24**	**18**	**48**				**72**	**138**	
MSc module - UNESCO-IHE										

MUNICIPAL WATER AND INFRASTRUCTURE

MASTERS PROGRAMME

Academic Year: 2012-2014
Specialization: WSE
Module Coordinator: S.G. Salinas Rodriguez, PhD, MSc

Module Sheet

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

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

Learning Objectives

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

- Understand the principles of low pressure membrane processes and their capabilities and constraints in water treatment applications, and have practical knowledge on the design and operation of these processes
- Understand the principles of desalination with reverse osmosis, and be capable of selecting appropriate membrane process for a specific application
- Identify appropriate pre-treatment and post treatment schemes, and cleaning protocols for desalination processes
- Understand advanced oxidation processes

Topics and Learning Activities

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

High pressure membranes
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. (2012) Low pressure membrane technology, LN0424/12/1
- Kennedy, M.D., Salinas Rodriguez, S.G. & Schippers J.C. (2012) Advanced oxidation processes / Granular activated carbon filtration.
- Kennedy, M.D., Salinas Rodriguez, S.G. & Schippers J.C. (2011), Desalination and membrane related technology, LN0076/11/1
- Kruithof, J.C., Martijn, B (2012), Advanced disinfection methods.
- 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

Assessment

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

2012/2014-MWI/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)**
	Low pressure membranes	**10**		**2**	**4**			**16**	**40**	Prof. M.D. Kennedy, PhD / S.G. Salinas Rodriguez, PhD
	High pressure membranes	**8**		**6**			**4**	**18**	**42**	Prof. M.D. Kennedy, PhD / S.G. Salinas Rodriguez, PhD
	Desalination	**4**						**4**	**12**	Prof. M.D. Kennedy, PhD
	Natural systems	**4**						**4**	**12**	S. Sharma, PhD
	Advanced oxidation processes	**6**	**2**					**6**	**20**	J. Kruithof, PhD
	Water reuse	**2**		**2**				**4**	**8**	S. Sharma, PhD / Prof. M.D. Kennedy, PhD
	Fieldtrip					**6**		**6**	**6**	
	Total	**34**	**2**	**10**	**4**	**6**	**4**	**58**	**140**	
MSc module - UNESCO-IHE										

WATER SCIENCE AND ENGINEERING

MASTERS PROGRAMME
Academic Year: **2012-2014**
Specialization: **Hydroinformatics: modelling and information systems for water management**
Module Coordinator: **Z. Vojinovic, PhD, MSc**

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

Environmental processes and water quality, H. J. Lubberding (IHE)

Environmental processes. Water quality problems from a modelling point of view: outfalls, BOD-DO,

eutrophication, toxic substances, best technical means approach, water quality objectives approach; Properties of the natural system from a modelling point of view, residence times, time scales of transport processes compared with those of water quality processes, spatial scales of phenomena, link between transport of substances and water quality processes.

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)

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)**
- **60%: Assignment**

2012/2014-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
	Environmental processes and water quality	**4**		**2**				**6**	**14**	H.J. Lubberding
	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
	Managing urban flood disasters	**4**			**3**			**7**	**18**	D. Sakulski
	Total	**36**		**13**	**8**			**57**	**137**	
MSc module - UNESCO-IHE										

MUNICIPAL WATER AND INFRASTRUCTURE

MASTERS PROGRAMME

Academic Year: 2012-2014
Specialization: Core Programme
Module Coordinator: H. Garcia / G. Ferrero

Module Sheet

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

Target Group	Prerequisites
Students of the SE. WSE and UWEM specialisation within the MWI 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 number of different European countries, to different internation practises in the design, operation and management of water supply, wastewater, solid waste and urban civil infraestructure 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

The internatioanl Field Trip will take up two weeks, during which we will jointly be traveling within Europw yet not in the Netherlands.

Learning Activities:

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

Lecturing Material

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

Assessment

- **100%: Assignment**

2012/2014-MWI/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**	
	Field Work					**47**		**47**	**47**	
	Total					**140**		**140**	**140**	
MSc module - UNESCO-IHE										

MUNICIPAL WATER AND INFRASTRUCTURE

MASTERS PROGRAMME

Academic Year: 2012-2014
Specialization: MWI-SE, MWI-UWEM
Module Coordinator: H. Garcia, PhD, MSc

Module Sheet

Module Name Industrial effluents treatment and residuals management	Module Code MWI/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**
- **25%: Assignment**
- **60%: Written Exam (open book)**

2012/2014-MWI/SE/UWEM/10: Industrial effluents treatment and residuals management											
Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: studyload hours	Lecturer(s)
1	Introduction	1						1	3	Dr. H. Garcia
2	Cleaner Production	3						3	9	Dr. M.S. Moussa
3	Industrial Water Management	6						6	18	Dr. M.S. Moussa
4	Toxicity	2						2	6	Dr. M.S. Moussa
5	Case Studies (Pollution Prevention)			3				3	3	Dr. M.S. Moussa
6	Pre and Primary Treatment	4						4	12	Dr. H. Garcia
7	Secondary Treatment	2						2	6	Prof. J. van Lier
8	Physical Chemical Treatment	3						3	9	Dr. H. Garcia
9	Case Study: Aquaculture			2				2	2	Prof. D. Brdjanovic
10	Case study: Oil Industry			1				1	1	TBD
11	Case Study: Industrial Waste and Resource Recovery			2				2	2	Ir. A. Mulder
12	Case Study: Potato, Sugar, Tannery, and Water Reuse									Ir. A. Mulder
13	Case Study:Water Reuse (Dow Chemical)			1				1	1	K. Majamaa
14	Case Study: Sugar, Steel, and Water Resue			2				2	2	Appelman
15	Case Study: Wastewater Reuse (Evides)			1				1	1	JW Mulder
16	Case Study: Field Trip (Heineken)			4				4	4	Dr. H. Garcia
17	Case Study: Process Water and Reuse			2				2	2	A. Vlaski
18	Case Study: Leachate Treatment			1				1	1	D. Jaksic
19	Case Study: Metal Surface Treatment			2				2	2	D. Jaksic
20	Case Study: Brewery Industry			1				1	1	D. Jacksic
21	Sludge Management	6		3				9	21	Â 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										

MUNICIPAL WATER AND INFRASTRUCTURE

MASTERS PROGRAMME

Academic Year: **2012-2014**
Specialization: **Core Programme**
Module Coordinator: **Z. Vojinovic**

Module Sheet

Module Name Urban water systems	Module Code MWI/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 on the modelling of the hydrologic/hydraulic processes that is necessary for understanding, analysis and planning of urban drainage systems.
- describe and model the Urban hydrological systems including: Processes: Mainly Infiltration, Overland flow, Urban Watershed modelling, Sewershed modelling;
- to appraise the numerical methods used in UDS methods, identify numerical issues in modelling;
- conduct modelling of Urban drainage Networks: Use advanced simulation software for urban drainage systems (e.g. SWMM), 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
- construct Urban Inundation models, for damage estimation due to sewer overflow, risk-based modelling (includig SOBEK).

Topics and Learning Activities

Theory and Workshops
Learning Activities:
Lecture, Exercise, Workshop

Hydrology for Urban Drainage
Learning Activities:
Lecture

Water Quality for Urban Drainage
Learning Activities:
Lecture, Exercise

Urban flood damage estimation
Learning Activities:
Lecture, Exercise

Lecturing Material

- Lecture notes (provided by each lecturer)

Workshop material (include Infiltration WS, SWMM 5.0 WS, Inundation WS
Additional material provided on the module web site.

Assessment

- **60%: Oral Exam**
- **40%: Homework**

2012/2014-MWI/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)
	Theory and Workshops	**20**	**10**	**20**				**40**	**90**	P.D.A. Pathirana, PhD, MSc
	Hydrology for Urban Drainage	**4**						**4**	**12**	Prof. S. Uhlenbrook, PhD, MSc
	Water Quality for Urban Drainage	**2**	**4**					**2**	**10**	Â Z. Vojinovic, PhD, MSc
	Urban flood damage estimation	**1**	**3**					**1**	**6**	S. Seyoum, MSc
	Total	**27**	**17**	**20**				**47**	**118**	
MSc module - UNESCO-IHE										

MUNICIPAL WATER AND INFRASTRUCTURE

MASTERS PROGRAMME
Academic Year: **2012-2014**
Specialization: **WSE**
Module Coordinator: **G. Ferrero**

Module Sheet

Module Name Water treatment processes and plants	Module Code MWI/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**
- **60%: Written exam (closed book)**

2012/2014-MWI/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**	G. Ferrero, PhD
	Â									
	Total	**12**		**12**		**8**	**28**	**60**	**140**	
MSc module - UNESCO-IHE										

MUNICIPAL WATER AND INFRASTRUCTURE

MASTERS PROGRAMME
Academic Year: **2011-2013**
Specialization: **Core Programme**
Module Coordinator: **M. Ronteltap**

Module Sheet

Module Name Faecal sludge management	Module Code MWI/SE/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..

Topics and Learning Activities

Lecturing Material

Assessment

2012/2014-MWI/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)
Total										
MSc module - UNESCO-IHE										

MUNICIPAL WATER AND INFRASTRUCTURE

MASTERS PROGRAMME

Academic Year: 2012-2014
Specialization: Elective module
Module Coordinator: N. Trifunovic, PhD, MSc

Module Sheet

Module Name Advanced water transport and distribution	Module Code MWI/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 calibrated 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 WaterGEMS 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

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

2012/2014-MWI/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, N.Trifunovic
2	**Advanced Water Distribution Modelling**	4	12				4	8	36	D.Savic, S.Velickov, N.Trifunovic
3	**GIS in Water Distribution**	4	6				4	8	30	Z.Vojinovic
4	**Introduction to Water Hammer**	4	6				4	8	30	J.van t Westende, N.Trifunovic
5	**Advanced O&M Water Distribution Practices**			6		8		14	14	Â K.van der Drift, E.Arpadzic
	Total	18	24	6		8	16	48	140	
MSc module - UNESCO-IHE										

MUNICIPAL WATER AND INFRASTRUCTURE

MASTERS PROGRAMME

Academic Year: 2012-2014
Specialization: Elective Module (Open for all specializations)
Module Coordinator: S.K. Sharma, PhD

Module Sheet

Module Name Decentralised water supply and sanitation	Module Code MWI/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. (2011) 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. (2011) Ecological Sanitation. UNESCO-IHE Lecture Notes
• Ronteltap, M. (2011) Solid Waste Management. UNESCO-IHE Lecture Notes
• van Dijk, M.P. (2011) 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**

2012/2014-MWI/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
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, Ronteltap
4.1	Participatory planning and evaluation	2		2				4	8	Guest lecturer IRC
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, Ronteltap
	Total	**35**	**6**	**25**		**4**		**64**	**140**	
MSc module - UNESCO-IHE										

MUNICIPAL WATER AND INFRASTRUCTURE

MASTERS PROGRAMME

Academic Year: 2012-2014
Specialization: Core Programme
Module Coordinator: M. Ronteltap, PhD, MSc

Module Sheet

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

Target Group	Prerequisites
Students from MWI Programme	MWI Specialisations

Learning Objectives

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

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

Topics and Learning Activities

Didactics

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

Lecturing Material

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

Assessment

- **50%: Assignment**
- **30%: Assignment**
- **20%: Presentation**

2012/2014-MWI/12: Groupwork Sint Maarten											
Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: studyload hours	Lecturer(s)
	Introduction Groupwork	**2**						**2**	**6**	Ronteltap
	Class on Master Planning	**4**						**4**	**12**	Vlaski
	Class on Engineering Consultancy	**4**						**4**	**12**	Buijs
	Specialist Group work			**40**				**40**	**40**	Group work mentors
	Interdisciplinary Group work			**60**				**60**	**60**	Group work mentors
	Final presentations			**10**				**10**	**10**	Panel members
	Total	**10**		**110**				**120**	**140**	
MSc module - UNESCO-IHE										

MUNICIPAL WATER AND INFRASTRUCTURE

MASTERS PROGRAMME

Academic Year: 2012-2014
Specialization: Core Programme
Module Coordinator: Y. Slokar

Module Sheet

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

Target Group All participants of the programme	Prerequisites

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**
- **60%: Written exam (closed book)**

2012/2014-MWI/13: Summer courses / research methodology for MWI											
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										

MUNICIPAL WATER AND INFRASTRUCTURE

MASTERS PROGRAMME

Academic Year: 2012-2014
Specialization: Core Programme
Module Coordinator: C.M. Hooijmans / S.G. Salinas Rodriguez

Module Sheet

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

Target Group	Prerequisites
All students of the Municipal Water and Infrastructure 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**

2012/2014-MWI/14: MSc research proposal development for MWI											
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)
	Â MSc research proposal		196						196	
	Total		196						196	
MSc module - UNESCO-IHE										

MUNICIPAL WATER AND INFRASTRUCTURE

MASTERS PROGRAMME

Academic Year: 2012-2014
Specialization: SE/WSE
Module Coordinator: C.M. Hooijmans / S.G. Salinas Rodriguez

Module Sheet

Module Name MSc Research	Module Code MWI/15	Credits 36

Target Group	Prerequisites
MWI 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..

- 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;
- 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;
- 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.

Topics and Learning Activities

Lecturing Material

Assessment

• 100%: Oral Exam

2012/2014-MWI/15: MSc Research											
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										