

Handbook ES 2014 - 2016

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1 UNESCO-IHE

1.1 Introduction

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

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

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

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

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

Disclaimer:

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 UNESCO-IHE or from partner organisations cannot be guaranteed. No rights can therefore be derived from the programme as specified in this handbook.

1.2 MSc Degree Programmes

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

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

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

1.3 Research and PhD Programmes

UNESCO-IHE carries out scientific research, often in co-operation with universities and research institutes in developing countries.

A number of positions are available for PhD research.

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

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

1.4 Organisation

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

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

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

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

2 Programme framework

2.1 Introduction

The Master of Science Degree Programmes

The Institute provides the following Master of Science degree programmes:

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

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

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

2.2 Academic Regulations

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

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

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

2.3 Structure of the Programmes

The programme specialisations which are offered solely in Delft are conducted over a period of 18 months during two academic years. The general planning structure is shown in the *Academic Calendar*.

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

Within each programme, the following generic components are distinguished:

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

2.4 Curriculum Information

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

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

2.5 Learning Objectives

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

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

2.6 Working Methods

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

Lectures serve one or more of the following functions:

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

An exercise takes one of the following forms:

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

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

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

2.7 Examinations

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

Examination work can also be produced by (small) groups of students working together on an assignment, e.g. the groupwork report.

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

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

2.8 Study Load

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

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

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

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

2.9 Planning and Scheduling

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

- Period 1 08:45 – 09:30 and 09:45 – 10:30
- Period 2 10:45 – 11:30 and 11:45 – 12:30
- Period 3 13:45 – 14:30 and 14:45 – 15:30
- Period 4 15:45 – 16:30 and 16:45 – 17:30

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

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

2.10 Participation in coursework and lunch seminars

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

Special attention is required for lunch seminars. During the academic programme lunch seminars are organised focusing on a specific topic.

Participants are required to attend these seminars as well

Students have to inform their programme coordinator as early as possible when they are not able to attend a scheduled programme activity.

2.11 Evaluation of the Programme by Students

As part of the quality assurance procedures of the Institute the programmes are routinely evaluated in order to obtain feedback from the students regarding the quality of the content and the performance of the lecturers. The evaluations are based on a module questionnaire, which the students complete in separate class sessions.

The questionnaire asks the students to provide a rating for achievement of the learning objectives, the study load feasibility, the contents of the subject matter, the balance between the various working and examination methods, the quality of the lecture materials, and the presentation by the lecturers. Furthermore, additional written comments and an overall rating for the module may be provided.

The module evaluations are carried after the examination, but before the results have been announced. Students can also request to address specific programme related issues in a group or individual discussion with the involved coordinator or lecturers.

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

3 Regulations

3.1 Exam regulations

Click here for the separate document:

See the separate part after the Academic Calendar

3.2 Library regulations

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

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

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

- 1) Systematic downloading of electronic journals articles using manual means is permitted only within reasonable amounts; no more than 50 downloads per user within 24 hours.
- 2) Programmatic downloading / 'web crawling' are not allowed. In addition to systematic downloading of files manually, the use of a spider (web crawler), the intention of which is to programmatically download data within a specific website, is prohibited.
- 3) Copyright/reproduction. It is prohibited to reproduce entire or parts of publications in your own publication without the consent of the publisher. You are obliged to provide a correct source reference of all of the material at all times.
- 4) Selling and providing material to third parties is strictly forbidden. The re-sale of material purchased subject to license to third parties is prohibited; this applies both within and outside of the Institute for which the materials have been purchased.
- 5) Permanent archiving. Large-scale archiving is not permitted on the local servers or your hostel personal computer nor is the continued use of these servers as an archive, in collaboration with third parties or otherwise. The temporary storage of archive material for personal use is permitted for a period not longer than 120 days.
- 6) Making changes to an original work. Infringing upon an original work by merging various original texts into a document or by amending original texts is prohibited. Processing materials in such a way is an infringement upon the copyright that is held by the publisher or the author him/herself.

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

3.3 Code of conduct

THE RECTORATE OF UNESCO-IHE

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

RESOLVES

To establish the following Regulations:

Article 1 Definitions

1.1 WHW

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

1.2 the Director

The director of UNESCO-IHE

1.3 the Rectorate

The director and the deputy director

1.4 Central services department

The central services department of UNESCO-IHE

1.5 Facilities

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

1.6 Buildings

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

1.7 Student

Anyone who is enrolled at UNESCO-IHE for the purpose of education provided by UNESCO-IHE and who uses the educational and examination facilities of UNESCO-IHE for this purpose;

1.8 Visitor

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

Article 2 Compliance requirement for rules, guidelines and instructions

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

- a. he or she does not cause direct or indirect damage to UNESCO-IHE or to other persons who are present on the grounds or in the buildings of UNESCO-IHE or who make use of the facilities of UNESCO-IHE, nor that he or she causes nuisance or annoyance;
- b. he or she does not infringe on the rights of UNESCO-IHE or of other persons who are present on the grounds or in the buildings of UNESCO-IHE or who make use of the facilities of UNESCO-IHE;
- c. he or she does not act contrary to statutory obligations;
- d. he or she does not act contrary to appropriate and proper social conventions with regard to people or property.

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

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

Article 3 Disciplinary Measures

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

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

Article 4 Exclusion Order by the Rectorate

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

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

4.3 The exclusion order will contain at least the following:

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

Article 5 Termination of the exclusion order

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

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

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

Article 6 Entry into force

These Regulations enter into force on October 1st 2007

Article 7 Method of Citation

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

Approved in the rectorate meeting of September 25th 2007

3.4 Plagiarism

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

In order to better understand what constitutes plagiarism and how to avoid it, you are directed to the following online resources.

Plagiarism detection

UNESCO-IHE uses a computer program called Turnitin® to assist with the detection of plagiarism. The plagiarism detection service is an online service that enables UNESCO-IHE and its staff to carry out electronic comparison of students' work against electronic sources including other students' work.

Turnitin ® works by executing searches of the World Wide Web, and extensive databases of reference material, as well as content previously submitted by other UNESCO-IHE students. Each new submission is compared with all the existing information. The software makes no decisions as to whether a student has plagiarised, it simply highlights sections of text that are duplicated in other sources. All work will continue to be reviewed by the course coordinator. Once work has been submitted to the system it becomes part of the ever growing database of material against which subsequent submissions are checked.

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

New text about plagiarism will follow...

Plagiarism guide's references

The following sources were used in the development of the plagiarism guide:

Blum, S. D. (2009). My word! : plagiarism and college culture. Ithaca: Cornell University Press.

Carroll, J. and Appleton, J. (2001). Plagiarism: A Good Practice Guide. Oxford: Oxford Brookes University and Joint Information Systems Committee

Eisner, C., & Vicinus, M. (2008). Originality, imitation, and plagiarism : teaching writing in the digital age. Ann Arbor: University of Michigan Press.

Sutherland-Smith, W. (2008). Plagiarism, the Internet and student learning : improving academic integrity. New York: Routledge.

Harvard University Guide to Plagiarism

- <http://isites.harvard.edu/icb/icb.do?keyword=k70847&pageid=icb.page355322>

Harvard Guide to using sources

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

Purdue University Writing Lab

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

University of Princeton Academic Integrity Site

- <http://www.princeton.edu/pr/pub/integrity/pages/plagiarism/>
- Princeton University about Academic Integrity

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

University of Teesside Plagiarism Guidance

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

ANNEX 1

TO WHOM IT MAY CONCERN

NAME STUDENT:

.....

STUDENT NUMBER :

.....

Own work declaration

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

1. I have clearly referenced all sources;
2. I have referenced and put in inverted commas all quoted text (from books, web, etc);
3. I have given the sources of all pictures, data etc that are not my own;
4. I did not make any use of the essay(s) of any other student(s) either past or present;
5. I did not seek or use the help of any external professional agencies for the work;
6. I acknowledged in appropriate places any help that I have received from others (e.g.fellow students, technicians, statisticians, external sources);
7. I understand that any false claim for any of the above will mean that the work in question will be penalised in accordance with the UNESCO-IHE regulations;
8. I hereby grant UNESCO-IHE, and Turnitin a non-exclusive licence to make an electronic copy of the work and make it available for assessment and archiving purposes.
9. I grant in perpetuity, without restriction, royalty free to UNESCO-IHE Institute for Water Education and partner Institutes the non-exclusive right and license to reproduce, distribute, and display, in whole or in part, my master thesis in any format now known or later developed.

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

Signature student:

Date:

4 ES programme

4.1 Introduction ES Programme

Problems and challenges

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

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

Aim of the programme

The aim of the Environmental Science programme is to provide professionals with the knowledge and skills necessary to contribute, directly or indirectly, to the conservation and wise-use of natural resources for the benefit of society. Successful participants will (i) develop the capacity to carry out independent scientific and technical research and assessments on environmental issues, (ii) learn to analyse and assess environmental systems and problems, (iii) be able to propose sustainable solutions to environmental problems and (iv) contribute to the development of policies and strategies for environmental planning.

Our Approach

To address environmental problems and find sustainable solutions, we must understand the processes that sustain the natural systems, how the systems function and how they interact with each other and with human society. A thorough understanding of how natural systems respond to human actions and interventions is crucial. Through knowledge of the dynamics, functioning and processes of natural systems and an appreciation of the delicate balance between the use and the conservation of our natural resources, improvement of quality of life for human society and sustainable development can be achieved. To equip professionals with the required capacities, the Environmental Science programme offers a systems approach that investigates different subsystems and the interactions between them at the global, regional and local scale, but without losing sight of the overall picture. In exploring the complexities of the human-environmental system the programme seeks a balance between the disciplines taught and the added value of bringing these disciplines together in one coherent programme.

Furthermore, the approach of UNESCO-IHE is problem-oriented with a primary focus towards developing countries. This means that the value of the achieved knowledge and skills is measured in terms of applicability of the science, technology, engineering, planning and policies to environmental management. Planning and good policy-making in Environmental Science is based on an understanding of how ecosystems work, how they respond to defined human actions and what remediation actions may be taken to reinvigorate the dynamism of sustainability and biodiversity conservation. As the concept of sustainable development needs its own unique elaboration in contexts where living conditions of large populations are in a critical stage and environmental protection is seen as a luxury, the programme provides tailored approaches and specific knowledge to serve these conditions.

In environmental science education, the development of knowledge together with skills is essential. In the UNESCO-IHE approach, lectures by experts in the field are complemented by assignments, exercises, laboratory and fieldwork and group-work. Innovative distance learning and electronic interactive educational tools support the programme, while further innovations and developments to link up with UNESCO-IHE's global network of partner institutions are ongoing.

Scope of the programme and specialisations

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

[1] World Summit, Johannesburg 2002; World Water Vision, The Hague 2000; UNCED Conference, Rio de Janeiro 1992; UN Conference on the Human Environment, Stockholm 1972.

4.2 Learning objectives for the programme

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

Knowledge & theory

- to demonstrate knowledge and understanding of the physical, chemical and biological processes of the environment, of the socio-economic concepts underlying the functioning and exploitation of environmental systems, and of the complex inter-relationship between the protection and wise use of environmental resources;
- to describe the rationale for an integrated and interdisciplinary approach for the sustainable management of water and environmental resources;

Methods, techniques & tools

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

Analysis, synthesis & integration

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

Research/General academic skills

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

to demonstrate academic attitude and learning skills (including thinking in multidisciplinary dimensions and distinguishing main issues from minor ones), to enhance and keep up-to-date the acquired knowledge and application skills in a largely independent manner.

4.3 Specializations

The Environmental Science programme has the following specialisations:

- Environmental Science & Technology (EST)
- Environmental Planning & Management (EPM)
- Water Quality Management (WQM)
- Limnology & Wetland Management (LWM)
- International Master of Science in Environmental Technology and Engineering (IMETE)

International Master in Environmental Technology for Sustainable Development (ETSuD)

4.4 EST

Objectives

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

Subjects

- Introduction Environmental science (natural processes, human dimensions, analytical tools), Environmental Systems Analysis, Environmental Engineering, Environmental Monitoring & Modelling, Cleaner Production & the Water Cycle, International Fieldtrip, Aquatic Ecosystems, Solid Waste Management, Group work, MSc Preparatory course, MSc Proposal Writing, MSc Thesis.

Additional learning objectives for Environmental Science & Technology

After successful completion of the specialisation graduates will be able:

Knowledge & theory

- to identify the impacts of human activities on the environment, under different levels of environmental stress and in different socio-economic contexts;
- to name and explain concepts, instruments and technologies for pollution prevention and remedial actions in a national and international context;

Methods, techniques & tools

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

to contribute as a flexible and creative member in interdisciplinary teams in developing solutions for prevention or remediation of environmental problems, by linking scientific knowledge to engineering interventions and to management decisions in different cultural and socio-economic contexts, and using different levels of available knowledge and information.

4.5 EPM

Objectives

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

Subjects

- Introduction Environmental science (natural processes, human dimensions, analytical tools), Environmental Systems Analysis, Environmental Policy Making, Environmental Planning, Water and Environmental Law & Institutions, International Fieldtrip, Aquatic Ecosystems, Watershed & River Basin Management, Group work, MSc Preparatory course, MSc Proposal Writing, MSc Thesis.

Additional learning objectives for Environmental Planning & Management

After successful completion of the specialisation graduates will be able:

Knowledge & theory

- to understand the environmental policy cycle and planning process and to analyse and prepare environmental policy strategies, taking into account the impact that society has on water and environmental resources;
- to name and explain principles, concepts and instruments of major national and international water and environmental legislation and common and desired institutional and management arrangements;

Methods, techniques & tools

- to apply general scientific methods (including statistics and environmental modelling) to processes of water and environmental resources allocation and use at different scales in order to gain an understanding of problems, trends, causes and effects;
- to apply environmental scientific methods (including environmental impact assessment, policy analysis, resource valuation, environmental economics) and models for institutional development with emphasis on policy development, functional decentralisation and good governance;
- to design and facilitate consultation- and decision-making processes between stakeholders, users and their representatives, water managers, politicians and other decision-makers..

Analysis, synthesis & integration

- to identify and critically assess the different ecological and socio-economic functions and values of the environmental system and the, often competing, interests of the various stakeholders;

to design comprehensive environmental resources policies and strategies that aim to enhance the sustainable use of the environment especially focusing on water, and that include a suitable combination of technical, legal, administrative and financial measures.

4.6 WQM

Objectives

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

Subjects

- Introduction Environmental science (natural processes, human dimensions, analytical tools), Water Quality Assessment, Wetlands for Water Quality, Environmental Planning, Water and Environmental Law & Institutions, International Fieldtrip, Aquatic Ecosystems, Watershed & River Basin Management, Group work, MSc Preparatory course, MSc Proposal Writing, MSc Thesis.

Additional learning objectives for Water Quality Management

After successful completion of the specialisation graduates will be able:

Knowledge & theory

- to identify the impacts of human activities on aquatic ecosystems;
- to name and explain principles, concepts and instruments of main national and international water and environmental legislation and common and desired institutional and management arrangements;

Methods, techniques & tools

- to interpret, design and optimise water quality monitoring and assessment schemes in the watershed;
- to apply experimental, statistical and modelling tools for interpreting and designing water quality management programmes;

Analysis, synthesis & integration

- to contribute as a flexible and creative member in interdisciplinary teams in developing solutions for water quality management problems in different cultural and socio-economic contexts, and using different levels of available knowledge and information;

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

4.7 LWM

Objectives

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

Subjects

- Introduction Environmental science (natural processes, human dimensions, analytical tools), Environmental Systems Analysis, Wetlands for Water Quality, Lake Ecology, Stream and River Ecology, East-African Wetlands for Water Quality, Fisheries and Aquaculture, Microbial Communities & Ecosystem Functioning, Conservation and Restoration Ecology, Group-work: IWRM & Management of Aquatic Ecosystems, Water Quality Monitoring & Bio-indicators, MSc Preparatory course, MSc Proposal Writing, MSc Thesis.

Additional learning objectives for Limnology & Wetland Management

After successful completion of the specialisation graduates will be able:

Knowledge & theory

- to identify the impacts of human activities on freshwater ecosystems in different socio-economic contexts;
- to demonstrate knowledge and understanding of the international water quality guidelines;
- to name and explain concepts, instruments and technologies for protection and remedial actions of freshwater ecosystems;

Methods, techniques & tools

- to design, optimise and interpret environmental monitoring and assessment schemes for freshwater ecosystems;
- to apply general scientific methods (including statistics and environmental modelling) for the development and application of scientific and technological approaches, concepts and interventions to address problems of freshwater ecosystems;

Analysis, synthesis & integration

- to critically analyse and evaluate a range of options and alternatives for the prevention or remediation of problems related with freshwater ecosystems, under different socio-economic and legal contexts, and under often data-poor conditions;

to contribute as a flexible and creative member in interdisciplinary teams in developing solutions for prevention or remediation of freshwater ecosystems problems, by linking scientific knowledge to engineering interventions and to management decisions in different cultural and socio-economic contexts, and using different levels of available knowledge and information.

4.8 IMETE

Objectives

- The IMETE programme will educate a new generation of environmental scientist and engineers that can provide adequate and state-of-the art environmental technology and engineering solutions to tackle complex, multidisciplinary environmental issues, such as today's global environmental pollution problems.

Subjects

- Introduction Environmental science (natural processes, human dimensions, analytical tools), Environmental Microbiology, Environmental Engineering, Wastewater Treatment, Sludge Management, Atmosphere Protection Technology, Waste Management and Treatment, Clean Technology, Environmental Fate and Management of Heavy Metals and Metalloids, Microbial Re-use Technology, Research Methodology, Elective Project, MSc Proposal Writing, MSc Thesis.

Additional learning objectives for International Master of Science in Environmental Technology and Engineering (IMETE)

After successful completion of the specialisation graduates will be able:

Knowledge & theory

- to identify the way polluted water, waste, gas, soils and sediments can be treated;
- to identify the way ecosystems and the atmosphere can be protected from pollution.
- to identify the way to prevent environmental pollution through resource management and application of re-use technologies.

Methods, techniques & tools

- to be able to develop, design and apply technologies for the prevention and remediation of environmental pollution by searching scientific information, by conducting scientific research in the field of environmental technology and engineering and by reporting their findings by means of scientific reports and papers;
- to communicate effectively in English and transferring knowledge to both the scientific and non-scientific world through oral presentations and media communications.

Analysis, synthesis & integration

- to demonstrate creativity and critical, multidisciplinary thinking for problem-solving and decision-making;
- to demonstrate responsibility and own initiative;

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

4.9 ETSuD

Objectives

- The ETSuD programme offers students the possibility to study at two renowned institutes for international postgraduate education: AIT and UNESCO-IHE. The coursework part of the programme starts at AIT in Bangkok in August, where students follow a number of courses until the second half of December. In early January, they move to Delft where they join students in UNESCO-IHE's Environmental Science programme for six modules and group work. Students then move back to Bangkok for their individual thesis research work with involvement of UNESCO-IHE counterparts.

Subjects

- Environmental Chemistry and Laboratory, Air Pollution Engineering and Management, Solid Waste Management, Environmental Impact Assessment, Wastewater treatment, Drinking Water Treatment, Environmental Health and Sanitation, Design of Water Supply and Wastewater Systems, Air Pollution Modelling and Applications, Hazardous Waste Technology and Management, Design of Air Pollution Control Systems, Membrane Technology in Water and Wastewater Treatment, Waste Reduction and Recycling, Applied Microbiology and Laboratory, Advanced Processes for Wastewater Treatment, Reuse and Recycle, Analytical tools in Environmental Science, Environmental Systems Analysis, Wetlands for wastewater treatment, Cleaner Production, Foreign Fieldtrip + Fieldwork, Aquatic Ecosystems, Group Work, Research Methodology, Elective Project, MSc Proposal Writing, MSc Thesis.

Additional learning objectives for International Master in Environmental Technology for Sustainable Development (ETSuD)

After successful completion of the specialisation graduates will be able:

Knowledge & theory

- to identify the impacts of human activities on the environment, under different levels of environmental stress and in different socio-economic contexts;
- to name and explain concepts, instruments and technologies for pollution prevention and remedial actions in a national and international context.

Methods, techniques & tools

- to apply general methods (including statistics and modelling) in scientific and technological approaches, concepts and interventions;
- to contribute as a flexible and creative member in interdisciplinary teams in developing solutions for prevention or remediation of environmental problems, by linking scientific knowledge to engineering interventions and to management decisions in different cultural and socio-economic contexts, using different levels of available knowledge and information.

Analysis, synthesis & integration

- to demonstrate creativity and critical, multidisciplinary thinking for problem-solving and decision-making;
- to demonstrate responsibility and own initiative;

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

4.10 EST-UNIVALLE

Objectives

- The EST-UNIVALLE programme offers students the possibility to study at two renowned institutes for international postgraduate education: Universidad del Valle and UNESCO-IHE. The coursework part of the programme starts at Univalle in Cali in August, where students follow a number of courses until the second half of December. In early January, they move to Delft where they join students in UNESCO-IHE's Environmental Science programme for eight modules and group work. Students then move back to Cali for their individual thesis research work with involvement of UNESCO-IHE counterparts.

Subjects

- Chemistry of Environmental Pollution, Environmental Pollution Microbiology, Fundamentals of Environmental Processes, Environment and Development, Engineering Research Introduction, Integrated project Environmental Science, Environmental Systems Analysis, Environmental Engineering, Environmental Monitoring & Modelling, Cleaner Production & the Water Cycle, International Fieldtrip, Aquatic Ecosystems, Solid Waste Management, Group work, MSc Preparatory course, MSc Proposal Writing, MSc Thesis.

Additional learning objectives for Environmental Science & Technology

After successful completion of the specialisation graduates will be able:

Knowledge & theory

- to identify the impacts of human activities on the environment, under different levels of environmental stress and in different socio-economic contexts;
- to name and explain concepts, instruments and technologies for pollution prevention and remedial actions in a national and international context;

Methods, techniques & tools

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

to contribute as a flexible and creative member in interdisciplinary teams in developing solutions for prevention or remediation of environmental problems, by linking scientific knowledge to engineering interventions and to management decisions in different cultural and socio-economic contexts, and using different levels of available knowledge and information.

5 Facilities

5.1 Location

The UNESCO-IHE buildings and facilities are located on a single compound at the Westvest 7 in the centre of Delft. The buildings provide a pleasant and efficient atmosphere for optimal learning and creativity, direct communication with lecturers and other staff, as well as meeting with fellow students. The building is open during the following times:

Monday to Friday 07:30 – 20:00
Saturday 08:00 – 12:30

5.2 Student Affairs (office)

The Student Affairs office provides non-academic support to students. The SA office takes care of student applications and student registration. The new students are also assisted with formalities such as applications for residence permits, insurance, bank accounts, and fellowship issues. Housing arrangements in one of the hostels are being made immediately upon arrival.

Throughout their study period, students can contact the staff during office hours for information or questions related to health, religion or other issues related to the student's well being. Personal matters can be discussed with the student counsellor and will be dealt with strictly confidential.

During the entire academic year, SA organizes a number of social and cultural activities including the weekly movie night, social evenings and the annual Christmas dinner. Other activities include cultural excursions to interesting cities and places in the Netherlands and other countries in Europe.

Furthermore, the students are given opportunity to actively practice sports on a regular basis. From October to May, the Institute arranges accommodation in Delft for such sports as soccer, volleyball, basketball and badminton. The SA office organizes sports events and tournaments, in which the teams can compete internally, but also against players from other international institutes.

5.3 Student Association Board

The Student Association Board (SAB) is composed of representatives who are elected by the students in annual elections that take place some four weeks after the opening of the academic year.

The SAB provides a forum through which students can share their experiences, problems and general issues on study-related matters. If necessary, the SAB will bring these matters forward in discussions with the executive levels of the Institute. The board can be contacted directly via its members or the general e-mail address sab@unesco-ihe.org.

The SAB closely co-operates with the Student Affairs office in organizing social and sporting events. The board also publishes its own magazine *The Informer*, in which the rich variety of contributions are entirely derived from, and produced by, the student community.

5.4 ICT services

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

All UNESCO-IHE desktop and laptop PCs are Intel based with Microsoft Windows operating system. The UNESCO-IHE laptop PC will be provided in order to get access to the IT-facilities. The laptop is on loan for use during studying at UNESCO-IHE. At the end of the study, UNESCO-IHE offers the possibility to buy the laptop. The contract given clearly states the terms and conditions for borrowing the laptop. Bringing one's own laptop is allowed; however, laptops other than the UNESCO-IHE laptop might not give access to all the required IT-facilities and might not be supported by IT-service desk.

A wide range of software packages is available, ranging from standard PC-software, like Microsoft Office (Word, Excel, etc.) to special modelling software used for the educational programmes. All participants will get a free UNESCO-IHE web-based e-mail box. A web-based E-learning and collaborative system is accessible for all participants to exchange learning information and documents.

For specific applications during the thesis study, it may be possible to use specialist software packages on the laptop PCs. This is, however, dependent on the particular type of licence agreement that the Institute has with the supplier. Enquiries for specific software should be made at the computer helpdesk.

5.5 General Facilities in the Building

In the reception area of the building, students have their own locker for the distribution of schedules, lecture notes and other study-related papers, and private mail. Last-minute changes in schedules are indicated on the announcement board near the entrance. Two monitor screens opposite the reception desk are regularly updated with news or information on events taking place at UNESCO-IHE.

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

The restaurant provides a wide variety of reasonable-priced multicultural meals and beverages during lunchtime. The meals can be paid using the chip-card or cash. Coffee, tea and soft drinks can be obtained from machines throughout the day.

The building houses a number of fully-equipped lecture rooms and theatres, which can accommodate groups of all sizes from 15 to 300 persons. Rooms for facilitating computer

classes and workshops are present and can be used freely by students outside class hours. Furthermore, the Institute has its own printing and reproduction facilities and also contains an in-house distance learning and video conferencing centre. The library, computer facilities and laboratory are described in detail below.

5.6 UNESCO-IHE Library and Information Services

UNESCO-IHE's Library provides access to over 35,000 printed titles, among which the complete collection of UNESCO-IHE Master thesis and PHD dissertations. Furthermore the collection contains over 8.000 online journals. The online journals collection is accessible on the network at the Westvest premises or through remote authentication through the UNESCO-IHE portal. For more information please visit the Library's Internet page <http://www.unesco-ihe.org/library>

The library is open to all UNESCO-IHE participants and staff, and to visitors by appointment. The services provided by the library include lending out books, requesting articles and other materials through the inter-library loan system and providing assistance in searching the electronic catalogue.

Membership

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

The catalogue

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

Borrowing library items

A maximum of ten items may be borrowed from the library at any one time. The maximum loan period is 21 days, renewable up to a maximum of 42 days. Renewals can be made online, <http://www.unesco-ihe.org/library> by using the borrower information function within the catalogue or by email (library@unesco-ihe.org). Please note that the loan period can be extended only if the items have not already been reserved by another person.

Reference works, M.Sc theses, bound and non-bound periodicals and materials bearing a green sticker may not be borrowed. By using their library card to borrow items from the library, borrowers agree to be responsible for those items, including the cost of replacing lost or damaged items.

Opening Hours : Monday 09:00–18.30
 Tuesday-Friday 09:00–19.00
 Saturday 09:30–12:30

Please note that the Library opening hours are subject to change.
Visit the Library webpage for regular updates.

From July 2011 until December 2011, the Library spaces are being renovated. Most of the printed collections and the reference desk have been relocated to A2 a/b on the first floor and

on account of missing the reading room, the opening hours have been changed to Monday-Friday 09-15-17.30

For further information please contact the library reference desk.

Email: library@unesco-ihe.org

Tel: +31 (0)15 215 1714

Fax: +31 (0)15 212 2921

5.7 Laboratories

Modern educational and research laboratories are available in the fields of chemistry, process technology, microbiology, aquatic ecology and soil science. A wide range of standard analytical tests can be performed for chemical, physical and microbiological water, air and soil quality analyses.

Elemental analyses, various kinds of microscopy and analytical techniques such as spectrophotometry, gas- and ion chromatography, and atomic absorption can be carried out. A wide range of laboratory and bench-scale reactors, temperature and light controlled growth chambers, and various constant temperature rooms are available for research in one of the departmental research programs, including waste water management using aquatic macrophytes and wetlands, the adsorption and/or (an-)aerobic degradation of micropollutants, self-purification in drains and filtration. Through close co-operation with the Delft University of Technology and other educational and research institutions, research possibilities are quite extensive.

In addition to the in-house facilities, the laboratory has a range of instrumentation and equipment available for field instruction and for conducting hydrological or environmental field experiments and measurements.

5.8 Study Materials

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

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

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

5.9 English support courses

Introduction

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

Placement Test for everyone

Every student must take the English Placement Test. Based on the result, the student may be required to follow an academic writing course.

Placement tests are held in October and January. Participants with weakest English skills are strongly advised to take the test in October, as they will receive support courses first. All remaining participants will be tested in January. Places on writing courses are allocated according to the student's placement test score. A student cannot join a writing course unless s/he has taken the placement test.

Students whose test score is at A1, A2 or B1 level CEFR (The Council of Europe's *Common European Framework* of Reference (CEFR) for Languages is a basis for recognising language qualifications. A1-A2 = Basic; B1-B2 = Intermediate; C1-C2 = Advanced) , are obliged to attend a support course: attendance is required. Students whose test score is B2 are strongly recommended to attend a course. If students who score B2 choose to take a support course, regular attendance is required. Those with score levels C1 and C2 are exempt from academic writing courses.

Scheduling and attendance

Academic Writing courses are given throughout the year, with the first courses starting in October and the last courses ending in August/September. Students are assigned a course based on their Placement Test performance.

English support courses usually consist of about 20 hours contact time, approximately 13 or 14 lectures. English support courses are always scheduled at the following times:

- Tuesdays 3.45pm-5.30pm
- Thursdays 8.45am-10.30am

Occasionally classes are given on Saturday mornings. In special cases, evening classes may be necessary.

A Certificate of Attendance will be provided on completion of an academic writing course, provided attendance requirements have been met.

If a student does not turn up for the allocated course without giving notification of absence, s/he forfeits their place on the course. An alternative course is not provided.

Summary descriptions of writing courses

First Steps in Academic Writing: lower intermediate

based on textbook '*First Steps in Academic Writing*', Longman

This course provides low-intermediate students with essential tools to master basic academic writing. It focuses on paragraph organization, sentence structure, and grammar. Students are guided through the writing process to produce well-organized, clearly developed paragraphs. Simple explanations are supported by clear examples to help students through typical rough spots, and numerous practices help students assimilate each skill.

New Headway Academic Skills: intermediate

Based on textbook '*New Headway Academic Skills*', Oxford University Press

This course combines reading, writing, and study skills, and is suited to those who have reasonable English but have not studied for a while. It aims to refresh and consolidate existing language through practice, as well as to learn new language. There is guided writing practice and relevant grammatical structures are explained. In addition, skills and strategies which develop good vocabulary learning and recording are included.

Academic Writing: upper intermediate

based on textbook '*Focus on Academic Skills for IELTS*', Pearson-Longman

- Focuses on academic writing skills
- Includes vocabulary building and reading techniques relevant to research.
- Specific writing skills include: collocations; useful phrases and language of research; the language of change (increase, decrease, etc); interpreting and comparing information from diagrams; presenting arguments and opinions; justifying solutions (modal verbs, conditionals) and much more to improve academic writing.
- Life-long learning. This textbook offers systematic preparation for the IELTS exam, hence it can help any student who wishes to gain this internationally-recognised certificate, or improve their existing score.

Advanced Academic Writing: advanced

based on textbook '*Academic Writing, A Handbook for International Students*' Routledge

- Specifically aimed at improving key academic writing skills, this is a very practical and thorough course.
- Three main areas are covered: The Writing Process – from making an outline to proof-reading; Elements of Writing – writing skills such as making comparisons, describing results and paraphrasing; Accuracy in Writing – to improve common problems, eg articles, passives, prepositions.

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

MSc Thesis Writing: for all participants. A reader is provided.

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

Delft, October 2014



Education and Examination Regulations for cohort 2014– 2016

For the Master Programmes in:

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

and

the short and online courses which are part of these programmes

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1 General Information

Article 1 Scope of the regulations

- 1.1 The present regulations apply to the education offerings and examinations within the following Master programmes:
- Urban Water and Sanitation
 - Environmental Science
 - Water Management
 - Water Science and Engineering

referred to hereafter as 'the programmes'.

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

- 1.2 For the following 4 joint specialisations of the master programmes mentioned under art 1.1 and 3.1, separate examination regulations apply as these lead to a joint Master degree issued jointly by the UNESCO-IHE and the partner institutes:
- Urban Water Engineering and Management (UWEM);
 - Limnology and Wetland Management (LWM);
 - International Master of Science in Environmental Technology and Engineering (IMETE);
 - Environmental Technology for Sustainable Development (ETSuD).
- 1.3 In case a joint specialisation (see art. 3.1) leads to a double or multiple degrees, the rules and regulations of the partner institute will be applicable for those parts of the programme organised and implemented by the partner.

Article 2 Definition of terms

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

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

Mentor:	staff member involved in the daily direction of a student during the MSc thesis research phase;
Module:	a self-contained programme unit with specified learning objectives, as stipulated in article 7.3 of the Act;
Module sheet:	a document describing a.o. the learning objectives, content, didactic methods and assessments. Modules sheets are part of the programme handbook;
Observer:	a person who is present at an oral examination in order to monitor and listen to what happens;
Online short course:	a module offered as an online non-degree course;
Peer review:	is the evaluation of work by one or more people of similar competence to the producers of the work (peers);
Plagiarism:	The practice of taking someone else's work or ideas and passing them off as one's own;
Practical:	a practical educational activity as stipulated in article 7.13, paragraph 2, clause d of the Act, taking one of the following forms: <ul style="list-style-type: none"> • the writing of a report or thesis; • producing a report, study assignment or design; • conducting a test or experiment; • performing an oral presentation; • participating in groupwork, fieldwork or a fieldtrip; • conducting a research assignment; or • participation in other educational activities that aim to develop specific skills;
Programme assessment:	the formal evaluation of the student performance before graduation (in the Act: <i>examen</i>);
Module assessment:	an examination consisting of a number of different parts (e.g. assignments, written or oral exams, presentations);
Examination:	an assessment for a part of the module;
Programme handbook:	a reference document for a specific programme containing generic and programme specific information, that students need to know throughout their programme;
Rector:	the rector of the Institute;
Short course:	a module offered as a face-to face non-degree course;
Student:	a person who is registered in a study programme and sits examinations;
Supervisor:	professor responsible for the work of student during the MSc thesis research phase.

Article 3 Master Programme and specialisations

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

1. Urban Water and Sanitation programme:

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

2. Environmental Science programme:

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

3. Water Management programme:

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

4. Water Science and Engineering programme:

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

Article 4 Aim of the programmes and courses

- 4.1 The aim of the master programmes is for students to acquire knowledge, insight and skills that are required to function as independent professionals within their field of study and to be appropriate candidates for further study towards a research career.
- 4.2 The qualifications of the master programme graduates are listed in Appendix A.
- 4.3 The aim of a short course or an online course is for students to acquire knowledge, insight and skills of a particular field of study.

Article 5 Full-time/part-time

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

Article 6 Programme assessment

- 6.1 Students in the master programmes are eligible to sit the programme examination leading to the degree of Master of Science in the programme they are registered for.
- 6.2 The programme assessment is passed if all designated module assessments of the programme curriculum have been successfully completed as stipulated in article 7.10a, paragraph 1 of the Act.
- 6.3 Students of short courses or online courses are eligible to sit for the module assessment of the course they are registered for.

2 Content of the Programme

Article 7 Composition of the specialisations and joint specialisations

- 7.1 The composition of each programme specialisation is described in the programme handbooks of UNESCO-IHE and the partner institutes (in case of joint or double degree programmes)
- 7.2 The learning objectives of the modules, the content and assessment methods are described in the module descriptions of the handbooks.

Article 8 Participation

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

3 Examinations

Article 9 Quality assurance of examinations

- 9.1 An examination has to test whether a student has met the learning objectives.
- 9.2 Module coordinators are responsible for organising module assessments and for compiling the written examinations.
- 9.3 The programme committees are responsible for approving the student assessment methodologies as proposed by the module coordinators.
- 9.4 The Examination Board annually approves the planned examinations of the taught modules, and later deviations from that plan, as described in the module sheets and proposed by the programme committees.
- 9.5 All written examinations have to be peer reviewed, before being used.
- 9.6 The programme or specialisation coordinators are responsible for checking the module examination for clarity, completeness and consistency.

Article 10 Periods and frequency of examinations

- 10.1 Sequence of the module assessments will take place according to the order as described in the programme handbook.
- 10.2 Students can sit each module assessment only two times per academic year.
- 10.3 The date and time of the examinations are announced in the programme schedules. Written examinations take place during the examination periods indicated in the academic calendar.
- 10.4 Written and oral examinations for short and online course participants are held immediately at the end of the module. When a module is not immediately followed by an examination week, separate examinations will be drafted by the examiners for these participants.
- 10.5 In case of an oral and written examination for an online course, the student has to provide proof of identity to the examiner.
- 10.6 Students are not allowed to re-sit (constituent parts of) module assessments for which a pass has been obtained.
- 10.7 Written and oral re-examinations take place during the next examination period as indicated in the academic calendar. The students involved are notified sufficiently in advance by email about the date and time allocation for re-examinations. Non or misreading emails are no excuse for not participating in an re-examination. All students will take the re-sit of a written examination at the same time.
- 10.8 Students are not allowed to sit for further module assessments during the programme period they are registered for, if they failed three (3) different module re-examinations for the first 13 modules of the programme.

Article 11 The nature of the examinations

- 11.1 A module is assessed through (a combination of) written and/or oral examinations, assignments and presentations as described in the module descriptions of the programme handbook.
- 11.2 A written examination has to take place in a period of max. 3 hours during a morning or afternoon session. In case examination work consists of two or more different parts, a break of 15 minutes is allowed, provided that all examination work of the first part(s) is collected by the invigilators.
- 11.3 In case of a combination of an oral and written examination of a module during the examination week the maximum total duration of both examinations shall not exceed 3 hours.
- 11.4 Students have to be seated in the examination room 10 minutes before the examination is scheduled to start.
Misreading the date, time or room allocation will not be accepted as an excuse for absence from an examination or for arriving too late.
- 11.5 Examinations are carried out according to the guidelines described in annex C of these regulations.
- 11.6 The format of a re-examination may deviate from that of the first examination for the same module.
- 11.7 Re-examination proceeds by re-examining one or more failed constituent module examination parts as described in the assessment part of the module sheet, as would be necessary to achieve a successful examination result.
- 11.8 Students who suffer from a physical or sensory impairment are offered the opportunity to take part in an examination such that, as much as possible, account is taken of their disability. If required, an expert will be consulted for advice.
- 11.9 MSc thesis proposal examination.
The MSc thesis proposal examination is an oral examination, organised during the week following module 14. The examination consists of a presentation of the proposal, and a discussion with the examining committee. The committee consists of the supervisor and the mentor of the student.

Article 12 Oral examinations

- 12.1 Oral examinations involve only one student at a time. During oral examinations, a second staff member has to be present as independent observer.
- 12.2 Oral examinations are non-public, unless stated otherwise in the module sheet.

Article 13 Exemptions and transfer of credit points

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

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

Article 14 Absence from examinations

- 14.1 Absence from an examination must be reported by the student to the programme coordinator as early as possible. Absence is only allowed if the student missed a substantial part of the education relevant for the examination and/or the examination itself due to:
- a. medical reasons, to be confirmed by a medical note stating the inability to participate; or
 - b. serious personal circumstances beyond control of the student which should be supported by written evidence as far as possible.
- 14.2 For cases in which the programme coordinator, in agreement with the chair of the examination board, decides that the absence is justified the student shall sit the examination as soon as is reasonably possible.
- 14.3 For cases in which the programme coordinator, in agreement with the chair of the examination board, decides that the absence is not justified the result 1.0 will be recorded.

Article 15 Fraud

- 15.1 If a student is caught in an attempt to take unfair advantage during an examination, the invigilators or examiners will inform the Academic Registrar who will submit a written report to the examination board after investigation of the incident, and after having had a discussion with the student.
- 15.2 Plagiarism is a serious act of fraud.
- 15.3 An examiner who observes or suspects fraud during the marking of examination work is required to submit a substantiating report to the examination board via the module coordinator.
- 15.4 If the examination board, after investigation of the incident, concludes that there has been a case of fraud, the offender will be given the mark 1.0 for the examination work.

4 Results of Examinations

Article 16 Assessment and notice of examination results

- 16.1 Examination assessment results (including the thesis examination) are represented on a scale of 1.0 to 10.0, with one decimal of accuracy. Marks 6.0 and higher indicate a pass.
The following grading scale is used:
- | | |
|---------------|------------|
| 9.0 - 10.0 | Excellent |
| 8.0 - 8.9 | Very good |
| 7.0 - 7.9 | Good |
| 6.0 - 6.9 | Sufficient |
| 5.9 and below | Fail |
- 16.2 Examination assessment results (including the thesis examination) obtained at partner institutes are represented according to the descriptions in annex D of these regulations.
- 16.3 The mark for a module assessment is determined by the weighted average of the results of the constituent parts. The weights for the constituent parts are stated in the module sheet. The minimum grade for each of the constituent parts should be 5.0.
- 16.4 All written examination work of the students will, where feasible, be blind marked by the examiners involved.
- 16.5 The examiner shall assess a written examination or assignment within a period of 14 days after the date of the examination.
- 16.6 Examination results shall be collected, processed, recorded and notified to the students by the Education Bureau within a period of 21 days after submission of the examination work by the student.
- 16.7 The examiner shall determine the result of an oral examination shortly after the examination has been conducted.
- 16.8 The examination committee for the thesis examination shall determine the result after the defence. The mark shall be formally communicated to the student before the diploma awarding by the Education Bureau
- 16.9 For each examination, the student receives a written statement from the Education Bureau of the result obtained for the module assessment and, if successful, the associated credit points granted for that module.
- 16.10 The maximum recorded module mark after a successful re-sit is limited to 6.0.

Article 17 Period of validity

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

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

Article 18 Right to inspection of assessments

- 18.1 Students may, upon their own request, peruse their assessed examination work within ten working days after they were notified of the examination result.
- 18.2 Where a practical forms part of an examination, the work for that part may be returned to the students after the full assessment of the examination is completed.
- 18.3 Written examination work is kept in archive for a minimum of 6 years.

Article 19 Study progress and study advice

- 19.1 All study results that are required for evaluating the performance of the students, are recorded by the Education Bureau on behalf of the Examination Board.
- 19.2 Upon request, students will be provided with a written summary of the study results obtained in the programme to date.

5 Thesis Examination

Article 20 Organisation of thesis examination

- 20.1 The thesis will be assessed by a thesis examination committee, normally consisting of three (3) members: a professor as chairperson, the mentor and an external examiner. In special circumstances the committee may consist of more than three members. In case a PhD fellow, who is mentoring MSc students in his/her own research, is proposed as member of the committee, a fourth additional staff member is compulsory. External examiners are from outside the institute or in incidental cases from a chair group within the institute not involved in the supervision of the research work. In case of a double degree or joint degree programme, where the MSc research work is carried out under supervision of staff members of the partnering institutes, the examination committee may consist of more than three (3) members.
- 20.2 The opportunity to sit the thesis examination is offered once every calendar month.
- 20.3 All students have to submit the examination version of the thesis report on the same date, and defend their thesis in the designated period, as annually announced by the Examination Board.
- 20.4 Students can sit the thesis examination only if all other module assessments of the programme have been successfully completed.
- 20.5 When the outcome of the thesis examination, including the defence, was negative, the examination can be repeated once. The supervisor and mentor will detail the reasons for the failure in writing and clarify what is required to pass the exam. The student has to finalise the work without further supervision and financial support. The re-sit shall be taken within three months after the first attempt and will in principle be assessed by the same committee as for the first attempt. In special circumstances the examination can take place via videoconference.
- 20.6 The maximum recorded mark for a re-sit of the thesis examination is 6.0.
- 20.7 The MSc thesis work shall be assessed according to the MSc thesis assessment criteria as outlined in appendix F.
- 20.8 The mark for the thesis examination is based on the following components: written MSc thesis report, oral presentation and examination. The latter includes the ability of the student to answer questions from the examination committee. The oral presentation of the thesis research has a maximum duration of 30 minutes and is followed by a maximum 30 minutes examination discussion with the examining committee. The oral presentation is open to public attendance and discussion.
- 20.9 The decision on a final mark for the thesis examination in principle will be based on a consent agreement of the examining committee. In case of insurmountable disagreements the chair of the examining committee takes a decision.
- 20.10 The maximum duration of the MSc research phase is 6 months for a full time study. In case of force majeure as supported by proving documents, extension of this period may be granted on request by the student and is subject to approval by the rector, upon advice from the Examination Board.

6 Assessment criteria, degrees and certificates

Article 21 Assessment of the programme

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

SINGLE DEGREES:

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

JOINT DEGREES:

- For the joint degree Limnology and Wetland Management programme (LWM):
 - Successfully completed all module assessments of the programme, according to the grading rules of BOKU, Egerton University and UNESCO-IHE; and
 - Obtained a minimum of 120 ECTS.
- For the joint degree International Master of Science in Environmental Technology and Engineering programme (IMETE) (Erasmus Mundus programme):
 - Successfully completed all module assessments of the programme, according to the grading rules of Ghent University, Institute of Chemical Technology in Prague and UNESCO-IHE; and
 - Obtained a minimum of 120 ECTS.
- For the joint degree Environmental Technology for Sustainable Development (ETSuD) conducted with the Asian Institute of Technology (AIT):
 - Obtained a minimum of 48 AIT credits / 125 ECTS credits, and
 - Obtained a minimum cumulative GPA of 2,75 for courses taken at AIT, and
 - Passed all module assessments taken at UNESCO-IHE, and
 - Has obtained a grade 'fair' or higher for his/her Master's thesis.
- For the joint degree Urban Water Engineering and Management (UWEM) conducted with the Asian Institute of Technology (AIT):
 - Obtained a minimum of 48 AIT credits / 120 ECTS credits, and
 - Obtained a minimum cumulative GPA of 2,75 for courses taken at AIT, and
 - Passed all module assessments taken at UNESCO-IHE, and
 - Has obtained a grade 'fair' or higher for his/her Master's thesis.

DOUBLE / MULTIPLE DEGREES:

- For the double degree programme Land and Water development conducted with the Asian Institute of Technology (AIT):
 - Obtained a minimum of 48 AIT credits / 120 ECTS credits, and
 - Obtained a minimum cumulative GPA of 2,75 for courses taken at AIT, and
 - Passed all module assessments taken at UNESCO-IHE, and
 - Has obtained a grade 'fair' or higher for his/her Master's thesis.
- For the double degree programmes in Water Supply Engineering, Sanitary Engineering, and Environmental Science and Technology conducted with Universidad del Valle:
 - Obtained a GPA of 3.5 or higher for the course work done at Univalle; and
 - Successfully completed all module assessments at UNESCO-IHE; and
 - Achieved a pass for the thesis examination; and

- Obtained a minimum of 113,36 ECTS.
- For the double degree programmes in Water Supply Engineering, and Sanitary Engineering conducted with KNUST:
 - Obtained a CWA of 55% or higher for the course work done at KNUST; and
 - Successfully completed all module assessments at UNESCO-IHE; and
 - Achieved a pass for the thesis examination; and
 - Obtained a minimum of 118 ECTS.
- For the double degree programme in Land and Water development, conducted with Sriwijaija University:
 - Successfully completed all module assessments of the programme; and
 - Obtained a minimum of 106 ECTS.
- For the double degree programme Land and Water development conducted with the University of Nebraska-Lincoln:
 - Successfully completed all examinations of the programme; and
 - Obtained a minimum of 112 ECTS.

DOUBLE / MULTIPLE DEGREES (Erasmus Mundus programmes):

- For the multiple degree programme on Flood Risk Management:
 - Successfully completed all assessments of the programme, according to the grading rules of TU-Dresden, University of Ljublijana, TU-Catalonia and UNESCO-IHE; and
 - Obtained a minimum of 120 ECTS.
- For the multiple degree programme in Ecohydrology:
 - Successfully completed all assessments of the programme, according to the grading rules of the University of Lodz, University of Algarve, University of Kiel, University of La Plata and UNESCO-IHE; and
 - Obtained a minimum of 120 ECTS.

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

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

Article 22 Awarding of degrees and certificates

22.1 Master of Science degree.

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

- graduate receives a degree supplement stating the results achieved and credit points for each component of the programme.
- 22.2 Certificate.
Students who have successfully completed the short or online course assessment will be awarded a Certificate. The Certificate is signed by the Rector of the Institute, the Course coordinator and the Academic Registrar. In addition to this Certificate the graduate receives a supplement stating the result achieved and credit points.
- 22.3 Students who fail to meet the master programme assessment requirements, or who suspend or terminate their registration, will be issued a certificate stating the result achieved and credit points for each successfully completed component of the programme, and the period of registration.
- 22.4 If a student within 4 years after termination re-registers and meets (after examination(s)) the requirements of a MSc degree, he /she is obliged to return the certificate as mentioned under art 26.1.
- 22.5 Certificate of Graduate Study.
Students who fail to meet the programme examination requirements and have accumulated a minimum of 45 credits will be awarded a certificate of graduate study in the programme for which they are registered. Registration as student will be terminated.
- 22.6 With reference to art 26.1, if a student re-registers within 4 years with the aim to obtain a MSc degree, he has to redo in full all failed and missed modules and to take part in all examinations and re-examinations. Re-registration is only possible for the next academic period.
- 22.7 Certificate of Attendance.
Students who have successfully completed the short or online course without an assessment, and who have demonstrated an active participation in the course throughout the whole study period, will be awarded a Certificate of Attendance. The Certificate of Attendance is signed by the Rector of the Institute and the Course coordinator.

Article 23 Criteria for MSc degree with distinction

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

For single degree programmes:

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

For double / multiple degree programmes where student sits for the thesis examination at UNESCO-IHE:

- the candidate obtained a mark of 8.5 or higher for the thesis examination, and

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

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

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

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

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

7 Appeals

Article 24 Grounds for appeal

- 24.1 Students have the right to appeal against an examination assessment or an evaluation of the examination board within a period of ten working days after notification, if
- a. the performance of the student suffered through illness or other factors;
 - b. a material administrative error in the conduct of an examination or assessment had occurred;
 - c. the examination or evaluation was not conducted in accordance with the regulations; or
 - d. some other material irregularity had occurred.
 - e. a serious non-solved conflict has arisen between the supervisor and /or the mentor.

Article 25 Procedure for appeal

- 25.1 A student shall first attempt to resolve the problem through the programme coordinator, with the examiner, or the chairman of the examination committee.
- 25.2 If the student proceeds, the appeal shall be written in a letter stating the grounds for appeal and enclosing documentation as appropriate. The letter shall be addressed to the Rector.
- 25.3 The Rector shall accept or reject the appeal (after consultation with the examination board) and communicate the decision to the appellant via the Academic Registrar as soon as possible but usually within a period of ten working days.

8 Final Articles

Article 26 Amendments

- 26.1 Amendments to these regulations are made by separate decision of the Academic Board.
- 26.2 No amendments shall be made in relation to the current academic year, unless there is reasonable expectation that the amendment will not work to the disadvantage of the students.

Article 27 Unforeseen situations

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

Article 28 Publication

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

Article 29 Period of application

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

Appendix A Qualifications of Graduates

1. Urban Water and Sanitation Programme

1.1 Sanitary Engineering

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

Knowledge and Theory

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

Methods, Techniques and Tools

5. Prepare conceptual engineering and process design of sanitation components;
6. Apply modern tools for technology selection and carry out modelling of sanitation components;

Analysis, Synthesis and Integration

7. Define and critically analyse, assess and evaluate various urban drainage and sewerage schemes, and wastewater, sludge and solid waste treatment process technologies;
8. Analyse, synthesise, integrate, interpret, and discuss both scientific and practical information in the context of various research and engineering projects including preparation of Master plans, feasibility studies and preliminary designs;

Research

9. Identify, develop and conduct independent research including formulation of hypotheses selection and application of research methodologies, and the formulation of conclusions and recommendations;
10. Carry on desk studies, field work, and laboratory based research;
11. Contribute to the development of innovative approaches to the provision of adequate and sustainable sanitation services in developing countries and countries in transition;

General Academic Skills

12. Clearly communicate concerning both oral and written skills;
13. Continuously acquire knowledge and assimilate and implement innovative learning methods and skills in an independent manner;
14. Operate both autonomously and in a multidisciplinary and multinational environment.

1.2 Water Supply Engineering

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

Knowledge and Theory

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

Methods, Techniques and Tools

7. to design and to rehabilitate raw water abstraction, transport, treatment and distribution processes and systems;
8. Understand the importance and methods for operation and maintenance of water supply systems;
9. Understand options for centralised and urban systems versus decentralized and rural systems;

Analysis, Synthesis and Integration

10. define and evaluate project alternatives on basis of chosen selection criteria;
11. use statistical and modelling tools for simulating, prediction of performance and operation of water supply system components;
12. Understand water supply engineering within a watershed context

Research

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

General Academic Skills

14. Posses the learning skills to acquire continual knowledge in an independent manner;
15. communicate effectively in oral and written presentations to technical and non-technical audiences.

1.3 Urban Water Engineering and Management

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

Subject knowledge and skills

1. understand the urban water cycle and its water system components, their characteristics and functioning within greater urban infrastructure systems;
2. understand urban water management problems including ability to: identify water systems' demand; deal with climatic and hydrologic uncertainties and/or extremes; institutional limitations; and work within a data-constrained environment;
3. make appropriate and critical use of methods, techniques and tools necessary to monitor, analyze and design urban water systems including: water supply infrastructure; drinking water treatment and distribution; wastewater collection, treatment, transport and disposal systems; drainage systems;
4. understand water infrastructure/asset planning, financing and management, and utility management;
5. familiarity with the concept of integrated water resources management (IWRM) and its application to a variety of water management problems at the urban catchment scale;

Core academic skills

6. identify, articulate, analyse and solve problems of the urban water cycle and systems, integrating theory and applications;
7. collect, summarise, analyse and interpret technical data/materials in a structured form to gain knowledge on urban water system design and operation and maintenance;
8. critically recognize and assess the need for continued-education and research on planning, design, maintenance and management of urban water systems;
9. have a working knowledge of a range of information technology tools available for solving urban water management problems and for effectively communicating with fellow water managers, researchers, scientists, planners, and policy-makers;

Personal skills

10. Improved skills for independent learning;
11. enhanced reporting and presentation skills;
12. improved IT skills;
13. work independently or as part of a team;
14. manage time effectively.

2. Environmental Science Programme

2.1 Environmental Science & Technology

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

Knowledge & theory

1. demonstrate knowledge and understanding of the physical, chemical and biological processes of the environment, of the socio-economic concepts underlying the functioning and exploitation of environmental systems, and of the complex inter-relationship between the protection and wise use of environmental resources;
2. describe the rationale for an integrated and interdisciplinary approach for the sustainable management of water and environmental resources;
3. identify the impacts of human activities on the environment, under different levels of environmental stress and in different socio-economic contexts;
4. name and explain concepts, instruments and technologies for pollution prevention and remedial actions in a national and international context;

Methods, techniques & tools

5. design, optimise and interpret environmental monitoring and assessment schemes (including statistics and modelling) in order to gain an understanding of problems, trends, causes and effects;
6. apply general methods (including statistics and modelling) in scientific and technological approaches, concepts and interventions;
7. contribute as a flexible and creative member in interdisciplinary teams in developing solutions for prevention or remediation of environmental problems, by linking scientific knowledge to engineering interventions and to management decisions in different cultural and socio-economic contexts, and using different levels of available knowledge and information;

Analysis, synthesis & integration

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

Research/General academic skills

9. conduct research, independently or in a multidisciplinary team, including the formulation of research questions and hypotheses, the selection and application of research methodologies and techniques and the formulation of well-founded conclusions and recommendations;
10. communicate, debate and defend, clearly and systematically, findings and generated insights, and provide rational underpinning of these in oral and written presentations to a variety of audiences;
11. demonstrate academic attitude and learning skills (including thinking in multidisciplinary dimensions and distinguishing main issues from minor ones), to enhance and keep up-to-date the acquired knowledge and application skills in a largely independent manner.

2.2 Environmental Planning & Management

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

Knowledge & theory

1. to demonstrate knowledge and understanding of the physical, chemical and biological processes of the environment, of the socio-economic concepts underlying the functioning and exploitation of environmental systems, and of the complex inter-relationship between the protection and wise use of environmental resources;
2. to describe the rationale for an integrated and interdisciplinary approach for the sustainable management of water and environmental resources;
3. to understand the environmental policy cycle and planning process and to analyse and prepare environmental policy strategies, taking into account the impact that society has on water and environmental resources;
4. to name and explain principles, concepts and instruments of major national and international water and environmental legislation and common and desired institutional and management arrangements;

Methods, techniques & tools

5. to design, optimise and interpret environmental monitoring and assessment schemes (including statistics and modelling) in order to gain an understanding of problems, trends, causes and effects;
6. to apply general scientific methods (including statistics and environmental modelling) to processes of water and environmental resources allocation and use at different scales in order to gain an understanding of problems, trends, causes and effects;
7. to apply environmental scientific methods (including environmental impact assessment, policy analysis, resource valuation, environmental economics) and models for institutional development with emphasis on policy development, functional decentralisation and good governance;
8. to design and facilitate consultation- and decision-making processes between stakeholders, users and their representatives, water managers, politicians and other decision-makers;

Analysis, synthesis & integration

9. to critically analyse and evaluate a range of options and alternatives for the prevention or remediation of environmental problems, under different socio-economic, cultural and legal contexts, and under often data-poor conditions;
10. to identify and critically assess the different ecological and socio-economic functions and values of the environmental system and the, often competing, interests of the various stakeholders;

Research/General academic skills

11. to conduct research, independently or in a multidisciplinary team, including the formulation of research questions and hypotheses, the selection and application of research methodologies and techniques and the formulation of well-founded conclusions and recommendations;

12. to communicate, debate and defend, clearly and systematically, findings and generated insights, and provide rational underpinning of these in oral and written presentations to a variety of audiences;
13. to demonstrate academic attitude and learning skills (including thinking in multidisciplinary dimensions and distinguishing main issues from minor ones), to enhance and keep up-to-date the acquired knowledge and application skills in a largely independent manner;
14. to design comprehensive environmental resources policies and strategies that aim to enhance the sustainable use of the environment especially focusing on water, and that include a suitable combination of technical, legal, administrative and financial measures.

2.3 Water Quality Management

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

Knowledge & theory

1. demonstrate knowledge and understanding of the physical, chemical and biological processes of the environment, of the socio-economic concepts underlying the functioning and exploitation of environmental systems, and of the complex inter-relationship between the protection and wise use of environmental resources;
2. describe the rationale for an integrated and interdisciplinary approach for the sustainable management of water and environmental resources;
3. identify the impacts of human activities on aquatic ecosystems;
4. name and explain principles, concepts and instruments of main national and international water and environmental legislation and common and desired institutional and management arrangements;

Methods, techniques & tools

5. design, optimise and interpret environmental monitoring and assessment schemes (including statistics and modelling) in order to gain an understanding of problems, trends, causes and effects;
6. interpret, design and optimise water quality monitoring and assessment schemes in the watershed;
7. apply experimental, statistical and modelling tools for interpreting and designing water quality management programmes;

Analysis, synthesis & integration

8. critically analyse and evaluate a range of options and alternatives for the prevention or remediation of environmental problems, under different socio-economic, cultural and legal contexts, and under often data-poor conditions;
9. contribute as a flexible and creative member in interdisciplinary teams in developing solutions for water quality management problems in different cultural and socio-economic contexts, and using different levels of available knowledge and information;
10. critically analyse and evaluate alternative water quality management programmes in the watershed under different socio-economic and legal contexts, often in data-poor conditions;

Research/General academic skills

11. conduct research, independently or in a multidisciplinary team, including the formulation of research questions and hypotheses, the selection and application of research methodologies and techniques and the formulation of well-founded conclusions and recommendations;
12. communicate, debate and defend, clearly and systematically, findings and generated insights, and provide rational underpinning of these in oral and written presentations to a variety of audiences;

13. demonstrate academic attitude and learning skills (including thinking in multidisciplinary dimensions and distinguishing main issues from minor ones), to enhance and keep up-to-date the acquired knowledge and application skills in a largely independent manner.

3. Water Management Programme

3.1 Water Management

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

Knowledge & theory

1. Be able to describe and predict for a given water resources system the main hydrological, hydraulic, chemical and ecological processes and how these processes are dynamically linked with human activities, including land and water use.
2. Be able to describe and explain the main concepts and instruments for analysing and influencing formal and informal arrangements over water, including policies, laws and institutions, and by adopting a historical perspective.
3. Be able to explain the key concepts for integrated, multi-disciplinary and interdisciplinary analyses of water systems and describe the challenges of such approaches.
4. Be able to describe different concepts to determine the value of water for various uses and users in (amongst others) economic and social terms and explain how these concepts can be used in water management at various spatial and temporal scales

Methods, techniques & tools

5. Be able to formulate and critically evaluate governance frameworks related to water resources management and apply tools for policy analysis with the emphasis on social inclusion and sustainability.
6. Be able to combine different types of method and through a process of triangulation synthesize outcomes in a coherent manner.

Analysis, synthesis & integration

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

Research

8. Be able to conduct, independently or in a multidisciplinary team, research including the formulation of research questions and hypotheses, the selection and application of adequate research methodologies and techniques and the formulation of well-founded conclusions, recommendations and limitations.

General academic skills

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

10. Think in multidisciplinary and integrated dimensions and be able to distinguish main issues from side issues.
11. Have the academic attitude and learning skills to enhance and keep up-to-date the acquired knowledge and application skills in a largely independent manner.

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

3.2 Water Resources Management

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

Knowledge & theory

1. Be able to describe and predict for a given water resources system the main hydrological, hydraulic, chemical and ecological processes and how these processes are dynamically linked with human activities, including land and water use.
2. Be able to describe and explain the main concepts and instruments for analysing and influencing formal and informal arrangements over water, including policies, laws and institutions, and by adopting a historical perspective.
3. Be able to explain the key concepts for integrated, multi-disciplinary and interdisciplinary analyses of water systems and describe the challenges of such approaches.
4. Be able to describe different concepts to determine the value of water for various uses and users in (amongst others) economic and social terms and explain how these concepts can be used in water resources planning at various spatial and temporal scales

Methods, techniques & tools

5. Be able to model processes of the water system (rainfall-runoff, flooding, water allocation, water accounting), validate models, critically interpret model outcomes in order to derive insight in trends, causes and effects, and define and explain model limitations.
6. Be able to formulate and critically evaluate governance frameworks related to water resources management and apply tools for policy analysis with the emphasis on social inclusion and sustainability.
7. Be able to combine different types of method and through a process of triangulation synthesize outcomes in a coherent manner.

Analysis, synthesis & integration

8. Be able to define a given water resources system, and compose the water flows across time and space, including the various water uses, and describe the interdependencies these create between the various water users.
9. Be able to critically evaluate technical and/or institutional water resources interventions (projects/ programmes/ policies/ agreements) through analysis of implications for the water resources system, its users and their interrelations at various spatial and temporal scales.

Research

10. Be able to conduct, independently or in a multidisciplinary team, research including the formulation of research questions and hypotheses, the selection and application of adequate

research methodologies and techniques and the formulation of well-founded conclusions, recommendations and limitations.

General academic skills

11. Be able to clearly and systematically communicate, argue and defend findings in oral and written presentations to a variety of audiences.
1. Think in multidisciplinary and integrated dimensions and be able to distinguish main issues from side issues.
2. Have the academic attitude and learning skills to enhance and keep up-to-date the acquired knowledge and application skills in a largely independent manner.

3.3 Water Conflict Management

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

Knowledge & theory

1. describe for a given water resources system the interplay between the main biophysical processes and social dynamics, in analyzing, anticipating, preventing and managing conflicts.
2. describe and explain the main concepts and instruments for analysing and influencing formal and informal arrangements over water for collaboration, including policies, laws and institutions, and by adopting a historical perspective.
3. explain the key concepts for integrated, multi-disciplinary and interdisciplinary analyses of water systems and describe the challenges of such approaches at sector, intersectoral and transboundary levels.
4. name and critically discuss theories, concepts and tools of conflict management and cooperation building techniques in the context of natural resources and water in particular.

Methods, techniques & tools

5. design and facilitate inclusive consultation and conflict management processes, such as consensus building, public participation, negotiation and mediation between actors at different levels.
6. formulate and critically evaluate governance frameworks related to water conflict management and apply tools for policy analysis with the emphasis on social inclusion and sustainability.
7. do combine different types of method and through a process of triangulation synthesize outcomes in a coherent manner.

Analysis, synthesis & integration

8. define a given water resources system, assess the different functions of the water resources system and the often competing interests of water using sectors and actors, describe the interdependencies between these, and finally assess the possibilities and limitations of cooperation.
9. critically evaluate technical and/or institutional interventions focused on conflict management (projects/ programmes/ policies/ agreements) through analysis of implications for the water resources system, its users and their interrelations at various spatial and temporal scales.

Research

10. conduct, independently or in a multidisciplinary team, research including the formulation of research questions and hypotheses, the selection and application of adequate research

methodologies and techniques and the formulation of well-founded conclusions, recommendations and limitations.

General academic skills

11. clearly and systematically communicate, argue and defend findings in oral and written presentations to a variety of audiences.
12. think in multidisciplinary and integrated dimensions and be able to distinguish main issues from side issues.
13. have the academic attitude and learning skills to enhance and keep up-to-date the acquired knowledge and application skills in a largely independent manner.

3.4 Water Quality Management

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

Knowledge and theory

1. describe and predict for a given water resources system the main hydrological, hydraulic, chemical and biological processes and how these processes are dynamically linked with aquatic ecosystems as well as with human activities such as land and water use and pollution.
2. describe and explain the main concepts and instruments for analysing and influencing formal and informal arrangements for water quality management, including policies, laws and institutions, and by adopting a historical perspective.
3. explain the key concepts for integrated, multi-disciplinary and interdisciplinary analyses of aquatic ecosystems and describe the challenges of such approaches.
4. describe concepts to determine the value of water for various uses and users in (amongst others) economic and ecological terms and explain how these concepts can be used in water resources planning at various spatial and temporal scales.

Methods, techniques and tools

5. interpret, design and optimize water quality assessment and monitoring programmes by applying experimental, statistical and modelling tools.
6. formulate and critically evaluate governance frameworks related to water quality management and apply tools for policy analysis with the emphasis on social inclusion and sustainability.
7. combine different types of method and through a process of triangulation synthesize outcomes in a coherent manner.

Analysis, synthesis and integration

8. define a given water resources system, and compose the water and pollution flows across time and space, including the various water uses, and describe the interdependencies these create between the various water users.
9. critically evaluate technical and/or institutional interventions focused on water quality (projects/ programmes/ policies/ agreements) through analysis of implications for the water resources system, its users and their interrelations at various spatial and temporal scales.

Research

10. conduct, independently or in a multidisciplinary team, research including the formulation of research questions and hypotheses, the selection and application of adequate research methodologies and techniques and the formulation of well-founded conclusions, recommendations and limitations.

General academic skills

11. clearly and systematically communicate, argue and defend findings in oral and written presentations to a variety of audiences.
12. think in multidisciplinary and integrated dimensions and be able to distinguish main issues from side issues.
13. have the academic attitude and learning skills to enhance and keep up-to-date the acquired knowledge and application skills in a largely independent manner

3.5 Water Services Management

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

Knowledge and theory

1. Be able to describe for a given water resources system the interplay between the main biophysical processes and social dynamics, in analyzing service delivery modalities.
2. Be able to describe and explain the main concepts and instruments for analysing and influencing formal and informal arrangements concerning water supply and sanitation services, including policies, laws and institutions, and by adopting a historical perspective.
3. Be able to explain the key concepts for integrated, multi-disciplinary and interdisciplinary analyses of water services management and describe challenges of providing water supply and sanitation services at different levels (from global to local).
4. Be able to summarize the current debates relevant for water supply and sanitation services, using institutional and management theories from different academic disciplines (e.g. economics, public administration, sociology, political science, law).

Methods, techniques and tools

5. Design and apply analytical tools to research issues of water services management and describe, modify and apply management tools (e.g. with the benchmarking, cost benefit analysis, management information systems) with the aim of improving water supply and sanitation provision.
6. Be able to formulate and critically evaluate governance frameworks related to water services management and apply tools for policy analysis with the emphasis on social inclusion and sustainability.
7. Be able to combine different types of method and through a process of triangulation synthesize outcomes in a coherent manner.

Analysis, synthesis and integration

8. Be able to analyze and evaluate governance processes and utility management arrangements in the water services sector, integrating technical, legal administrative, social and financial components.
9. Be able to critically evaluate technical and/or institutional interventions (projects/ programmes/ policies/ agreements) through analysis of implications for water supply and sanitation services, its users and their interrelations at various spatial and temporal scales.

Research

10. Be able to conduct, independently or in a multidisciplinary team, research including the formulation of research questions and hypotheses, the selection and application of adequate research methodologies and techniques and the formulation of well-founded conclusions, recommendations and limitations.

General academic skills

11. Be able to clearly and systematically communicate, argue and defend findings in oral and written presentations to a variety of audiences.
12. Think in multidisciplinary and integrated dimensions and be able to distinguish main issues from side issues.
13. Have the academic attitude and learning skills to enhance and keep up-to-date the acquired knowledge and application skills in a largely independent manner.

4. Water Science and Engineering Programme

4.1 Hydraulic Engineering and River Basin Development

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

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

4.2 Coastal Engineering and Port Development

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

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

4.3 Hydroinformatics– Modelling and Information Systems for Water Management

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

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

4.4 Hydrology and Water Resources

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

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

4.5 Land and Water Development

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

1. have in-depth understanding and specific knowledge of:
 - a. the latest concepts and theories of irrigation, drainage, flood protection, land reclamation and consolidation technologies for sustainable development;
 - b. the cross-sectoral linkages comprehending wider aspects of society, economy and the environment;
2. use latest hydraulic engineering and hydrological methods to apply in planning, design and implementation of irrigation, drainage and flood protection schemes, independently or in a multidisciplinary team;

3. identify and cross-evaluate alternative land and water development options for areas under different land uses and assess their technical, economic, institutional and environmental feasibility;
4. engage in or advise developers, system managers and water users on the participatory development and management, as well as modernisation of irrigation, drainage and flood protection schemes for their planning, design, implementation, operation and maintenance, financing and performance assessment;
5. acquire knowledge and understanding of contemporary research issues in the field of land and water development;
6. formulate research questions, articulate research methodologies, develop study plans, and adequately communicate research results and conclusions in written and oral forms to a wide variety of audience.

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

After successful completion of the programme graduates will :

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

- economic feasibility, as well as the environmental sustainability of the proposed development and/or management plans;
11. Have adopted the academic attitude and learning skills to enhance and broaden the acquired knowledge and application skills in a largely independent manner.

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

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

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

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

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

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

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

4.9 Ecohydrology

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

1. demonstrate knowledge and understanding of the ecological and hydrological processes on varying spatiotemporal scales in the environment, of the socio-economic concepts underlying the functioning and exploitation of environmental systems, and of the complex inter-relationship between the protection and wise use of environmental resources;
2. design, optimise and interpret environmental monitoring and assessment schemes (including statistics and modelling) in order to gain an understanding of problems, trends, causes and effects;
3. critically analyse and evaluate a range of options and alternatives for the prevention or remediation of environmental problems, under different socio-economic, cultural contexts, and under often data-poor conditions;
4. contribute as a flexible and creative member in interdisciplinary teams in developing solutions for prevention or remediation of ecohydrological systems, by linking scientific knowledge to engineering interventions and to management decisions in different cultural and socio-economic contexts, and using different levels of available knowledge and information;

5. conduct research, independently or in a multidisciplinary team, including the formulation of research questions and hypotheses, the selection and application of research methodologies and techniques and the formulation of well-founded conclusions and recommendations;
6. communicate, debate and defend, clearly and systematically, findings and generated insights, and provide rational underpinning of these in oral and written presentations to a variety of audiences;
7. demonstrate academic attitude and learning skills (including thinking in multidisciplinary dimensions and distinguishing main issues from minor ones), to enhance and keep up-to-date the acquired knowledge and application skills in a largely independent manner.

4.10 Flood Risk management

After successful completion of the programme graduates will have:

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

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

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

Appendix B Examination Procedures

GENERAL RULES

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

WRITTEN EXAMINATIONS

PROCESS:

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

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

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

Student card: Students are required to bring their UNESCO-IHE student card and are allowed to enter the examination room after a signal from the invigilators. Students display their student card on their table.

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

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

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

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

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

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

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

Other materials: The use of materials other than listed above, including blank paper, texts, laptops, computing and communication devices, personal audio and video devices, of any kind, is not allowed.

Examiners may nevertheless allow students to use specified text matter or other effects in a so-called 'open book' examination. These materials shall not include previous or example examinations and solutions.

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

Submission of exam papers: Students who finish the examination at least 15 minutes after the start and at least 15 minutes before the ending of the examination are allowed to submit their work to the invigilator and quietly leave the examination room.

Students have to ensure that all required papers are submitted to the invigilator. Papers cannot be submitted after the student has left the examination room.

ASSIGNMENT REPORTS AND INDIVIDUAL DISCUSSIONS

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

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

THESIS PROPOSAL

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

Appendix C GRADING SYSTEMS used by partner institutes

JOINT SPECIALISATION IN:

- SANITARY ENGINEERING
- WATER SUPPLY ENGINEERING
-

Kwame Nkrumah University of Science & Technology (KNUST)

Grading scale of 0 to 100%, where 50% or higher implies a pass.

The minimum grade needed to have a postgraduate degree conferred upon an individual is a CWA of 55%.

CWA (Cumulative Weighted Average) = $\frac{\text{sum [credits x mark]}}{\text{sum of all credits}}$

Example:

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

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

JOINT SPECIALISATION IN:

- UWEM
- AWELWP
- ETSuD

Asian Institute of Technology

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

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

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

JOINT SPECIALISATION IN:

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

Universidad del Valle

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

Degree is awarded when

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

JOINT SPECIALISATION IN:

- **ILDMP**

Sriwijaija University

Same system as used at UNESCO-IHE

JOINT SPECIALISATION IN:

- **LWM**

Egerton University

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

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

BOKU

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

The following grading scale is used:

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

ERASMUS MUNDUS PROGRAMME: 'IMETE'**Gent, Prague**

ECTS			Gent University		UNESCO-IHE*			ICTP
A++ (exceptional only 1%)			19 or 20		10			100
A (top 5%)			18		9.2			90-100 A
A (top 10%)			17		8.8			
B (top 20%)			16		8.4			80-89 B
B (top 35%)			15		8			
C (top 50%)			14		7.6			70-79 C
C (top 65%)			13		7.2			
D (top 80%)			12		6.8			60-69 D
E (top 90%)			11		6.4			50-59 E
E (just pass)			10		6			
F (fail)			9		5.4			0-49 F
			8		4.8			
			7		4.2			
			6		3.6			
			5		3			
			4		2.4			
			3		1.8			
			2		1.2			
			1		0.6			
			0		0			

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

ERASMUS MUNDUS PROGRAMME: 'FLOOD RISK MANAGEMENT'**TU Dresden:**

A = 1 "very good"

B = 2 "good"

C = 3 "satisfactory"

D = 4 "sufficient"

E = 5 "insufficient"

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

University of Ljubljana

10-(excellent: outstanding results with negligible mistakes),

9-(very good: high pass with minor mistakes),

8-(very good: sound knowledge),

7-(good: sound knowledge with major mistakes),

6-(satisfactory: adequate knowledge suiting minimum criteria),

5 - 1-(insufficient: failure, poor knowledge below minimum criteria).

Candidates with grades satisfactory (6) or more, have passed the examinations successfully.

The student has two grades per subject: separately theory and lab exercise (seminar work).

For thesis there are also two grade: written report and presentation, both should be more than

6. Finally we have one grade for thesis and common final grade of study (special formula).

TU-Catalonia

Scale from 0-10

MH Honors (is given on exceptional cases)

9.0 - 10.0 excellent

7.0 - 8.9 very good

5.0 - 6.9 satisfactory

4.0 - 4.9 marginal fail

0.0 - 3.9 fail

NP not examined

R recognition

ERASMUS MUNDUS PROGRAMME: 'ECOHYDROLOGY'

University of Algarve

University of Lodz

University of Kiel

University of La Plata

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

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

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

Appendix D MSc modules: names, credits & assessment methods

1. Urban Water and Sanitation programme

Water supply engineering

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

Sanitary engineering

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

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

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

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

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

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

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

2. Environmental Science programme

Environmental Science and Technology

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

Environmental Policy Making

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

Water Quality Management

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

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

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

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

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

3. Water Science and Engineering programme

River Basin Development

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

Coastal Engineering and Port Development

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

Land and Water Development

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

Hydroinformatics

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

Hydrology and Water Resources

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

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

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

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

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

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

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

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

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

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

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

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

Ecohydrology Programme Components

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Third Semester (Period 4: UNESCO - IHE):

Period P4: 30 ECTS, 20 SWS

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

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

Period 4 UNESCO - IHE – free elective courses

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

Third Semester (Period 4: CAU Kiel):

Period P4: 30 ECTS, 20 SWS

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

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

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

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

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

Fourth Semester (Period 5):

Master Thesis (30ECTS):

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

Explanations:

Course: Course Identification Code
Course name: Title of the course

Teaching form: Kind of teaching
L= Lecture
S= Seminar
P= Practice
TO=Theoretical-practical
OT=Tutorial
W= Workshop
E= Excursion

SWS: Hours of teaching (face to face)

Evaluations: = Prüfungsleistungen

Oral exam = Mündliche Prüfung
Written Examination = Schriftliche Prüfung
Presentation = Vortrag
Exercise = Hausaufgabe
Project = Protokoll
Report = Hausarbeit



Michael McClain
Chair of the WSE Programme Committee

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

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

4. Water Management programme

Water Resources Management

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

Water Conflict Management

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

Water Services Management

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

Water Quality Management

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

Appendix E MSc thesis marking guidelines

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

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

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

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

UNESCO-IHE - Academic Calendar 2014/2016



YEAR 1	2014						2015						2016																																								
	October	November	December	January	February	March	April	May	June	July	August	September	October	...	...	...																																		
Week	42	43	44	45	46	47	48	49	50	51	52	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
Mon	13	20	27	03	10	17	24	01	08	15	22	29	05	12	19	26	02	09	16	23	30	06	13	20	27	04	11	18	25	01	08	15	22	29	06	13	20	27	03	10	17	24	31	07	14	21	28	05	12				
Tue	14	21	28	04	11	18	25	02	09	16	23	30	06	13	20	27	03	10	17	24	31	07	14	21	28	05	12	19	26	02	09	16	23	30	07	14	21	28	04	11	18	25	01	08	15	22	29	06	13				
Wed	15	22	29	05	12	19	26	03	10	17	24	31	07	14	21	28	04	11	18	25	02	09	16	23	30	06	13	20	27	03	10	17	24	31	07	14	21	28	05	12	19	26	02	09	16	23	30	07	14				
Thu	16	23	30	06	13	20	27	04	11	18	25	01	08	15	22	29	05	12	19	26	02	09	16	23	30	07	14	21	28	04	11	18	25	02	09	16	23	30	06	13	20	27	03	10	17	24	31	08	15				
Fri	17	24	31	07	14	21	28	05	12	19	26	02	09	16	23	30	06	13	20	27	03	10	17	24	31	08	15	22	29	05	12	19	26	03	10	17	24	31	07	14	21	28	04	11	18	25	02	09	16				
Sat	18	25	01	08	15	22	29	06	13	20	27	03	10	17	24	31	07	14	21	28	04	11	18	25	02	09	16	23	30	06	13	20	27	04	11	18	25	01	08	15	22	29	05	12	19	26	03	10	17				
Sun	19	26	02	09	16	23	30	07	14	21	28	04	11	18	25	01	08	15	22	29	05	12	19	26	03	10	17	24	31	07	14	21	28	05	12	19	26	02	09	16	23	30	06	13	20	27	04	11	18				
	(2x5 ECTS)						(2x5 ECTS)						(2x5 ECTS)						(1x5 ECTS)						(2+7 ECTS)																												
	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6	Module 7	Module 8	Module 9	Module 10	Module 11	Module 12	Module 13	Module 14																																							

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

- Legend
- = Lecture period
 - = Examination days
 - = MSC thesis writing
 - = Holiday/free time
 - = Opening acad. year
 - = Diploma awarding
 - = Summer course
-
- Chistmas: 25/26 Dec 2014
- Good Friday: 3 April 2015
- Easter: 5/6 April 2015
- Kingsday: 27 April 2015
- Liberationday: 5 May 2015
- Ascencion: 14 May 2015
- Pentecost: 24/25 May 2015
- Chistmas: 25/26 Dec 2015
-
- Good Friday: 25 March 2016
- Easter: 27/28 March 2016

Environmental Science programme overview 2014-2016

		EST Environmental Science and Technology	EPM Environmental Planning and Management	WQM Water Quality Management	IMETE IMETE	ETSuD ETSuD	LWM Limnology and Wetland Management	EST-Univalle	
1	.....-19/10 20/10-28/10	Week ONE introduction (ALL)				Programme at AIT, Bangkok		Programme at Univalle, Cali
	27/10-02/11 03/11-09/11	Introduction to environmental science (ES0123)							
2	10/11-16/11 17/11-23/11 24/11-30/11	Introduction to environmental science (ES0123)				Travel to Delft (-.)		Travel to Delft (-.)	
...	01/12-07/12	Examination Week							
3	08/12-14/12 15/12-21/12	Introduction to environmental science (ES0123)				Travel to Delft (-.)		Travel to Delft (-.)	
...	22/12-28/12 29/12-04/01	Free Period							
3	05/01-11/01	Introduction to environmental science				Integrated project environmental science (ES04)		Integrated project environmental science (ES04)	
4	12/01-18/01 19/01-25/01 26/01-01/02	Integrated project environmental science (ES04)							
...	02/02-08/02	Examination Week				Travel to Prague (-.)	Travel to Kenya (-.)	Industrial Resource Management & Cleaner Production (ES05TM)	
5	09/02-15/02 16/02-22/02 23/02-01/03	Industrial Resource Management & Cleaner Production (ES05TM)	Water and environmental law (=> WM05)	Water and environmental law (=> WM05)	Industrial Resource Management & Cleaner Production (ES05TM)				Programme in Egerton	Industrial Resource Management & Cleaner Production (ES05TM)
6	02/03-08/03 09/03-15/03 16/03-22/03	Environmental systems analysis (ES06TM)	Environmental systems analysis (ES06TM)	Water quality assessment (ES06W)	Programme in Prague (-.)	Environmental systems analysis (ES06TM)	Lake ecology (ES06bL)	Environmental systems analysis (ES06TM)	
...	23/03-29/03	Examination Week				Examination Week	Stream and river ecology (ES06L)	Examination Week	
7	30/03-05/04 06/04-12/04 13/04-19/04	Environmental engineering (ES07T)	Water and environmental policy making (ES07M)	Constructed Wetlands for Wastewater Treatment (ES07W)	Programme in Prague (-.)	Constructed Wetlands for Wastewater Treatment (ES07W)	Tropical wetlands for water quality (ES07L)	Environmental engineering (ES07T)	
8	20/04-28/04 27/04-03/05 04/05-10/05	Environmental monitoring and modelling (ES08T)	Environmental planning and implementation (ES08MW)	Environmental planning and implementation (ES08MW)		Environmental monitoring and modelling (ES08T)	Fisheries and aquaculture (ES08L)	Environmental monitoring and modelling (ES08T)	
...	11/05-17/05	Examination Week				Examination Week	Travel to Delft (-.)	Examination Week	
9	18/05-24/05 25/05-31/05 01/06-07/06	Foreign fieldtrip and fieldwork ES (ES09TMW)				Foreign fieldtrip and fieldwork ES (ES09TMW)	Data analysis and modelling for aquatic ecosystems (ES09L)	Foreign fieldtrip and fieldwork ES (ES09TMW)	
10	08/06-14/06 15/06-21/12 22/06-28/06	Aquatic ecosystems processes and applications (ES10TWL)	Environmental Assessment for Water-related Policies and Developments (ES10M)	Aquatic ecosystems processes and applications (ES10TWL)	Aquatic ecosystems processes and applications (ES10TWL)	Aquatic ecosystems processes and applications (ES10TWL)	Aquatic ecosystems processes and applications (ES10TWL)	Aquatic ecosystems processes and applications (ES10TWL)	
Click HERE TO CHOOSE YOUR MODULE 10+11 (2014-2016)									
11	29/06-05/07 06/07-12/07 13/07-19/07	Solid waste management (ES11T) or Watershed and river basin management (ES11MW) or IWRM as a tool for adaptation to climate change (ES11X) or Wetlands for Livelihoods and Conservation (ES11LM) or a module from another programme(WSE UWS WM)				Summer schools	Mandatory (ES11ETSuD)	Wetlands for Livelihoods and Conservation (ES11LM)	Solid waste management (ES11T) or Watershed and river basin management (ES11MW) or IWRM as a tool for adaptation to climate change (ES11X) or Wetlands for Livelihoods and Conservation (ES11L) or a module from another programme(WSE UWS WM)
...	20/07-26/07	Examination Week				Examination Week			
12	27/07-02/08	Summer course (ES12)				Summer course (ES12)			
13	03/08-09/08 10/08-16/08 17/08-23/08	Groupwork ES (ES13TMW)				Travel to AIT (-.)	Groupwork ES (ES13TMW)		
...	24/08-30/08	Examination Week				Examination Week			
...	31/08-06/09	Free				Travel to Ghent (-.)	Free	Travel to Cali (-.)	
14	07/09-13/09 14/09-20/09 21/09-27/09 28/09-04/10 05/10-11/10	MSc preparatory course and thesis research proposal(ES14)				Programme in Ghent (-.)	MSc preparatory course and thesis research proposal (ES14)	Programme in Cali (-.)	
...	12/10-18/10	Examination Week					Examination Week		
15	19/10/15 10/04/16	MSc thesis period (6 months) (ES15)				MSc proposal MSc thesis AIT	MSc thesis period (6 months) (ES15)		
...	11/04-17/04 18/04-24/04	Final Examination Week(s) - Diploma awarding 26/04/2016					Final Examination Week(s) - Diploma awarding 26/04/2016		

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ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

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

Module Sheet

Module Name		Module Code	Credits
Week 1 + Introduction to environmental science		ES0123	15
Target Group	Prerequisites		
Programme target group	Programme prerequisites		

Learning Objectives

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

- Make a critical analysis of the global and national agendas and policies for "Water and Environment" in the context of sustainable development;
- Identify and describe the major global, regional and local environmental problems;
- Identify and describe the basic natural, chemical, hydrological and socio-economic processes in relation to the environment;
- Explain basic environmental concepts, such as ecological footprint, feedback mechanisms, ecosystem dynamics, carrying capacity and nutrient cycling.
- Apply basic principles of data analysis, statistics, environmental modelling and GIS
- Apply the principles of the scientific method to design, develop and communicate a research project

Topics and Learning Activities

Water, environment and sustainable development (week 1)

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

Learning Activities:

Week 1 will consist of lectures, exercises, workshops, video-conferencing sessions, and role play sessions.

Hydrology and Chemistry (two separate topics)

In hydrology the main items will be precipitation and collection of meteorological data, evaporation, soil moisture, geo-hydrology and the hydrodynamics of ecosystems.

Environmental) chemistry will first discuss electrolytes in water, solubility and redox systems. Subsequently emphasis will be given to sources and fate of micro-pollutants in water and sediments.

Learning Activities:

Lectures (the lectures in chemistry are supported by laboratory sessions)

GIS, environmental modelling, data analysis and statistics

You will apply the basic principles with practical examples and case studies

Learning Activities:

Lectures and exercises

Case study environmental problem: eutrophication

Learning Activities:

The case study eutrophication consists of laboratory activities.

Microbiology and ecology two separate topics)

The basic aspects of natural processes in relation to the environment will be discussed. In microbiology the (micro-)biological actors in the cyclic processes of the most important elements (C, N, P, S) will be discussed. The lectures in microbiology are supported by laboratory sessions

In ecology basic ecological concepts will be discussed in relation to the structure and function of major ecosystems. Interactions between ecosystems and human activities will be analysed. Human beings always affect the environment.

Learning Activities:

Lectures and laboratory sessions (microbiology)

Lectures (ecology)

Economics with special focus on use and scarcity of natural resources

The subject of use and scarcity of natural resources starts with reviewing resource and scarcity concepts and mechanisms leading towards and away from scarcity. In a second part, the cases of specific resources are

treated: food, wood, fish, biodiversity, water and energy.

Learning Activities:

Lectures + simulation game

Integration topics

This topic deals with critical thinking, academic writing, presentation skills, group dynamics.

Learning Activities:

Lectures, excercises

Lecturing Material

- Lecture notes, laboratory notes

Cunningham & Cunningham, Environmental Science, a global concern. 11th ed.

Assessment

- 70%: Written Exam (closed book) -- Assessment 1: two separate written exams (Hydrology=28%) and (Chemistry=42%)
- 30%: Assignment -- Assessment 1: (GIS assignment)
- 60%: Written Exam (closed book) -- Assessment 2: (DAM - Data analysis, statistics and environmental modelling)
- 40%: Assignment -- Assessment 2: assignment in three parts: (DAM statistics=20%) and (annotated bibliography=10%) and (enquiry.1=10%)
- 80%: Written Exam (closed book) -- Assessment 3: written exam in three parts: (Microbiology=32%), and (Ecology=24%) and (Economics=24%)
- 20%: Assignment -- Assessment 3: assignment in two parts about academic skills and communication skills: (enquiry.2=10%) and (enquiry.3=10%)

2014/2016-ES0123: Week 1 + Introduction to environmental science														
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, environment, sustainability		15	20								20	35	several
	Introduction of module ES0123			4								4	4	van Dam and Hes
	Chemistry	10		10								20	40	Kelderman
	Hydrology	8										8	24	Wenninger and Stigter
	Lab eutrophication			10								10	10	Irvine, Kelderman and de Ruyter
	Microbiology	10		16								26	46	van de Vossenbergh and van Bruggen
	Ecology	10										10	30	de Ruyter
	Economy, natural resources	8		8								16	32	Bijlsma
	GIS	8		8								16	32	van der Kwast
	Data analysis, statistics and modelling	24		26								50	98	van Dam, Tran Duy, Singer and Hes
	Integration topics	17		18								35	69	Gettel, Irvine, Darvis and others
	Exams		8										8	
	Å													
	Total	95	23	120								215	428	

MSc module - UNESCO-IHE

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

Academic Year: 2014-2016
Specialization: Core Programme
Module Coordinator: Dam, A.A. van

Module Sheet

Module Name		Module Code	Credits
Integrated project environmental science		ES04	5
Target Group	Prerequisites		
Programme target group	Programme prerequisites		

Learning Objectives

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

- Describe the environmental policy process and the role and sources of data and information that play a role in formulating policy
- Gather information on an environmental problem from various sources and critically assess its quality and role in the debate about the problem
- Formulate a scientific research question, compare and contrast scientific information relevant to the research question from a variety of sources and present the findings in a concise report
- Make an oral presentation of scientific information
- Analyze, evaluate and present scientific data
- Perform a basic multi-criteria analysis in the context of decision making for an environmental problem

Topics and Learning Activities

Introductory and closing session

Introduction to module objectives and procedures. Expectations of students and lecturers. Presentation of policy briefs and reports in closing session.

Learning Activities:

Lectures and discussion. Presentations by participants.

Evidence-based policy making

Learning Activities:

Lectures. Exercise.

Documentary

Learning Activities:

Viewing of a documentary film about the case study environmental problem, followed by group discussions about the film and division of tasks for individual research topic.

Research questions

Learning Activities:

Lectures about formulating research questions. Exercise in which participants formulate their own research question.

Data analysis

Learning Activities:

Exercise with data sets about the environmental problem with students using R to analyze and present the data.

Multi-criteria analysis

Learning Activities:

Lecture and exercise about multi-criteria analysis

Group sessions

Learning Activities:

Group sessions with content discussions, Powerpoint presentations by individual participants, coordination of group work and feedback from group mentor.

Lecturing Material

Assessment

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

2014/2016-ES04: Integrated project environmental science

Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM:		Lecturer(s)
								contact hours	study/load hours	
1	Introductory and closing session	8						8	24	Hes / Van Dam
2	Evidence-based policy making	4					8	12	36	Irvine / Wehn de Montalvo
3	Documentary			4			4	8	16	Bijlsma / Van Dam
4	Research questions	4					4	8	24	Irvine / Wehn de Montalvo
5	Data analysis						4	4	12	van Dam
6	Multi-criteria analysis	2		2			4	8	20	Hes
	Group sessions			8				8	8	Bijlsma / Van Dam
	Total	18		14			24	56	140	

MSc module - UNESCO-IHE

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

Academic Year: 2014-2016
 Specialization: Core Programme
 Module Coordinator: Raj, E.R.

Module Sheet

Module Name Industrial Resource Management & Cleaner Production		Module Code ES05T	Credits 5
Target Group The module on Industrial Resource Management and Cleaner Production (IRM&CP) is directed at engineers and scientists working in the urban or industrial water field and wanting to have a better grasp at the efficient dealing with water. As such the module is of interest to engineers and scientists in the fields of urban, municipal and industrial sanitation, water-related chemistry and biology, water resources, process design and implementation.	Prerequisites Participants should possess a BSc degree in an area relate environmental engineering and science, microbiology, chemical engineering, chemistry, public health, etc. Professional experience in the water field helps to fully grasp the significance of the back-ground thinking relayed in the module and of the practical benefits of some of the concepts presented. A good command of the English language is required.		

Learning Objectives

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

- suggest options for preventing pollution within urban and industrial water management settings;
- assess the environmental impact of products and processes;
- suggest treatment/disposal methods for industrial wastewater from which the value has been taken out;
- understand the importance of environmental management systems in the industrial context;
- indicate how the sustainable use of resources can be beneficial for reducing environmental burden(s);
- analyze the different system tools that support industrial ecology and make basic calculations related to life cycle analysis.

Topics and Learning Activities

Introduction to the field of Cleaner Production (CP)

What is Cleaner Production (CP)? How did it develop, in what context? How can Cleaner Production be applied to industrial, domestic, institutional management? How does Cleaner Productin relate to Water Management

Learning Activities:

Introductory lectures, group discussions, application in own (home) conditions

Life Cycle Analysis (LCA), Eco Design and Material Flow Analysis (MFA)

What is Life Cycle Analysis (LCA)? What does it aim at? How does it work in practice and what is the practical significance of LCA?

Learning Activities:

Lectures, examples, calculational exercises

Environmental Management Systems (EMS)

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

Learning Activities:

Lectures, group studies, group exercises, calculation examples

Corporate social responsibility (CSR)

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

Learning Activities:

Lectures, class room activities, role play, discussion, learning by practice

Industrial Water Management (IWM)

What is Industrial Water Management (IWM)? What does industry management water? WHat are pitfalls, what are options? What is the role of CP in UWM?

Learning Activities:

Lectures, group exercises, calculations, discussion

Water Footprint (WF)

What is water stress, How is water footprint related to climate change, How can global water scarcity be

measured, What are the temporal and spatial dimensions of water scarcity and How do we estimate the water footprint of a product?

Learning Activities:

Lectures, class assignments, simple calculations and the use of water footprint calculator, discussions and case studies

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

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

Learning Activities:

Lectures, discussions and case studies

Lecturing Material

- Lecture notes in electronic form
- Reading materials published by others
- Case studies
- Movies
- Group work, group discussions, role play
- Use of software for water footprint calculations
- Class room role play

Assessment

- **60%: Written Exam (open book) -- Examination is on-line using MOODLE**
- **35%: Assignment -- Group work (Dajajama), final presentation and final report submission**
- **5%: Presentation -- Part of the 5% from Presentation includes contribution in class, presence, initiative, creativity**

2014/2016-ES05T: Industrial Resource Management & Cleaner Production										
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 the field of Cleaner Production	8		4				12	28	Don Huisingh
	Material flow analysis	6						6	18	Susanne Rotter
	Life cycle analysis	3			3			6	15	Leon Dijk
	Environmental management systems	3						3	9	John Stans
	Corporate social responsibility	4		2				6	14	Eva Froger
	Industrial water management	4						4	12	Richard Hill
	Eco-industrial parks and industrial ecology	2						2	6	Eldon R. Rene
	Simulation game - fun factory			3				3	3	Susanne Rotter
	Group exercise	1	8	20				21	31	Eldon R. Rene, Maarten Siebel
	Field trip (Processing facility)					8		8	8	Eldon R. Rene, Maarten Siebel
	Water footprint	4		2				6	14	Ashok Chapagain
	Exam									
	Total	35	8	31	3	8		77	158	
MSc module - UNESCO-IHE										

WATER MANAGEMENT

MASTERS PROGRAMME

Academic Year: 2014-2016
 Specialization: Core Programme
 Module Coordinator: Jaspers, F.G.W.

Module Sheet

Module Name Water and environmental law		Module Code WM05	Credits 5
Target Group Students of the Masters of Science Programmes of Water Management and Environmental Science and Technology . Practitioners with a relevant Bachelor's degree in a water related discipline		Prerequisites Preferably a relevant water science and engineering related bachelor's degree or equivalent; affinity with water management; good command of English.	

Learning Objectives

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

- demonstrate and apply knowledge in the fields of national and international water and environmental law and to perceive and discuss the main concepts, theories, discourses
- apply, compose and recreate legal instruments to operationalize integrated water resources management (water quantity and water quality)
- demonstrate and apply knowledge in the field of contract management for use in water projects.
- analyze and prepare a contract for a specific situation
- describe and apply concepts of water allocation, water rights and international benefit sharing
- discuss and explain complexity of decision making for water allocation in national and international rivers.

Topics and Learning Activities

Introduction to national and international water law and institutions

Comparative environmental law and water law principles. Innovative legal and policy instruments; changing patterns of global governance. Introduction to the UN system. Introduction to the Law of Treaties. Key international environmental and water treaties. Principles of dispute resolution.

Processes of water policy development

Water sector reform, functional decentralization and development and benchmarking of river basin organizations.

Systems of (transboundary) water allocation and (customary) water rights

Shared vision and strategy development, water and benefit sharing from international rivers.

Regulations for international and trans-boundary water quality management

EU Framework Directive, Dutch water policy and organizations, application of environmental standards and others.

Lecturing Material

- F.G.W. Jaspers - Chapters in Water and Environmental Resources Law, UNESCO-IHE Lecture Notes.
- F.G.W. Jaspers - Role Play International Rivers, UNESCO-IHE Lecture Note.
- F.G.W. Jaspers - Introduction in Contract Management, UNESCO-IHE Lecture Note.
- J. Gupta - International Water Law and Institutions, UNESCO-IHE Lecture Note.
- P. van der Zaag e.a - Legislation of International Waters, UNESCO-IHE Lecture Note.
- Various inputs from guest lecturers.

Assessment

- **70%: Written Exam (closed book) -- Open Questions**
- **30%: Assignment -- Assignment contract design (Workshop)**

2014/2016-WM05: Water and environmental law

Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: study/load hours	Lecturer(s)
1	Water Law									
1.1	Introduction Water Law	2						2	6	Jaspers
1.2	International Water Law	2		4				6	10	Gupta
1.3	Legal Instruments Environmental Law	2		4				6	10	Jaspers
1.4	Contract Management	2						2	6	Jaspers
1.5	International Environmental Law	4		2				6	14	Gupta
1.6	Case studies Environment / Forestry			4				4	4	Gupta
2	Legal Arrangements									
2.1	Contract Management Case Study / Workshop			4				4	4	Jaspers
2.2	Trans-boundary Water Allocation	4						4	12	Van der Zaag/Shubber
2.3	Beneift Sharing	4						4	12	Van der Zaag/Shubber
2.4	WQM Regulation	2		2				4	8	Hendry
2.5	EUWFD	2		2				4	8	Hendry
3	Organisations									
3.1	Contract Management			4				4	4	Jaspers
3.2	River Basin Organization (Intro)	4		2				6	14	Jaspers
3.3	Visit International Court of Justice					4		4	4	Shubber
3.4	Case: Customary Water Rights			6				6	6	van der Zaag/Wessels
	Assignment		12						12	
	Exam		3						3	
	Total	28	15	34		4		66	137	
MSc module - UNESCO-IHE										

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

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

Module Sheet

Module Name Lake ecology		Module Code ES05bL	Credits 5
Target Group Programme target group	Prerequisites Programme prerequisites		

Learning Objectives

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

- Characterise lakes based on formation, morphometry, mixing types and chemical composition of water;
- Describe the composition and production of plankton and benthic communities
- Evaluate factors influencing trophic interactions in lakes
- Evaluate climate change and anthropogenic impacts on lake ecosystems; generate suitable methods for their protection and management.
- Overall objective:

At the end of this course the participants should be able to demonstrate the understanding of the structure and functioning of lake ecosystems, the interaction of physical, chemical and biological processes in lakes for their wise use and proper management.

Topics and Learning Activities

Physical limnology and limno-chemistry

introduction to formation and structure of different lake ecosystems; lake morphometry; physical, chemical and biological characteristics of lake ecosystems; interactions of geomorphology and physico-chemical characteristics;

Learning Activities:

lectures, laboratory work, field-work, group discussions, assignments and data analysis.

Plankton and benthic community composition & ecology

Plankton community composition (a. Phytoplankton composition and biomass estimation; b. Zooplankton composition (Rotifera, Cladocera, Copepoda)), macrophytes and macrozoobenthos composition; and biomass estimation:

Learning Activities:

lectures, laboratory work, field-work, group discussions, assignments and data analysis.

Production (Primary and secondary production) and trophic relationships(energy flow) in lakes

Production in lakes: Primary (phytoplankton, macrophytes and periphyton) and secondary production. trophic relationships and energy flow in lakes; Role of microbes, zooplankton, fish and other organisms in trophic interactions;

Learning Activities:

lectures, laboratory work, field-work, group discussions, assignments and data analysis.

Lake Management Strategies and Impact of Climate Change on Lakes

Climate change and anthropogenic impacts on lake ecosystems. Lake restoration and management strategies.
Role of lakes in livelihoods: Case studies (L. Victoria, L. Baringo, L. Bogoria, L. Naivasha).

Learning Activities:

lectures, laboratory work, field-work, group discussions, assignments and data analysis.

Lecturing Material

- Lecture notes, laboratory manuals, reference materials (text books, scientific publications)

Assessment

- **60%: Written Exam (closed book) --**
- **20%: Presentation --**
- **10%: Lab Report --**
- **10%: Assignment --**

2014/2016-ES05bL: Lake ecology

Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: study/load hours	Lecturer(s)
1	Module introduction	1						1	3	various lecturers
2	Lake formation, morphometry, types and classification	1						1	3	
3	Physical characteristics of lakes I: Temperature and L. Mixing types	1						1	3	
4	Physical characteristics of lakes II: Light attenuation	1						1	3	
5	Chemical characteristics of lakes I: Oxygen concentration	1						1	3	
6	Chemical characteristics of lakes II: Carbon systems	1						1	3	
7	Nutrients dynamics in lakes	1						1	3	
	Introduction to lake community structure	1						1	3	
	Fieldtrip Laker Naivasha: Preparation of reagents and equipment					1		1	2	
	Sampling L. Naivasha					4		4	4	
	Samples processing			2				2	2	
	L. Naivasha samples analysis				5			5	10	
	Lake Naivasha data presentation			3				3	3	
	Phytoplankton composition	1						1	3	
	Phytoplankton characteristics and biomass	1						1	3	
	Factors influencing phytoplankton growth, composition and distribution	1						1	3	
	Lake Sampling techniques	1						1	3	
	Phytoplankton identification and biomass (Chl-a) analysis				1			1	2	
	Phytoplankton biovolume analysis				2			2	4	
	Zooplankton composition	1						1	3	
	Zooplankton characteristics and biomass	1						1	3	
	Sampling techniques for zooplankton study	1			1			2	5	
	Zooplankton identification and biomass analysis				2			2	4	
	Primary production	1			2			3	7	
	Primary production measurements				2	2		4	6	
	Secondary production	1						1	3	
	Trophic relationships and energy flow in lakes	1						1	3	
	Climate change and Anthropogenic impacts on lakes	1						1	3	
	Lake restoration and management strategies	1						1	3	
	Case study I: Limnology of Lake Victoria	1						1	3	
	Case study II: Kenyan Great Rift Valley lakes	1						1	3	
	Lake Baringo and Bogoria				10	8		18	28	
	Examination		3						3	
	Total	22	3	5	26	14		67	140	

MSc module - UNESCO-IHE

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

Academic Year: 2014-2016
 Specialization: Core Programme
 Module Coordinator: Dam, A.A. van

Module Sheet

Module Name Environmental systems analysis		Module Code ES06TM	Credits 5
Target Group Participants in the Environmental Science MSc-programme at UNESCO-IHE	Prerequisites BSc in a topic appropriate for admission to UNESCO-IHE Environmental Science MSc-programme (e.g., biology, agronomy, animal science, etc.) Modules 1-4 of Environmental Science programme		

Learning Objectives

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

- List and describe environmental systems analysis (ESA) concepts and methods, and in particular the Ecosystem Services framework
- Perform a problem analysis and stakeholder analysis for a given environmental system
- Perform an analysis of ecosystem functions and services and their drivers of change for a given environmental system
- Construct a simple dynamic simulation model of an environmental system
- Discuss critically the strengths, weaknesses, missing information, advantages and disadvantages of the analyses
- Communicate effectively the methods, results and conclusions of a case study (presentation and written report)

Topics and Learning Activities

Lectures Environmental Systems Analysis

Lectures with overview of module, learning goals, learning activities, and basic concepts of ESA. Lectures introducing ecosystem functions and services framework, Millennium Ecosystem Assessment, other concepts and frameworks for ecosystem functional analysis and assessment, scale aspects (temporal and spatial), examples of rivers and wetlands. Lecture introducing concept of drivers of change. Direct and indirect drivers, exogenous and endogenous drivers, impacts of drivers on decision makers and decision making at different spatial scales. Interactions between drivers. Examples of drivers of change. Case study Basse Cassemance, Senegal. Introduction to Bayesian Network models as tools for operationalizing causal network models of environmental systems. Bayes' theorem and conditional probability, components of a BN (nodes and links), conditional probability tables (CPTs), data requirements for BN models, example with case study of Nyando wetland, Kenya. Human well-being and livelihoods.

Learning Activities:

Lectures, total 12 hours

Problem analysis and conceptual models

Problem analysis and problem trees, rich pictures

Learning Activities:

Group exercise, 4 hours

Stakeholder analysis

Definitions of stakeholder and stakeholder analysis, importance and objectives of stakeholder participation in research and capacity development, primary and secondary stakeholders, identification of stakeholders and stages in stakeholder participation, strategic and participatory approach in stakeholder participation, stakeholder matrix, rich pictures, Venn diagrams, and influence and importance matrix

Learning Activities:

Group exercise, 4 hours

Guest lectures ESA

Guest lectures consist of the following topics:

1. Integrated Biodiversity Modelling, by Dr. Jan Janse and Mr. Wilfried van Rooij of the Netherlands Environmental Assessment Agency,
2. Ecosystem valuation, by Dr. Rudolf de Groot of the Environmental Systems Analysis group of Wageningen University.

Learning Activities:

Lectures, 6 hours

Exercise Environmental Systems Analysis

During this exercise, participants apply the ESA concepts to case studies of environmental systems in different parts of the world. Participants work in group to use functional analysis, DPSIR analysis and causal networks and produce the relevant diagrams and figures. This material will be used for producing an individual report on the case studies. Part of these exercises is a writing workshop with peer review during which participants practice and improve their academic writing skills.

Learning Activities:

Exercise 8 hours + writing workshop 6 hours

Field trip DELTARES

During a visit to DELTARES in Delft, the DELTARES researchers present their work on modelling of ecosystems in various parts of the world. There is time for questions and discussion.

Learning Activities:

Field trip, 4 hours

Modelling group work/case study

Participants work in group to produce a simple dynamic simulation model of an environmental system. They use Stella as a modelling tool. They start by producing a conceptual model, then gather the data and information needed for constructing the mathematical model and for parameterization and calibration. The model is presented to the other participants during the last plenary session of the module.

Learning Activities:

Group work, 32 hours + final presentation, 4 hours

Lecturing Material

- Powerpoint presentations of all lectures
- Background reading materials consisting of scientific articles and other publications (list with reading materials to be provided at start of module)
- Case study descriptions and instructions for individual report and modelling group work

Assessment

- **40%: Written Exam (closed book) -- This is an exam covering all the material presented in the module. It consists of closed questions (Yes/No). At the beginning of week 3 of the module, participants can take this exam as a test which, when passed, gives participant a waiver for the exam.**
- **40%: Assignment -- This assignment consists of an individual report on the case study. The participants use the material developed during the exercises in the module and the text written during the writing workshop as building blocks for this individual report. Reports are judged by the module coordinator and (depending on the number of participants) other lecturers according to clear criteria that are provided to the students before the exercise.**
- **20%: Presentation -- This is a presentation made by each group about the Stella model developed during the group work in the last week of the module. Presentations are judged by two independent UNESCO-IHE lecturers who were not involved in the rest of the ESA module.**

2014/2016-ES06TM: Environmental systems analysis

Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM:		Lecturer(s)
								contact hours	study/load hours	
1	Introduction ESA	2						2	6	van Dam
2	Ecosystem functions and services	4						4	12	Hes/van Dam
3	Drivers of change in ecosystems	2						2	6	van Dam
4	Bayesian Networks	2						2	6	van Dam
5	Human well-being and livelihoods	2						2	6	van Dam
6	Problem analysis & conceptual models		4						4	Hes
7	Stakeholder analysis		4						4	Hes
8	Integrated biodiversity modelling	4						4	12	Janse/van Rooij
9	Ecosystem valuation	2						2	6	de Groot
10	Field trip DELTARES						4	4	12	Kelderman/van Dam
11	Exercise ESA		8						8	van Dam
12	Group work (case study)	4		42				46	54	van Dam/Hes/Gettel
Total		22	16	42			4	68	136	
MSc module - UNESCO-IHE										

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

Academic Year: 2014-2016
 Specialization: Water quality management
 Module Coordinator: Kelderman, P.

Module Sheet

Module Name Water quality assessment		Module Code ES06W	Credits 5
Target Group Young and mid-career professionals (scientists, consultants, decision makers) with a background in Water management or Environmental science.	Prerequisites Preferably a bachelor's degree in chemistry, chemical engineering, biology, environmental science, hydrology, geography or equivalent. Basic knowledge in computer operations (MS-Windows; Office). Good command of English.		

Learning Objectives

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

- Describe different water pollutant groups, their risks and fates, and ways of modelling these fates
- Describe and apply the different tools, criteria and assessment methods for successful monitoring of surface waters in river basins
- Describe and apply groundwater quality monitoring concepts
- Design sustainable water quality monitoring programmes for river basins

Topics and Learning Activities

Water quality monitoring

Water quality variables.

Natural water quality and pollution variables.

The monitoring cycle. Items of the monitoring programme: why, what, where, how, how often. Physico-chemical and biological water quality monitoring.

Basic concepts and applications of Aquatic Ecotoxicology in Water quality monitoring.

Monitoring in the EU Water Framework Directive.

Workshop: Recent trends in Water Quality monitoring: use of mobile phones; GIS; low cost instruments such as sensors; case studies and examples.

Exercise: optimization of water quality monitoring programmes. Group work: design of a river basin monitoring network.

Practical field&lab work: sampling, preservation, field analyses; Quality control in the laboratory.

Learning Activities:

Lectures, exercises, workshop, group work, lab and fieldwork

Optimization of water quality monitoring networks

Design of a water quality monitoring network: objectives; requirements; cost, etc. Compliance checks. Dimension of a network; consistency, representativity. QA/QC; optimization and modernization; relevant trends. Different steps in optimization programmes. Case studies and examples. Classroom exercise monitoring in an Ugandan wetland.

Learning Activities:

Lectures; classroom exercise

Data analysis and presentation

Use of statistics in water quality monitoring. Statistical tests: z-test; t-test, confidence intervals, etc. Hypothesis setting. Non-parametric statistics. Applications: minimum sampling frequency; significant differences between data sets, correlation between variables, etc.

Introduction to more advanced techniques such as ANOVA and FACTOR analysis.

Presentation of data.

Hands-on computer exercises

Learning Activities:

Lectures, workshops, exercises

Groundwater quality monitoring

Basics of hydrogeology. Pollutants reactions and transport in groundwater. Design of a groundwater monitoring network; surveys; design and installation; locations; monitoring frequency; optimization.

Learning Activities:

Lectures

Water quality modelling

Introduction to Modelling: types of models and model components.

BOD-DO modelling in a river.

Spatial-Dynamic Modelling of nitrate in the Scheldt Catchment, using a GIS based nutrient model. Modelling point and non-point sources. In-class exercise.

Learning Activities:

Lectures, computer exercises

Field trips

(Liable to change): half-whole day visit(s) to water quality monitoring and modelling Institutions.

Learning Activities:

Field trips

Lecturing Material

- P. Kelderman (2011) - Water quality and monitoring. UIHE lecture notes LN5/11/1.
- C.A.M. van Gestel (2014) - Handout Aquatic Ecotoxicology.
- P. Kelderman and A. Houben- Michalkova - Hand outs on network design and its optimization.
- P. Kelderman (2014) - Handout Design of a Water Quality Monitoring Network in a River Basin.
- P. Kelderman (2014) - Handout Data handling and presentation.
- J. van der Kwast (2014) - Exercises Water Quality Assessment using GIS-based modelling
- J. van der Kwast (2014)- Handout Introduction to Modelling/Nitrate modelling in the Scheldt basin.
- G.F. Kruis and P. Kelderman (2012) - Handout Fieldwork water quality monitoring and Laboratory QA/QC. Febr. 2012.
- J.W.A. Foppen (2014) - Handout groundwater quality monitoring.
- Compiled power point slides on all above topics; exercise materials; additional materials: relevant info, field trips materials, etc.

Assessment

- **60%: Written Exam (closed book) -- Topics: Surface water quality monitoring; Data handling; Groundwater quality monitoring.**
- **15%: Assignment -- Groupwork: presentation on Case study - design of a sustainable water quality monitoring programme in a specific river basin in a developing country**
- **10%: Lab Report -- Written individual report on field/labwork.**
- **15%: Assignment -- Writtem individual report on Exercise - GIS Water quality model of the Scheldt river basin.**

2014/2016-ES06W: Water quality assessment

Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: study/load hours	Lecturer(s)
1	Water Quality Monitoring									
1.1.	Introduction			3				3	3	Kelderman
1.2.	Water quality monitoring and assessment	11		4	8			23	53	Kelderman, van Gestel, Houben, Kruis
1.3.	Case study water quality monitoring						4	4	12	Kelderman, Houben
1.4.	Workshop - New trends			4				4	4	Alfonso, Gettel
2	Data analysis and presentation	6		6				12	24	Kelderman, van Dam
3	Water Quality Modelling			2	8			10	18	van der Kwast/Kelderman
4	Groundwater quality monitoring	6		2				8	20	Foppen
6.	Fieldtrip					8		8	8	
	Exam		3						3	
	Total	23	3	21	16	8	4	72	145	
MSc module - UNESCO-IHE										

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

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

Module Sheet

Module Name Stream and river ecology		Module Code ES06L	Credits 5
Target Group Programme target group	Prerequisites Programme prerequisites		

Learning Objectives

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

- Overall Objective
The aim of this module is to equip the participants with the skills and knowledge necessary in conservation and management of stream and river ecosystems for the benefit of humankind.
- Distinguish the main stream ecosystem boundaries at watershed, ecosystem and stream segment scales;
- Characterize the bio-geophysical components of watersheds;
- Relate and conceptualize the inter connectedness between riverine and other ecosystems;
- Analyse, identify and discriminate the various riparian vegetation in terms of their importance as sources of energy to streams;
- Assess water quality using physical and biological characteristics of the stream;
Evaluate the importance of socio-economics in sustainable management of watersheds (riverine ecosystems);
Design suitable sampling strategies for stream benthos (i.e. organic matter, biofilms, and nutrients).

Topics and Learning Activities

Watershed ecology and management

Concepts of the watershed ecology and management. Watershed characteristics and geomorphology (climate, slopes, geology, geological structures, soils, geomorphology and land-use).

Learning Activities:

lectures, laboratory and fieldwork, case studies

Stream Characterization

structure and function of streams, basic concepts (river continuum, disturbance/stability, habitat template, connectivity, matter & energy flow and decomposition processes, drift, biozoenotic zonation, substrate characterization. Hydrological exchange processes in the hyporheic zone, floodplain ecology, Ecological integrity

Learning Activities:

lectures, laboratory and fieldwork, case studies

Stream hydrology

hydrologic flow paths and hydrodynamic exchange processes; aquatic-terrestrial connectivity; water current measurements; discharge calculations.

Learning Activities:

lectures, laboratory and fieldwork, case studies

River/stream riparian vegetation interactions/connectivity

vegetation types and distribution. Species composition, social biology, mapping, sampling and identification techniques

Learning Activities:

lectures, laboratory and fieldwork, case studies

Organic matter, biofilm and nutrient dynamics in streams and rivers

sampling techniques, sample processing and data analysis on organic matter, biofilm, and nutrient, POM & DOM, food-webs in streams and rivers

Learning Activities:

lectures, laboratory and fieldwork, case studies

Stream macroinvertebrate communities

Benthic invertebrates, taxonomic groups, bio-indicators, the role of macroinvertebrates in water quality monitoring

Learning Activities:

lectures, laboratory and fieldwork, case studies

Socio-economics of riverine ecosystem

Interaction of water & gender, water supply (quantity and quality), Water resource utilization conflicts, case studies

of socio-economics.

Learning Activities:

lectures, laboratory and fieldwork, case studies

Lecturing Material

- Lecture notes, laboratory guidelines & method descriptions, reference materials

Assessment

- 60%: Written Exam (closed book) --
- 20%: Presentation --
- 20%: Lab Report --

2014/2016-ES06L: Stream and river ecology										
Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: study/load hours	Lecturer(s)
	Introduction			1				1	1	M Erimba
	Watershed ecology	1				3		4	6	Gichaba
	Geomorphology and landuse	2						2	6	Gichaba
	Stream characterization, morphometry, ecosystems theories and concepts	3				3		6	12	M Erimba, Kitaka, Mathooko
	Riparian vegetation	3				3		6	12	Kariuki
	Organic matter, biofilms and nutrient dynamics	4				1		5	13	Kihia, Kitaka
	Stream hydrology & Physico-chemical parameters			2		3		5	5	Kitaka
	Invertebrate ecology	3		3		6		12	18	M Erimba
	Stream integrity	3						3	9	Raburu
	Floodplain, regulated rivers in tropics	2						2	6	Mathooko
	Socioeconomics, water and gender	2						2	6	Muhia
	Group work/lab		1	6		6		12	13	
	Excursion (Naromoru River)			7				7	7	
	Sample processing, Data analysis, presentations, and discussion			23				23	23	
	Exam			2				2	2	
	Total	23	1	44		25		92	139	
MSc module - UNESCO-IHE										

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

Academic Year: 2014-2016
Specialization: Core Programme
Module Coordinator: Raj, E.R.

Module Sheet

Module Name Environmental engineering		Module Code ES07T	Credits 5
Target Group Programme target groups (MSc and short course participants)	Prerequisites - Basic knowledge on chemistry and biology - Fundamental understanding of different physical, chemical and biological processes of environmental significance - Motivation to design and understand the working mechanism of different physico-chemical and bioprocesses for water and wastewater treatment - Problem solving skills		

Learning Objectives

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

- Describe the basic chemical and biological processes and their engineering applications for water and wastewater treatment;
- Evaluate different approaches to wastewater treatment and select the best option that suits local conditions (for instance constructed wetlands);
- Understand the importance of the prevailing interactions between microbes in the environment and human activities;
- Be able to ascertain the thermodynamics, and reaction rate of any environmental process under the given set of operating conditions;
- Envisage through field trip the functioning of a water treatment plant and wetland in the Netherlands;
- Solve problems pertaining to the design and operation of different environmental systems (for instance, plug flow type reactor, activated sludge process, upflow anaerobic sludge blanket, etc).

Topics and Learning Activities

Water treatment

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

Learning Activities:

Lectures, laboratory, fieldtrip, classroom tutorials

Wastewater treatment

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

Learning Activities:

Lectures, laboratory, classroom tutorials and discussions

Environmental Process Technology

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

Learning Activities:

Lectures, Tutorials for solving problems

Environmental Microbiology

- Interactions between microbes in the environment and human activities

- The role of microorganisms in Environmental Biotechnology / Environmental Engineering
- Application of different microorganisms for environmental remediation (including case studies)

Learning Activities:

Lecture materials, laboratory session

Lecturing Material

- Lecture notes on Water treatment, problem solving tutorials, Discussions on assignments topics
- Lecture notes + laboratory notes wastewater treatment + Tutorials
- Lecture notes on EPT, Problem solving in class
- Lecture notes on Microbiology and powerpoint presentations

Assessment

- **50%: Written Exam (closed book) -- Wastewater treatment**
- **25%: Written exam (closed book) -- EPT**
- **25%: Assignment -- Water treatment**

2014/2016-ES07T: Environmental engineering										
Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: studyload hours	Lecturer(s)
	Water treatment	8	25		6			14	61	Buiteman
	Wastewater treatment, natural processes	12			6			18	48	Eldon R. Rene, Hans van Bruggen, Peter Kelderman, Ja
	Environmental process technology	12						12	36	Peter van der Steen
	Fieldtrip					6		6	6	Hans van Bruggen, Eldon R. Rene
	Exam									
	Total	32	25		12	6		50	151	
MSc module - UNESCO-IHE										

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

Academic Year: 2014-2016
 Specialization: Core Programme
 Module Coordinator: Douven, W.J.A.M.

Module Sheet

Module Name Water and environmental policy making		Module Code ES07M	Credits 5
Target Group The specialization is intended for professionals with an interest in environmental policy making in the water management (or related) context.	Prerequisites Programme prerequisites		

Learning Objectives

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

- understand the nature of policy making as a continuous negotiation process
- identify the drivers of policy agendas and policy making decisions and explain them in terms of conflicting stakeholder interests
- apply basic tools and techniques to the planning and design of water and environmental policies
- interrelate water policies to other policy areas as well as to international environmental governance
- draw on the basic philosophy of team role management in negotiation processes

Topics and Learning Activities

Water Policy and the Policy Cycle

Introduction principles governance, the relationship governance and policy, policy as continuous negotiation driven by interests and agendas of stakeholders, areas of environmental policy, and overview over socio-economically and naturally driven water issues and policy areas

Learning Activities:

lectures, assignments and group discussions

Policy Planning and Design - Tools and Methods

Principles of planning, policy analysis and environmental assessment methods, overview over policy instruments, basics of policy enforcement, and approaches to public participation in policy design and decision-making, application of policy analysis tools to assess a water conflict case

Learning Activities:

lectures, classroom exercises, assignment (report) and group discussion/presentations

International Processes, Network Management, and Negotiation

Global Environmental Change as driver for policy changes and international, integrated approaches to water management, network management, and basic of negotiation based on teamrole analysis

Round Table Discussion and Fieldtrip

Roundtable discussion with high-level Dutch government and NGO representatives on participatory policy making, fieldtrip to the Dutch Delta Works

Learning Activities:

Groupwork and Fieldtrip

Lecturing Material

- Lectures
- Reader
- Handouts

Assessment

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

2014/2016-ES07M: Water and environmental policy making

Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM:		Lecturer(s)
								contact hours	study/load hours	
1	Introduction to Water and Environmental Policy Making	2						2	6	Å Leentvaar, Evers
2	Theory of Policy Making and Policy Cycle	4						4	12	Thissen
3	Policy Elements, Instruments and Institutions	2						2	6	Leentvaar
4	Policy Analysis: Processes and Methods	2			8			10	22	Leentvaar
5	Policy Design and Decision Making Process	3						3	9	Leentvaar
6	Water Governance in the Anthropocene	1		8				9	11	Leentvaar
7	Network Management	5						5	15	Bijlsma
8	A Teamrole Approach to Negotiation and Developing EQ	6	4					6	22	Ter Beek, Leentvaar, Houweling
9	Transboundary Water Conflicts	4						4	12	Leentvaar, Evers
10	Round Table Discusion			2				2	2	De Vries, Houweling, Leentvaar
11	Fieldtrip	1				8		9	11	Evers
12	Exam		3						3	
Total		30	7	10	8	8		56	131	
MSc module - UNESCO-IHE										

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

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

Module Sheet

Module Name Constructed wetlands for water quality		Module Code ES07W	Credits 5
Target Group Programme target group	Prerequisites Programme prerequisites		

Learning Objectives

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

- assess the value of wetlands and explain the use of natural and constructed wetlands for the treatment of wastewater;
- describe the concept of wastewater treatment by wetlands;
- design and operate a wetland treatment system.

Topics and Learning Activities

Introduction on natural wetlands

what are wetlands, where are wetlands, wetland ecology, biodiversity, economics. The role of wetlands in the catchment: general aspects, hydrological aspects, wetlands as buffers and the role in relation to climate.

Learning Activities:

lectures, and video presentations.

Natural wetlands for wastewater treatment

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

Learning Activities:

lectures, and video presentations.

Constructed wetlands for wastewater treatment

the different types, the design and criteria for design. Advantages and disadvantages. Constructed wetlands in The Netherlands, the tropics and the rest of the world.

Learning Activities:

lectures, and video presentations, field trip

Integrated wetland production systems

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

Field visits.

Learning Activities:

lectures, and video presentations, assignment

Lecturing Material

- Lecture notes and case studies

Assessment

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

2014/2016-ES07W: Constructed wetlands for water quality

Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM:		Lecturer(s)
								contact hours	study/load hours	
1	Introduction into the module	1						1	3	
2	Wetlands	8	2					8	26	
3	Wastewater treatment aspects	6						6	18	
4	Natural wetlands for water treatment	4						4	12	
5	Constructed wetlands	14						14	42	
6	Integrated production systems	6						6	18	
7	Fieldtrip					16		16	16	
8	Exam		3						3	
Total		39	5			16		55	138	
MSc module - UNESCO-IHE										

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

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

Module Sheet

Module Name Tropical wetlands for water quality		Module Code ES07L	Credits 5
Target Group Programme target group	Prerequisites Programme prerequisites		

Learning Objectives

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

- Identify types of wetlands and explain processes in natural wetlands, assess their functions and values
- Evaluate the water quality function and explain the process of wastewater purification by natural and constructed wetlands
- Design and operate constructed wetland for wastewater treatment

Topics and Learning Activities

Introduction to natural wetlands

Definition and characteristics of wetlands, classification, wetland biota, vegetation zonation and dynamics, wetland assessment and monitoring, functions and values, sustainable use and community based wetland management, wetlands and climate.

Learning Activities:

lectures, fieldwork, laboratory work, structured exercises, assignment, group and individual presentations and discussions. Field work will include natural and constructed wetlands.

The ability to make a proper design for the treatment of wastewater by a constructed wetland will be tested by group and or individual assignment.

Wastewater sources & characteristics

challenges and options for wastewater management-conventional wastewater treatment, use of wetlands and Eco-sanitation.

Learning Activities:

lectures, fieldwork, laboratory work, structured exercises, assignment, group and individual presentations and discussions. Field work will include natural and constructed wetlands.

The ability to make a proper design for the treatment of wastewater by a constructed wetland will be tested by group and or individual assignment.

Use of natural wetlands for wastewater treatment

basic principles, the role of the different wetland components (biota, soil and water), contaminant removal mechanisms, Natural wetlands for water treatment-Case studies on wetlands for water quality.

Learning Activities:

lectures, fieldwork, laboratory work, structured exercises, assignment, group and individual presentations and discussions. Field work will include natural and constructed wetlands.

The ability to make a proper design for the treatment of wastewater by a constructed wetland will be tested by group and or individual assignment.

Constructed wetlands for wastewater treatment

Why constructed wetlands? Types of constructed wetlands, factors influencing performance, design, construction and set up (features, criteria, wetland sizing, planting), operation and maintenance, case studies-industrial and domestic constructed wetlands for wastewater treatment and modelling. Economics of constructed wetlands and re-use of treated wastewater.

Learning Activities:

lectures, fieldwork, laboratory work, structured exercises, assignment, group and individual presentations and discussions. Field work will include natural and constructed wetlands.

The ability to make a proper design for the treatment of wastewater by a constructed wetland will be tested by group and or individual assignment.

Lecturing Material

- Lecture notes, Laboratory manuals, case studies, reference materials (books, scientific publications).

Assessment

- 60%: Written Exam (closed book) --
- 10%: Assignment --
- 20%: Presentation --
- 10%: Integrated in modules --

2014/2016-ES07L: Tropical wetlands for water quality										
Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: study/load hours	Lecturer(s)
1	Introduction			1				1	1	
2	Natural wetlands	8	3	9		6		23	42	Kipkemboi
3	Wastewater and treatment options	3		1		8		12	18	Kipkemboi
4	Natural wetlands for WWT	5		2				7	17	Muchiri/Abira
5	Constructed wetlands for WWT	8	13	14		8		30	59	Kansiime/Ngiringacha
	Examination									Kimwaga/Abira
	Total	24	16	27		22		73	137	

MSc module - UNESCO-IHE

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

Academic Year: 2014-2016
 Specialization: Environmental Science and Technology
 Module Coordinator: Kelderman, P.

Module Sheet

Module Name Environmental monitoring and modelling		Module Code ES08T	Credits 5
Target Group Young and mid-career professionals (scientists, consultants, decision makers) with a background in Water management or Environmental science	Prerequisites Preferably a bachelor's degree in Chemistry, Biology, Environmental science, Hydrology, or related/equivalent. Basic knowledge in computer operations (MS Windows; Office). Good command of English		

Learning Objectives

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

- Describe and apply main monitoring requirements and programmes for surface water, groundwater and air, and some common analytical techniques used therein.
- Describe and apply the different criteria for successful monitoring of lakes and rivers.
- Describe and apply basic Environmental Impact Assessment techniques.
- Describe and apply a number of water quality models as a tool in Environmental management.

Topics and Learning Activities

Water quality monitoring

Introduction on Environmental monitoring. Water quality parameters. Natural water quality and pollution parameters. The monitoring cycle. Items of the monitoring programme: why, what, where, how, how often. Fieldwork and sampling. Physico-chemical and biological water quality assessment. Monitoring in the EU Water Framework Directive. Practical field&lab work: sampling, preservation, field analyses; Quality control in the laboratory.

Learning Activities:

Lectures, exercises, lab and fieldwork

Groundwater monitoring

Basics of hydrogeology. Pollutants reactions and transport in groundwater. Design of a groundwater monitoring network; surveys; design and installation; locations; monitoring frequency; optimization.

Learning Activities:

Lectures

Air quality monitoring and modelling

Impacts of main air quality pollutants. Emission and dispersion under different meteorological conditions. Air quality monitoring: background; networks (EMEP, GEMS, etc.); automated instrumentation. Examples of air quality models: CAR, LOTOS, etc. Case studies and exercises: Emission data base; setting up a monitoring network; hands-on computer exercises with air quality models.

Learning Activities:

Lectures, exercises

Water quality modelling

Introduction to Modelling: types of models and model components. BOD-DO model in a river. Spatial-Dynamic Modelling of Nitrate in the Scheldt Catchment, using a GIS based nutrient model. Modelling point and non-point sources. In-class exercise.

Learning Activities:

Lectures, exercises

Environmental Impact assessment

Objectives of EIA; participants and approaches. Screening tables. Scoping and mitigation. Identification of impacts; Impact matrix: scaling and weighing. Factors of success; cost of EIA. Practical examples such as Impacts of dams and reservoirs. Hands-on exercises EIA.

Learning Activities:

Lectures, exercises

Laboratory Environmental monitoring

Introduction to the different techniques and instruments. Analysis of heavy metals with AAS: sample destruction, use of conventional and graphite oven AAS. Analysis of organic micropollutants with GC; standards; detectors.

Quality Control in AAS and GC.

Learning Activities:

Laboratory work

Fieldtrip

Liable to change: Visits are planned to water quality monitoring/modelling as well as to air quality monitoring Institutions.

Learning Activities:

Excursions

Lecturing Material

- P. Kelderman (2011) - Water quality and monitoring. UIHE lecture notes LN5/11/1.
- G.F. Kruis and P. Kelderman (2011) - Handout Fieldwork water quality monitoring and Laboratory QA/QC. Febr. 2011.
- M.P. Keuken/J.S. Henzing (2014). Handout Air quality monitoring and modelling.
- J. van der Kwast - Exercises Water Quality Assessment using GIS-based modelling - Febr. 2014.
- J. van der Kwast - Handout Introduction to Modelling/Nitrate modelling in the Scheldt basin - Febr. 2013.
- Compiled powerpoint slides on Groundwater monitoring; on Environmental Impact Assessment. Powerpoint slides on all above topics; additional materials: relevant info, fieldtrips materials, etc.

Assessment

- **70%: Written Exam (closed book) -- Topics: Water quality monitoring; Groundwater quality monitoring and modelling; Air quality monitoring and modelling; Environmental Impact Assessment**
- **15%: Assignment -- Written individual assignment on Water Quality Modelling**
- **15%: Lab Report -- Written individual report on field work and QA/QC laboratory work**

2014/2016-ES08T: Environmental monitoring and modelling										
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 and monitoring									
1.1.	Introduction on Environmental monitoring			2				2	2	McClain
1.2.	Water quality monitoring	7			8			15	37	Kelderman, Kruis
2	Groundwater monitoring and modelling	6		2				8	20	Foppen
3	Air quality monitoring and modelling	6		6				12	24	Henzing
4	Water quality modelling			2	8			10	18	van der Kwast/Kelderman
5	Environmental Impact assessment				10			10	20	Vis, Clouting
6	Laboratory Environmental monitoring			8				8	8	Kruis
	Fieldtrip					8		8	8	
	Exam		3						3	
	Total	19	3	20	26	8		73	140	
MSc module - UNESCO-IHE										

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

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

Module Sheet

Module Name Environmental planning and implementation		Module Code ES08MW	Credits 5
Target Group Young and mid-career professionals (scientists, decision-makers) with a background in environmental management, water management and / or watershed management.	Prerequisites Affinity with environment policy and enforcement, development economics, and preferably experience in water management arena. Good command of English.		

Learning Objectives

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

- Explain the concept and importance of sustainable development into environmental planning and management
- demonstrate basic knowledge on the principles, processes and methods of environmental assessment (EIA-SEA) and be able to apply them in water related plans, programmes and projects
- Apply and discuss economic valuation methods and policy instruments for environmental policy
- Apply basic theories behind policy enforcement, monitoring and evaluation to master effective environmental policies
- Use environmental information systems to support planning and management

Topics and Learning Activities

Globalization of Water

Water footprints, inter dependencies of various sectors

Learning Activities:

Face-to-face lecture, role plays, exercises, case studies group work, presentations

Environmental Planning Process, Spatial planning

Planning processes, theory of environmental planning, land use planning, issue of scale and its importance, watershed planning

Learning Activities:

Face-to-face lecture, role plays, exercises, case studies group work, presentations

Environmental Assessments (EIA/SEA)

introduction of environmental and social impact assessment for projects, plans and programme, and its application in water development programmes and projects.

Learning Activities:

Face-to-face lecture, role plays, exercises, case studies group work, presentations

Environmental Economics

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

Learning Activities:

Face-to-face lecture, exercises, Assignment

Environmental Policy Implementation

Constraints in policy implementation, Monitoring, setting indicators etc

Learning Activities:

Case studies, Exercises, groupwork

Lecturing Material

- Lecture Notes
- Additional Reading Materials
- Lecture powerpoint slides

Assessment

- 55%: Written Exam (closed book) -- - Globalization of water
- Environmental Planning, Spatial Planning
- Environmental Policy & Enforcement
- Environmental Assessment (EIA-SEA)
- 30%: Assignment -- Environmental Economics
- 15%: Assignment -- Policy Plan Analysis

2014/2016-ES08MW: Environmental planning and implementation												
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	Globalization of Water	2		4						6	10	Hoekstra
2	Environmental Planning	10	8							10	38	Hamdard, Evers
3	Environmental Economics	6	8							6	26	Bijlsma
4	Environmental Assessment (EIA/SEA)	2		4						6	10	Hamdard
5	Environmental Policy Implementation & Monitoring	10		8						18	38	Hofstra, Guest lecture
6	Fieldtrip							8		8	8	Hamdard
7	Exam		3								3	
Total		30	19	16				8		54	133	
MSc module - UNESCO-IHE												

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

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

Module Sheet

Module Name Fisheries and aquaculture		Module Code ES08L	Credits 5
Target Group Programme target group		Prerequisites Programme prerequisites	

Learning Objectives

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

- Evaluate global/national production trends and emerging issues in fisheries
- Appraise and apply the ecology of fish to fisheries management and aquaculture exploitation
- Evaluate the interaction of fish and the environment (water quality, environmental impacts, etc.)
- Appraisal of aquaculture systems and their productivity potential
- Assess interactions and emerging issues on fish and people
- Evaluate techniques for fish post-harvest handling (preservation, processing, packaging & Marketing)

Appraise measures to reduce fish diseases and fish parasites in aquaculture

Topics and Learning Activities

Capture fisheries and management

global and regional production trends; economic contribution of capture fisheries; status and dynamics of inland fisheries; marine fisheries; fisheries management (fishermen, fishing gears, destructive fishing methods and efforts, environmental impacts of fisheries); emerging fisheries issues (e.g. transboundary conflicts, alien species).

Learning Activities:

lectures, laboratory work, field-work, excursions, sampling, sample processing, data analysis and group discussion on case studies. Field-work is done at Lake Victoria and experimental fish-ponds at Egerton University. Excursions are organized to cage culture sites, a fish hatchery and a marine fish culture farm.

Fish ecology

Temporal and spatial distribution (abiotic and biotic factors); life history and reproduction strategies; habitats and resources partitioning; food habits; trophic relationships; sampling techniques and methods of fish stock assessment; wild fish diseases and parasites

Learning Activities:

lectures, laboratory work, field-work, excursions, sampling, sample processing, data analysis and group discussion on case studies. Field-work is done at Lake Victoria and experimental fish-ponds at Egerton University. Excursions are organized to cage culture sites, a fish hatchery and a marine fish culture farm.

Socio-economics

People and fish;- socio-economic challenges in fisheries development (sectorial conflicts, trade, poverty alleviation); policies and emerging issues; economic valuation in fisheries and aquaculture

Learning Activities:

lectures, laboratory work, field-work, excursions, sampling, sample processing, data analysis and group discussion on case studies. Field-work is done at Lake Victoria and experimental fish-ponds at Egerton University. Excursions are organized to cage culture sites, a fish hatchery and a marine fish culture farm.

Aquaculture

Introduction to aquaculture. Definition & principles, species & site selection, types of ponds. production trends, potential, limitations and risks; water quality and pond management (liming, fertilization, environmental carrying capacity, stocking densities, predation control); main culture systems; key factors affecting fish growth; fish breeding; fingerling production enhancement; manipulation of production systems (feeding rates/frequencies, integrated systems, etc.); fish breeding & genetics, selective breeding, Fish nutrition fish feed formulation, processing and handling; environmental impacts of aquaculture practices, introduction to mariculture

Learning Activities:

lectures, laboratory work, field-work, excursions, sampling, sample processing, data analysis and group discussion on case studies. Field-work is done at Lake Victoria and experimental fish-ponds at Egerton University. Excursions are organized to cage culture sites, a fish hatchery and a marine fish culture farm.

Post- harvest and fish handling

harvesting techniques; processing and preservation techniques

Learning Activities:

lectures, laboratory work, field-work, excursions, sampling, sample processing, data analysis and group discussion on case studies. Field-work is done at Lake Victoria and experimental fish-ponds at Egerton University. Excursions are organized to cage culture sites, a fish hatchery and a marine fish culture farm.

Fish pathology and parasitology

parasites and diseases, zoonotic fish diseases and economic importance

Learning Activities:

lectures, laboratory work, field-work, excursions, sampling, sample processing, data analysis and group discussion on case studies. Field-work is done at Lake Victoria and experimental fish-ponds at Egerton University. Excursions are organized to cage culture sites, a fish hatchery and a marine fish culture farm.

Lecturing Material

• Lecture notes, laboratory & fieldwork, Excursion, manuals, videos, reference materials (text books, scientific publications)

Assessment

- 60%: Written Exam (closed book) --
- 10%: Integrated in modules --
- 20%: Presentation --
- 10%: Integrated in modules --

2014/2016-ES08L: Fisheries and aquaculture										
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)
1.1	Socio-economics: fish & people	2		2				4	8	Muhia
2.1	Fish ecology	4		8				12	20	Njiru , Manyala
2.2	Fish diseases and parasites	2		10				12	16	Mbuthia, Wathuta
2.3	Aquaculture & ecology of fishponds	12		15				27	51	Liti, Munguti, Lokoruka, Charo
2.4	Data analysis			12				12	12	All resource persons
3.0	Excursion					13		13	13	Munguti, Kitaka
4.0	Exam			3				3	3	
Total		24		58		13		95	143	
MSc module - UNESCO-IHE										

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

Academic Year: 2014-2016
 Specialization: LWM specialisation
 Module Coordinator: Dam, A.A. van

Module Sheet

Module Name		Module Code	Credits
Data analysis and modelling for aquatic ecosystems		ES09L	5
Target Group Participants in the Limnology and Wetland Management specialisation of the UNESCO-IHE Environmental Science MSc-programme; Other UNESCO-IHE participants who select this module as an elective; Participants who take this module as a short course.	Prerequisites Programme prerequisites; Basic course in statistics.		

Learning Objectives

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

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

Topics and Learning Activities

DAMAE Module introduction

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

Learning Activities:

Lecture

Data analysis

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

Learning Activities:

Lectures with demonstrations

Ecosystem modelling

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

Learning Activities:

Lectures

Exercises data analysis

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

Learning Activities:

Exercises in which the participants do hands-on exercises with Excel and R using realistic datasets from earlier MSc and other research projects.

Exercises ecosystem modelling

Participants learn to use the Stella software for ecosystem modelling.

Learning Activities:

Exercises in which the participants make simple ecosystem models themselves using Stella

Case study ecosystem modelling

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

Learning Activities:

Group work (3-4 persons per group) in which students work on a simple ecosystem simulation model using Stella. Results are presented to the other students by means of a Powerpoint presentation.

Advanced topics (optional depending on participants background)

Examples of other ecosystem models (Ecopath trophic models, Bayesian Network models, PC-Lake, advanced Stella models). This activity is only offered to participants who have demonstrated sufficient skills in the basic module activities.

Learning Activities:

Lecture; exercises.

Lecturing Material

Assessment

- 40%: Written Exam (closed book) -- This is an exam covering the material on ecosystem modelling presented in the module. It consists of closed questions (True/False) and open questions.
- 40%: Assignment -- This assignment consists of an individual report on a data analysis problem. The participants receive an assignment and a dataset which they need to use to produce some graphs and/or do some statistical tests using the R-software. The report on this analysis is submitted through the Moodle platform.
- 20%: Presentation -- This is a presentation made by each group about the Stella model developed during the group work in the last week of the module. Presentations are judged by two independent UNESCO-IHE lecturers.

2014/2016-ES09L: Data analysis and modelling for aquatic ecosystems												
Nr	Course/Topic	Lecture	Assignment	Workshop Case study	Role play Exercise	Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: study/load hours	Lecturer(s)
	Module intro	2								2	6	
	Ecosystem modelling lectures	10								10	30	
	Data analysis lectures	10								10	30	
	Ecosystem modelling exercises			25						25	25	
	Data analysis exercises			29						29	29	
	Case study ecosystem modelling			20						20	20	
	Exam		3								3	
	Total	22	3	74						96	143	
MSc module - UNESCO-IHE												

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

Academic Year: 2014-2016
Specialization: Core Programme
Module Coordinator: Vossenbergh van de, J.

Module Sheet

Module Name Foreign fieldtrip and fieldwork ES		Module Code ES09TMW	Credits 5
Target Group All Environmental Science participants	Prerequisites Programme prerequisites		

Learning Objectives

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

- integrate knowledge of air-soil-water quality. Link earlier knowledge with fieldwork and visits.
- link water quality and economic development.
- have experienced how nature conservation and river management are done at different locations.
- find out what (historical) approaches worked and what did not work.

Topics and Learning Activities

International Fieldtrip

Excursions to environment-related organisations and companies in Western Europe.

Visits will also be made to different ecosystems, as well as to sites where clearly environmental pollution has taken place.

Learning Activities:

Excursions, Field visits, Preparation of visits and report writing.

Fieldwork

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

Learning Activities:

Fieldwork in a river system

Lecturing Material

- Handout with programme of International Fieldtrip

Practical and field guides.

Assessment

• **50%: Assignment -- A short report of what was learned. How do these findings relate to the situation in the participant's own country (or to another, developing country)? What knowledge could be used in the other country? And vice versa.**

• **50%: Presentation -- The findings of the individual assignments will be presented in the group in a short presentation.**

2014/2016-ES09TMW: Foreign fieldtrip and fieldwork ES

Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: study/load hours	Lecturer(s)
1	International fieldtrip					60		60	60	Van de Vossenbergh, Hamdard, Van Bruggen
2	Fieldwork					60		60	60	À Irvine, Gettel
3	Assessment									
3.0	Case report		8						8	Van de Vossenbergh, Kelderman
3.1	Group Presentation				4			4	8	Lens, Irvine, Gettel, Kelderman, Hamdard, Van Bruggen
	Total		8		4	120		124	136	
MSc module - UNESCO-IHE										

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

Academic Year: 2014-2016

Specialization: ES-EPM

Module Coordinator: Evers, J.G.

Module Sheet

Module Name	Module Code	Credits
Environmental Assessment for Water-related Policies and Developments (new)	ES10M	5
Target Group Young and mid-career professionals (scientists, decision-makers) with a background in environmental management, water management and / or watershed management.	Prerequisites Affinity with environment policy and enforcement, development economics, and preferably experience in water management arena. Good command of English.	

Learning Objectives

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

- Explain the principles of environmental assessment (EIA/SEA) and the potential role in water sector development, climate proofing and related fields like delta management and river basin management;
- Distinguish and describe the processes of environmental assessment (EIA/SEA), and the role of experts, stakeholders, government, and other stakeholders;
- Describe the range of methodologies applied, and understand criteria used for selecting appropriate methodologies available for environmental assessment;
- Identify and assess likely environmental impacts of water related policies, programmes, plans and projects;
- Design an appropriate environmental assessment approach for a specific case, including needs for public participation, presentation of reports and verbal communication of environment impacts and their mitigation
- Analyse the decision-making related to EIA and SEA, and critically reflect its role in decision-making
 - Identify conditions for effective integration of EA into the planning/project approval process in different context including developing and transition countries.

Topics and Learning Activities

Introduction to environmental assessment for water policies and developments

Environmental impacts of water related policies, programmes, plans and projects

Principles of EIA and SEA, and legal and policy framework

EIA and SEA tools and methods

Decision-making context of an EIA and SEA

Case study (group and individual work): design an appropriate EA approach for a specific case

Conditions for effective integration of EA into the planning/project approval process in different contexts in particular those of developing and transition countries

Role of EIA and SEA in water sector development, climate proofing and related fields like delta management and river basin management

Learning Activities:

face-to-face lectures, exercises, case studies and group work, presentations

Lecturing Material

- Lecture Notes, power point presentations, and additional reading materials

Assessment

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

2014/2016-ES10M: Environmental Assessment for Water-related Policies and Developments (new?)

Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: study/load hours	Lecturer(s)
	À Introduction to environmental assessment	2						2	6	Irvine
	Environmental impacts of water related policies, programmes, plans and projects	5						5	15	Douven, Evers
	Principles of EIA and SEA, and legal and policy framework	5						5	15	Jaspers, Gupta
	EIA and SEA tools and methods	4						4	12	Vis
	Decision-making context of an EIA and SEA	5						5	15	Evers
	Case study (group and individual work): design an appropriate EA approach for		40						40	Douven, Evers, NCEA
	Conditions for effective integration of EA into the planning/project approval process	5						5	15	Kolhoff, Schijf, Verheem
	Role of EIA and SEA in water sector development, climate proofing and related fields	5						5	15	Douven
	Fieldtrip					8		8	8	Evers
	Total	31	40			8		39	141	
MSc module - UNESCO-IHE										

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

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

Module Sheet

Module Name		Module Code	Credits
Aquatic ecosystems: processes and applications		ES10TWL	5
Target Group Programme target group (Participants in the programmes at IHE) and qualified short course participants	Prerequisites Programme prerequisites (BSc in a topic appropriate to UNESCO-IHE programme) and basic knowledge of aquatic ecology.		

Learning Objectives

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

- Conduct laboratory techniques used for basic limnological studies. Specifically, you will be able to measure physical-chemical properties, chlorophyll a concentration in seston and periphyton; measure and calculate primary production and community respiration, measure nutrient concentration and turbidity, calculate and measure ash free dry mass, and perform zooplankton counts.
- Develop a research question based on the experimental design.
- Analyze data using either statistical or modeling techniques to answer your research question.
- Produce a report in the format of a scientific article that presents your research question, the data supporting it, and a discussion of your results, including a review of relevant literature.
- Critically analyze your colleagues' work in the form of a professional peer review.

Topics and Learning Activities

Eutrophication in shallow-lake ecosystems

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

Learning Activities:

Students will conduct laboratory experiments to generate a data set, which they will analyze using appropriate tools. Students will then write a scientific report and perform a peer review.

Lecturing Material

Assessment

- **80%: Assignment** -- The scientific report serves as the exam and the bulk of the grade for this course.
- **10%: Assignment** -- The peer review will comprise 10% of the grade for this course.
- **10%: Presentation** -- Students will be asked to present conclusions from in-class discussions and exercises. This mark would be more accurately called "class participation."

2014/2016-ES10TWL: Aquatic ecosystems: processes and applications

Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: study/load hours	Lecturer(s)
	Lecture	14						14	42	Gettel, Irvine
	Laboratory Work				16			16	32	Gettel, Irvine
	In-class activity (data analysis, group work)			44				44	44	Gettel, Irvine
	Paper Writing and Review		20						20	Gettel, Irvine
	Total	14	20	44	16			74	138	
MSc module - UNESCO-IHE										

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

Academic Year: 2014-2016
 Specialization: Core Programme
 Module Coordinator: Raj, E.R.

Module Sheet

Module Name MSc research proposal development for ETSuD		Module Code ES11ETSuD	Credits 7
Target Group Master students under the ETSuD joint degree programme between AIT (Bangkok) and UNESCO-IHE.	Prerequisites The pre-requisites for ETSuD students to join the MSc proposal development phase (July to September 15) can be summarized as follows: (1) Selection of MSc topic and IHE mentor, (2) Students should be able to critically comment on the articles they are reading on the selected topic, (3) Ability to consolidate previous work and formulate his/her own research statement and objectives, (4) Possess adequate knowledge on soft skills such as powerpoint presentations, interpretation of technical documents, lab course, etc, and, (5) Adequate knowledge on preparing technical/scientific documents.		

Learning Objectives

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

- 1) How to carry out systematic literature search on the chosen topic,
- 2) How to formulate research objectives based on the research gaps identified from the literature review,
- 3) How to plan research methodologies in advance,
- 4) How to write a systematic scientific report,
- 5) How to make an "error-free" scientific presentation and facilitate adequate discussion(s) with the participants.

Topics and Learning Activities

Literature search:

- to identify data bases, journals and published scientific and technical reports

Research Methodology:

- to identify the required analytical tools and materials to perform the research,
- to plan the research investigations/discuss with the supervisor and mentor and to finalize the analytical procedures to be used for research

Scientific report writing:

- How to formulate research objects, scope, literature, methodology and references of the research
- To consolidate a brief periodic report and discuss the results with the supervisor and mentor
- Ability to write a scientific manuscript that is published in a SCI-indexed journal with high impact factor

Lecturing Material

- 1) Scientific literature from international journal publications and other scientific database,
- 2) Reports and earlier thesis which may have carried out similar research methodologies,
- 3) Preliminary background data from literature,
- 4) Visiting industries and sites for case studies,
- 5) Discussion with PhD students and fellow researchers in the lab.

Assessment

- 100%: Presentation --

2014/2016-ES11ETSuD: MSc research proposal development for ETSuD

Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM:		Lecturer(s)
								contact hours	study/load hours	
	Proposal development		240	12				12	252	
	Total		240	12				12	252	
MSc module - UNESCO-IHE										

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

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

Module Sheet

Module Name		Module Code	Credits
Wetlands for livelihoods and conservation		ES11LM	5
Target Group	Prerequisites		
Programme target group	Programme prerequisites		

Learning Objectives

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

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

Topics and Learning Activities

Ecosystem functions and services

Learning Activities:

lectures, field-work and data analysis

Climate change as a driver of change in wetland management planning

Learning Activities:

lectures and exercises

Objective Oriented Planning

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

Learning Activities:

lectures, field-work and case study

Stakeholder analysis and participatory approaches

Learning Activities:

lectures, field-work, case study and role play

Lecturing Material

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

Assessment

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

2014/2016-ES11LM: Wetlands for livelihoods and conservation

Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: study/load hours	Lecturer(s)
	Ecosystem functions and services	8		4		16		28	44	
	Climate change as a driver of change in wetland management planning	8		4				12	28	
	Objective Oriented Planning	2		16		16		34	38	
	Stakeholder analysis and participatory approaches	2		14		8		24	28	
	Examination		2						2	
	Total	20	2	38		40		98	140	

MSc module - UNESCO-IHE

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

Academic Year: 2014-2016

Specialization: Water Resources Management & Water Quality Management

Module Coordinator: Jiang, Y.

Module Sheet

Module Name Watershed and river basin management		Module Code ES11MW	Credits 5
Target Group Young and mid-career professionals (scientists, decision-makers) with a background in water management, environmental management, and / or watershed management.	Prerequisites Affinity with hydrology, development economics, agronomy or geography (preferably a relevant water science or engineering related bachelor's degree or equivalent) and preferably experience in watershed and / or river basin management. Good command of English.		

Learning Objectives

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

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

Topics and Learning Activities

Introduction

This section introduces watershed and river basin management

Learning Activities:

Lecture, group exercise/workshop

Biophysical processes and anthropogenic interactions

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

Learning Activities:

Lecture, group exercise/workshop

Watershed and river basin planning

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

Learning Activities:

Lecture, group exercise/workshop

Watershed economics

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

Learning Activities:

Lecture, group exercise/workshop

Watershed and river basin management

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

Learning Activities:

Lecture, group exercise/workshop

Role play- ShaRiva

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

Learning Activities:

group exercise

Field trip

Lecturing Material

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

Assessment

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

2014/2016-ES11MW: Watershed and river basin management												
Nr	Course/Topic	Lecture	Assignment	Workshop Case study	Role play Exercise	Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: study/load hours	Lecturer(s)
1	Introduction	1								1	3	Jiang
2	Biophysical processes and anthropogenic interactions											
2.1	Soil & Water Management	4		4						8	16	Van der Zaag
2.2	Watershed hydrology and human interventions	4		4						8	16	Ilyas
2.3	Environmental flow allocation	4		4						8	16	McClain
2.4	Groundwater Management	4		4						8	16	Guest Lecturer
3	Watershed economics											
3.1	Economic issues in watersheds and river basins	2								2	6	Jiang
3.2	Payment for watershed services	2		4						6	10	Jiang
3.3	Game theory	4		4						8	16	Gues lecturer
4	Watershed and river basin planning and management											
4.1	Planning process	2		2						4	8	Evers
4.2	Watershed and river basin management	4								4	12	Evers
4.3	Case study			4						4	4	Guest lecturer
5	Role-play SHA-RIVA		12								12	Ilyas
6	Field trip							5		5	5	Jiang
	Exam		3								3	
	Total	31	15	30			5			66	143	

MSc module - UNESCO-IHE

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

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

Module Sheet

Module Name Solid waste management		Module Code ES11T	Credits 5
Target Group Engineers, academicians, staff from Non-Government Organizations, Community-based Organizations, politicians, health officials, students, scientists, local, regional or national government officials, etc., involved or interested in the management of solid waste.		Prerequisites 1) Involved in or familiar with one or more of the key elements of solid waste management, or 2) having studied the topic in a formal educational setting, or 3) having a university engineering degree.	

Learning Objectives

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

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

Topics and Learning Activities

1) Introduction & Stakeholders

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

Learning Activities:

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

2) Generation, collection & separation

How/why is SW generated? how can generation be reduced? what are collection schemes & means, what means waste separation? at what point in the process? what are advantages? how can separation/reuse be stimulated?

Learning Activities:

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

3) Biological processes, composting, digestion

Aerobic and anaerobic conversion of waste organics, process characteristics, fields of application, impacts on waste reduction

Learning Activities:

lecture, calculation exercise, laboratory experiment

4) Landfill technology, CDM, MBT and Incineration

What are main waste management technologies? in more or in less developed countries? design elements, application areas? GHG issues

Learning Activities:

lecture, group activity/learning from each other, calculation exercise

5) Transboundary issues in SWM

What is Basel Convention? what is transboundary waste transport, processing and storage? What are environmental, social, economic aspects thereof?

Learning Activities:

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

6) Prevention & Recycling

How can waste generation be reduced? what are policy, economic tools? How can generated waste quickest be brought into the economic cycle?

Learning Activities:

lecture, group activity/learning from each other, calculation exercise

7) SWM planning and financing

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

Learning Activities:

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

Lecturing Material

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

Assessment

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

2014/2016-ES11T: Solid waste management											
Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: studyload hours	Lecturer(s)	
1	Introduction	6						6	18	Siebel	
2	Waste prevention	4						4	12	Dijk	
3	Exercise household waste generation			9				9	9	Siebel	
4	Waste collection/ source separation	3						3	9		
5	Composting and biogas	6						6	18	Valencia	
6	Excursion					4		4	4	Siebel	
7	Informal sector	4						4	12	Rotter	
8	Material cycles			4				4	4	Rotter	
9	Landfill processes	3						3	9	Valencia	
10	Landfill technology	3						3	9	Valencia	
11	Mechanical biological treatment	4						4	12	Rotter	
12	Lab landfill			3				3	3	Rotter	
13	Integrated planning			8				8	8	Siebel	
14	Presentations			2				2	2	Siebel	
15	Assignments		13						13		
16	Exam		2						2		
Total		33	15	26		4		63	144		
MSc module - UNESCO-IHE											

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

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

Module Sheet

Module Name		Module Code	Credits
IWRM as a tool for adaptation to climate change		ES11X	5
Target Group Programme target group (Participants in the programmes at IHE) and qualified short course participants.	Prerequisites Programme prerequisites (BSc in a topic appropriate to UNESCO-IHE programme) and basic knowledge of water management.		

Learning Objectives

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

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

Topics and Learning Activities

Principles of Integrated Water Resources Management

Introduction into the concept of IWRM

Learning Activities:

Lecture and discussion

Climate change and impacts

The climate system and the causes of climate change and variability. Impacts of climate change on the hydrological cycle, the environment and on water use sectors. Country presentations by participants

Learning Activities:

Lectures and exercises

Vulnerability and adaptation under uncertainty

What determines vulnerability to CC. Adaptation measures and strategies how to adapt under a high level of uncertainty. Economic aspect of climate change. Integrating IWRM and climate change

Learning Activities:

Lecture, exercise and fieldtrip

Institutional aspects and stakeholder participation

The importance of involving stakeholders in water management and CC adaptation and strategies on involving stakeholders

Learning Activities:

Lecture, exercise and role play

Multi sector/multicriteria decision making

Modelling effects of CC on water resources using Climateland as a case study

Learning Activities:

Lecture and computer/modelling exercise

Lecturing Material

- Lecture notes, power point presentations, background materials

Assessment

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

2014/2016-ES11X: IWRM as a tool for adaptation to climate change

Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM:		Lecturer(s)
								contact hours	study/load hours	
1	IWRM, climate change and the hydrological cycle	6						6	18	de Ruyter, van Dorland, Maskey
2	Climate change: impacts and adaptation	17		6				23	57	de Ruyter, van der Meulen, de Fraiture, Pathirana, Popes
3	Vulnerability and adaptation under uncertainty	6		6				12	24	Bresser, deRuyter
4	Institutional aspects and stakeholder participation			6				6	6	Kemerink
5	Multi sector/multicriteria decision making			24				24	24	Venneker/Wenninger
6	Oral presentations			6				6	6	
7	Field trip					6		6	6	Gersonius, van der Meulen
8	Examination			3				3	3	
Total		29		51		6		86	144	

MSc module - UNESCO-IHE

URBAN WATER AND SANITATION

MASTERS PROGRAMME

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

Module Sheet

Module Name Faecal sludge management		Module Code UWS/SE/11	Credits 5
Target Group This course is a specialist course fitting within Sanitary Engineering. It is designed for sanitary, civil / wastewater and environmental engineers who are facing challenges with faecal sludge. As on-site sanitation is by far the most applied sanitation technology, faecal sludge management is of paramount importance globally.	Prerequisites Preceding modules in Sanitary Engineering; an interest in and working knowledge of the business of faecal sludge management help to bring this module to a good end.		

Learning Objectives

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

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

Topics and Learning Activities

(Overview) Faecal sludge management

Faecal sludge management (FSM) is incredibly important in sanitation. While the focus has been on the provision of toilets mainly in the light of the MDGs, the adequate collection and treatment of the remaining faecal sludge was not always a priority, to say the least. As so many factors play a role in faecal sludge management - climate, hard ware, a vast number of stakeholders, willingness to pay, space to store and treat, groundwater pollution, different toilet types - a proper and well-functioning faecal sludge management system is hard to achieve. In this module we will address a holistic approach on FSM. There will be a focus on technology; however, technology cannot be seen separately from planning and management aspects; therefore, non-technical aspects will also be addressed in this module.

Learning Activities:

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

Topics in the module:

- Public Health and Sanitation
- Excreta Characterisation
- Faecal Sludge Sanitation Systems
- Non-technical aspects of FSM
- Specific circumstances

Lecturing Material

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

Assessment

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

2014/2016-UWS/SE/11: Faecal sludge management										
Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM:		Lecturer(s)
								contact hours	studyload hours	
	Public Health	6						6	18	
	Black Soldier Flies	4						4	12	
	Reinventing the Toilet Challenge	2		2				4	8	
	Emergency Sanitation	6	2					6	20	
	Co treatment	2						2	6	
	Sludge characterisation	2						2	6	
	Treatment Mechanisms	12		8				20	44	
	Institutional Aspects	4						4	12	
	Financial Aspects	2		2				4	8	
	Slum sanitation	2						2	6	
	Total	42	2	12				54	140	
MSc module - UNESCO-IHE										

URBAN WATER AND SANITATION

MASTERS PROGRAMME

Academic Year: 2014-2016
 Specialization: Elective module
 Module Coordinator: Trifunovic, N.

Module Sheet

Module Name Advanced water transport and distribution		Module Code UWS/WSE/11a	Credits 5
Target Group Engineers and scientists with keen interest in modern methods, technologies and tools used in design, operation and maintenance of water transport & distribution networks.	Prerequisites BSc degree in Civil Engineering or similar; a few years of relevant experience; knowledge of steady-state hydraulics of pressurised flows; basic use of network models; good English command. Students without any WTD experience should first complete the module Water Transport and Distribution.		

Learning Objectives

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, corrosion assessment, prevention and control, optimal water composition, principles of water quality modelling of distribution networks, modelling of chlorine residuals.

Learning Activities:

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

Advanced Water Distribution Modelling

Principles of genetic algorithm; pressure-driven demand calculations; network calibration; failure analysis and calculation of demand losses; economic aspects of capital investments and network operation.

Learning Activities:

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

GIS in Water Distribution

The aim of this course is to provide both a solid theoretical understanding and a comprehensive practical introduction of how to use geographic information systems and remote sensing technologies for the analysis and solution of water distribution related problems. The course focuses on the analysis of digital spatial data, preparation for numerical modelling, presentation of modelling results and support to the decision making process. The topics covered in the course include the following: introduction to geographic information systems and remote sensing technologies, active and passive remote sensing, data structures, map projections and coordinate systems, processing of digital geographic information, creation of digital elevation models, visualisation,

mapping of water related features, 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 hydraulic analyses conducted by network modelling software.

Introduction to Water Hammer

Basic equations and applications; computer modelling: model building, simulations of simple cases (full pump trip, emergency shut down; protection devices: practical methods of surge suppression, direct action, diversionary tactics, choice of protection strategy.

Learning Activities:

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

Advanced O&M Practices in Water Distribution

Monitoring of network condition and operation; data collection and management; organisation of maintenance, emergency water supply, asset management plans, water company organisation.

Learning Activities:

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

Lecturing Material

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

Assessment

- **60%: Written Exam (closed book) -- Multiple choice test covering theoretical aspects of (1) advanced water distribution modelling, (2) water quality and corrosion in distribution networks and (3) water hammer (20% each)**
- **28%: Assignment -- Report on four short assignments regarding advanced water distribution modelling done in WaterGEMS software: (1) Network design using GA optimiser, (2) Network criticality analysis, (3) Water quality analysis, and (4) Water hammer analysis.**
- **12%: Assignment -- GIS assignment on the exercise using ArcGIS.**

2014/2016-UWS/WSE/11a: Advanced water transport and distribution										
Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: studyload hours	Lecturer(s)
1	Water Quality in Distribution Networks	6					4	10	30	S.Sharma, S.Velickov, N.Trifunovic
2	Advanced Water Distribution Modelling	6		12			6	24	48	D.Savic, S.Velickov, N.Trifunovic
3	GIS in Water Distribution			4			4	8	16	Z.Vojnovic
4	Introduction to Water Hammer	6		4			4	14	34	E. Arpadzic, S.Velickov, N.Trifunovic
5	Advanced O&M Water Distribution Practices			4		8		12	12	K.van der Drift
Total		18		24		8	18	68	140	
MSc module - UNESCO-IHE										

URBAN WATER AND SANITATION

MASTERS PROGRAMME

Academic Year: 2014-2016
 Specialization: Elective Module (Open for all specializations)
 Module Coordinator: Sharma, S.K.

Module Sheet

Module Name Decentralised water supply and sanitation	Module Code UWS/WSE/11b	Credits 5
Target Group 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.	Prerequisites 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), solid waste management and fecal sludge management and their implementation in small towns, peri-urban and urban poor areas of developing countries
- prepare concept design for small-scale water supply treatment and ecosan technology
- facilitate planning, financing, implementation and operation and maintenance of decentralised water supply and sanitation infrastructures based on stakeholder participation and community management

Topics and Learning Activities

Introduction

Introduction to the module; Water Supply and Sanitation situations in small towns, peri-urban areas and urban poor areas. Rationale for decentralised water supply system

Learning Activities:

Lecture and discussions

Decentralised Water Supply and Treatment Systems

Water Supply Systems (water sources, source selection, service levels, suitability of types of water supply systems under different conditions); Rainwater Harvesting (introduction, collection systems, advantages and limitations, design considerations). Small-scale Water Treatment Methods (design water treatment systems for small community or household. Roughing filtration, slow sand filters, small-scale disinfection)

Learning Activities:

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

Decentralised Sanitation Systems

Ecological sanitation (introduction to ecosan approach; characteristics of urine, faeces and greywater; overview of technologies for ecosan; treatment aspects for urine, faeces and greywater; conventional on-site sanitation; storage and transport logistics; introduction to anaerobic treatment, composting and constructed wetlands; safe reuse of ecosan products in agriculture with WHO guidelines; financial institutional, social and policy aspects of ecosan). Faecal Sludge Management (treatment goals and standards, treatment options, faecal sludge management (planning, financial, economic, agronomic, institutional and legal aspects), transmission of excreta-related infections and risk management). Solid waste management in developing countries (technical and practical aspects of collection, transport, segregation, disposal and reuse)

Learning Activities:

Lectures, Workshop/Discussion, Assignment, Field Trip

Management Aspects of Watsan

Participatory planning and evaluation of DWSS systems, demand responsive approach; Institutional arrangements (community based management; small-scale independent providers), Financial and Operational aspects (financing, cost recovery, operation and maintenance of DWSS systems)

Learning Activities:

Lectures and discussion

Presentation of the participants

All participants make a presentation of 10 minutes in the field of decentralised water supply and sanitation in order to share experiences or problems they are facing now and learn from each others experience.

Learning Activities:

Individual presentations and discussion

Lecturing Material

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

Assessment

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

2014/2016-UWS/WSE/11b: Decentralised water supply and sanitation										
Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: studyload hours	Lecturer(s)
1	Introduction									Sharma
1.1	Module introduction			1				1	1	
1.2	Introduction to decentralised water supply and sanitation	2						2	6	
2	Decentralised Water Supply and Treatment Systems									Sharma
2.1	Water supply systems	3						3	9	
2.2	Rain water harvesting	2		2				4	8	
2.3	Small-scale water treatment	6	6					6	24	
3	Decentralised Sanitation Systems									Rontelap, Schertenleib
3.1	Ecological sanitation	6		2		4		12	24	Rontelap
3.2	Soild waste management in small towns and urban poor areas	4						4	12	Rontelap/Guest Lecturer
3.3	Sanitation planning and strategic tools	2		2				4	8	Schertenleib (EAWAG)
3.4	Fecal sludge management	2		4				6	10	Schertenleib (EAWAG)
4	Management Aspects of DWSS									Sharma, van Dijk
4.1	Participatory planning and evaluation	2		2				4	8	Guest lecturer
4.2	Institutional arrangements	2		2				4	8	van Dijk
4.3	Financing and cost recovery aspects	2		2				4	8	van Dijk
4.4	Operation and maintenance aspects	2		2				4	8	Sharma
5	Presentation of the Participants			6				6	6	Sharma
	Total	35	6	25		4		64	140	
MSc module - UNESCO-IHE										

WATER MANAGEMENT

MASTERS PROGRAMME

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

Module Sheet

Module Name Urban water governance		Module Code WSM11	Credits 5
Target Group Young mid-career professionals who are 1) working at middle and upper level in an organization in the water sector, 2) employed in policy making institutions in the water sector, 3) working for organizations engaged in management of water resources and water services.	Prerequisites Mandatory: High level of ability to read and discuss academic articles and book chapters in English; willingness to engage in social science theory and new conceptual frameworks; willingness to engage in cross-disciplinary discussions and applications. Preferred: completion of the Institutional Analysis module.		

Learning Objectives

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

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

Topics and Learning Activities

Introduction to urban development in the global South

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

Learning Activities:

lecture, assigned reading

Urban development & inequality

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

Learning Activities:

lecture, assigned reading

Urban growth & slum urbanism

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

Learning Activities:

lecture, assigned reading

Urban resilience

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

Learning Activities:

lecture, assigned reading

Right to the City

social movements and urban politics; grassroots urban coalitions

Learning Activities:

lecture, assigned reading

Urban waterscapes & the hydro-social cycle

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

Learning Activities:

lecture, assigned reading

The modern city

Integrated urban infrastructural ideal; hydraulic paradigm and urban planning ideals

Learning Activities:

lecture, assigned reading

Lecturing Material

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

Assessment

- **20%: Assignment** -- Students will work in small groups to identify how the current key challenges for urban development, discussed in week 1, relate to access to water supply and sanitation.
- **30%: Assignment** -- Students will read 2-3 journal articles per topic for week 2 and submit short written assignments.
- **50%: Assignment** -- Students will write a final essay to apply the concepts learned in Week 1-2.

2014/2016-WSM11: Urban water governance														
Nr	Course/Topic	Lecture	Assignment	Workshop	Case study	Role play	Exercise	Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: study/load hours	Lecturer(s)
	Introduction to urban development challenges in the global South	2	4									2	10	Kooy
	Urban poverty & inequality	2	4									2	10	Pouw (UvA)
	Urban growth & slum urbanism	2	4									2	10	Kooy
	Urban resilience	2	4									2	10	Kooy
	Right to the city	2	4									2	10	Rusca
	Urban waterscapes & hydro-social cycle	2	4									2	10	Smit/Kooy
	Modern city	2	4									2	10	Kooy
	The Modern city: case study	2										2	6	guest (March)
	The Splintered city	2	4									2	10	Kooy
	The Splintered city: case study	2										2	6	Kooy
	The Informal city	2	4									2	10	Schwartz/Rusca
	The Informal city: case study	2										2	6	guest
	Essay assignment		30										30	
	Total	24	66									24	138	
MSc module - UNESCO-IHE														

WATER SCIENCE AND ENGINEERING

MASTERS PROGRAMME

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

Module Sheet

Module Name Water resilient cities	Module Code WSE/11	Credits 5
Target Group All participants and external professionals dealing with urban water and flood risk management working for municipalities, water management organisation, consulting firms, educational institutions and NGOs.	Prerequisites BSc degree in Engineering or Social Sciences background; basic knowledge of urban water and flood risk management; good command of English.	

Learning Objectives

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

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

Topics and Learning Activities

Flood and drought resilience

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

Learning Activities:

Lecture, assignment, workshop, self study.

Water Sensitive Urbanism

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

Learning Activities:

Lecture, workshop, fieldtrip, self study.

Community participation and collaborative governance

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

Learning Activities:

Lecture, workshop, self study.

Lecturing Material

- Reader with journal papers and classroom presentations

Assessment

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

2014/2016-WSE/11: Water resilient cities

Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: study/load hours	Lecturer(s)
1	Flood and drought resilience	6	4				8	14	46	Bachhin, Gersonius, Zevenbergen
2	Water Sensitive Urbanism	8				8	6	22	50	Ashley, Nillisen, Veerbeek
3	Community participation and collaborative governance	8					6	14	42	Anema, Rijke, Pathirana
Total		22	4			8	20	50	138	

MSc module - UNESCO-IHE

WATER SCIENCE AND ENGINEERING

MASTERS PROGRAMME

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

Module Sheet

Module Name Flood protection in lowland areas	Module Code WSE/HECEPD/11/e	Credits 5
Target Group	Prerequisites Basic knowledge of hydraulics, basic knowledge of soil mechanics	

Learning Objectives

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

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

Topics and Learning Activities

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

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

Learning Activities:

Lectures

Probabilistic Design (P. van Gelder)

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

Learning Activities:

Lectures

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

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

Learning Activities:

Lectures and Assignment

Lecturing Material

- Verhagen, H.J.: Revetments, Sea Dikes and River Levees-Lecture notes hh292/99/1
- Hassan, R.M.: handouts, Dikes and Revetments, 2002
- Groot, M.: Handouts, Geotechnical Aspects for Dikes, 2003
- Verhagen, H.J. : Design of closure of dams- Lecture notes In0052/02
- Vrijling, J.K.: Probabilistic Design, Lecture notes In0217/04/
- Handout: collection of tutorials and papers related to OpenEarth, Delft3D and XBeach applications.

Assessment

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

2014/2016-WSE/HECEPD/11/e: Flood protection in lowland areas														
Nr	Course/Topic	Lecture	Assignment	Workshop	Case study	Role play	Exercise	Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM:		Lecturer(s)
												contact hours	studyload hours	
1	Dikes and Revetments	8			4							12	28	C. Dorst
2	Dikes and Revetments	12										12	36	J. Salazar
3	Probabilistic design	6			6							12	24	P. van Gelder
4	Storm Impact modelling	2										2	6	J. A. Roelvink
5	Storm Impact modelling	6			5							11	23	M. van Ormondt
6	Storm Impact modelling	6			5							11	23	J. van Thiel de Vries
Total		40			20							60	140	
MSc module - UNESCO-IHE														

WATER SCIENCE AND ENGINEERING

MASTERS PROGRAMME

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

Module Sheet

Module Name Innovative approaches and practices		Module Code WSE/HELWD/11/e	Credits 5
Target Group All WSE participants and from other programmes with specific interest.	Prerequisites General knowledge about drip and sprinkler irrigation systems as well as GIS and remote sensing.		

Learning Objectives

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

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

Topics and Learning Activities

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

Historical background, modern irrigation, definition, decision variables.

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

Drip irrigation: The emitter: types, hydraulics, theoretical and empirical equations; the lateral: hydraulics, length; The set: decision variables, uniformity, automation, control, fertigation.

Learning Activities:

lecture, exercise

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

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

Learning Activities:

lecture, exercise

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

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

Learning Activities:

lecture, exercise

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

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

Learning Activities:

lecture, exercise

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

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

Learning Activities:

lecture

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

Flood based farming systems, small scale private irrigation systems

Learning Activities:

lecture

Lecturing Material

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

Assessment

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

2014/2016-WSE/HELWD/11/e: Innovative approaches and practices

Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM:		Lecturer(s)
								contact hours	studyload hours	
1	Sprinkler and Drip	8		8				16	32	F.B. Reinders
2	Subsurface Drainage	12		8				20	44	Dr Ir H.P. Ritzema
3	Remote Sensing for Irrigation and Drainage	8		4				12	28	Dr. Z. Vekerdy
4	Reuse of Low Water Quality	6						6	18	N.P. van der Steen, PhD, MSc
5	Land Use and Water in Flood Prone Areas	4						4	12	Prof. C. de Fraiture, PhD, MSc
6	Emerging trends in irrigation such as Flood Based Farming and Private Irrigation	2						2	6	Prof. C. de Fraiture, PhD, MSc
Total		40		20				60	140	
MSc module - UNESCO-IHE										

WATER SCIENCE AND ENGINEERING

MASTERS PROGRAMME

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

Module Sheet

Module Name Modelling and operation of river systems		Module Code WSE/HERBD/11/e	Credits 5
Target Group All participants in the WSE programme	Prerequisites Hydraulics & Basic mathematics		

Learning Objectives

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

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

Topics and Learning Activities

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

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

Learning Activities:

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

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

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

Learning Activities:

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

Reservoir control and optimisation (M.Werner, IHE)

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

Learning Activities:

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

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

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

Learning Activities:

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

Lecturing Material

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

Assessment

- 30%: Written Exam (closed book) -- This component refers to the Computational Hydraulics subject.
- 30%: Written exam (closed book) -- This component refers to the Reservoir control and optimisation subject
- 40%: Assignment -- This component is comprised of 2 components, assignments in Reservoir control and optimisation (10%) and the assignments in Modelling applications (lakes and rivers) (30%)

2014/2016-WSE/HERBD/11/e: Modelling and operation of river systems										
Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: studyload hours	Lecturer(s)
1	Computational Hydraulics	6		8				14	26	I. Popescu (IHE)
2	Model quality assessment & uncertainty	2		2				4	8	M. Werner (IHE)
3	Reservoir control and Optimisation	12						12	36	M. Werner (IHE)
4	Modelling Applications: reservoirs				10			10	20	M. Werner (IHE)
5	Modelling Applications: lakes	4			10			14	32	F. Martins (Algarve University)
6	Modelling Applications: rivers			4	6			10	16	I. Popescu, M. Mukolwe (IHE), L. Beevers (Herriot Watt)
	Total	24		14	26			64	138	
MSc module - UNESCO-IHE										

WATER SCIENCE AND ENGINEERING

MASTERS PROGRAMME

Academic Year: 2014-2016

Specialization: Hydroinformatics: modelling and information systems for water management

Module Coordinator: Jonoski, A.

Module Sheet

Module Name Hydroinformatics for decision support		Module Code WSE/HI/11/e	Credits 5
Target Group Participants from all Master Programmes of UNESCO-IHE	Prerequisites Hydrological and hydraulic modelling concepts; Basic programming skills		

Learning Objectives

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

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

Topics and Learning Activities

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

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

Learning Activities:

Attending lectures;
Computer exercises;
Home assignment;

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

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

Learning Activities:

Attending lectures;
Computer exercises;
Home assignment;

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

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

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

Learning Activities:

Attending lectures;
Computer exercises;
Home assignment;

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

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

Learning Activities:

Attending lectures;
Computer workshop;

Lecturing Material

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

Assessment

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

2014/2016-WSE/HI/11/e: Hydroinformatics for decision support										
Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: studyload hours	Lecturer(s)
1	Systems analysis in water resources	12		4	4			20	48	D. P. Loucks
2	Decision support systems	6		4	4			14	30	A. Jonoski, I. Popescu
3	Software technologies for integration	4		10	10			24	42	A. Jonoski, G. Corzo, S. Seyoum, L. Alfonso
4	Integration of weather prediction and water models	4		4				8	16	S.J. van Andel
Total		26		22	18			66	136	
MSc module - UNESCO-IHE										

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

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

Module Sheet

Module Name Summer course		Module Code ES12	Credits 1
Target Group All participants of the programme		Prerequisites The successful completion of at least 8 of the first 11 modules of the programme	

Learning Objectives

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

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

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:

- Water and Climate
- Environmental Flows
- Conflict Resolution
- Flood resilient planning and building

Learning Activities:

Lectures, workshops, assignments

Lecturing Material

- To be announced

Assessment

- 100%: Assignment -- Pass / fail based on attendance to research methodology and summer course

2014/2016-ES12: Summer course											
Nr	Course/Topic	Lecture	Assignment	Workshop	Case study	Role play	Exercise	Lab session	Laboratory work	Fieldtrip - Fieldwork	Lecturer(s)
	Summer Course	9									9 27 Various
	Total	9									9 27
MSc module - UNESCO-IHE											

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

Academic Year: 2014-2016
 Specialization: Core Programme
 Module Coordinator: Evers, J.G.

Module Sheet

Module Name Groupwork ES		Module Code ES13TMW	Credits 5
Target Group Programme target group		Prerequisites Programme prerequisites	

Learning Objectives

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

- Solve complex environmental problems by integrating the content of the preceding modules;
- Make decisions on the basis of a limited amount of information;
- Work in a team to solve complex environmental problems

Topics and Learning Activities

Ecoland

The group work consists of a case study in which the techniques and knowledge obtained in the preceding modules are integrated. The group work is located in the fictitious country Ecoland. Ecoland faces enormous environmental problems, which have to be addressed by the participants in their role as consultant or EPA member. During the group work participants have discussion meetings, give presentations and write a report.

Learning Activities:

The group work is carried out as a role-play, in which participants are either belonging to a consultancy or to a local EPA. The participants have group discussions and individual tasks, give progress and final presentations and write a final report.

Lecturing Material

- Handout Ecoland

Assessment

- **100%: Assignment** -- The assessment is based on the final report, the oral presentations and the individual contributions.

2014/2016-ES13TMW: Groupwork ES										
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)
Discussions										
Presentations			16						16	
Selfstudy, report writing			122						122	
			Total						140	
MSc module - UNESCO-IHE										

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

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

Module Sheet

Module Name		Module Code	Credits
MSc preparatory course and thesis research proposal		ES14	9
Target Group All students of the Environmental Science programme		Prerequisites 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;
 - 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.

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.

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

Lecturing Material

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

Assessment

• **100%: Presentation -- The MSc research proposal needs to be approved by the mentor and the professor before the student can actually start the research work.**

2014/2016-ES14: MSc preparatory course and thesis research proposal

Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: study/load hours	Lecturer(s)
	MSc research proposal drafting		188						188	
	MSc research proposal presentation				4			4	8	Mentor and professor
	Total		188		4			4	196	
MSc module - UNESCO-IHE										

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

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

Module Sheet

Module Name MSc thesis research work		Module Code ES15	Credits 36
Target Group Programme target group		Prerequisites Programme prerequisites	

Learning Objectives

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

- Explore the background of the research problem by critically reviewing scientific literature; Evaluate relevant theories and applying these theories to a relevant scientific problem; Assure adequate delineation and definition of the research topic; Formulate research questions and hypotheses.
- Conduct research, independently or in a multidisciplinary team by selecting and applying appropriate research methodologies and techniques, collecting and analysing data.
- Formulate well-founded conclusions and recommendations based on a comprehensive discussion of the results.
- Demonstrate academic attitude and learning skills (including thinking in multidisciplinary dimensions and distinguishing main issues from minor ones), to enhance and keep up-to-date the acquired knowledge and application skills in a largely independent manner.
- Communicate, debate and defend, clearly and systematically, findings and generated insights, and provide rational underpinning of these in oral and written presentations to a variety of audiences.

Topics and Learning Activities

Lecturing Material

Assessment

- **100%: Assignment** -- The MSc work is assessed based on the written report, the final presentation, the defense

2014/2016-ES15: MSc thesis research work														
Nr	Course/Topic	Lecture	Assignment	Workshop	Case study	Role play	Exercise	Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: studyload hours	Lecturer(s)
Total			1008									1008		
MSc module - UNESCO-IHE														