Delft, December 2011

Master Programme
Environmental Science

Handbook 2011-2013

UNESCO-IHE
Institute for Water Education

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 Certain modules or parts of modules may be changed, withdrawn and/or replaced by other modules.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 UNESCOIHE or from partner organisations cannot be guaranteed. No rights can therefore be derived from the programme as specified in this handbook.

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1 UNESCO-IHE

1.1 Introduction

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

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

In November 2001, UNESCO's 31st General Conference decided to make IHE an integral part of the Organisation. By March 2003, the necessary treaties and agreements between the IHE Delft Foundation, UNESCO and the Netherlands Government were signed, allowing for the entry into operation of the new UNESCO-IHE Institute for Water Education. UNESCO-IHE is governed by a thirteen-member Governing Board appointed by the Director General, and is managed by a Director and Deputy Director. The IHE Delft Foundation provides all other staff and facilities to UNESCO-IHE.
The mission of the Institute is to contribute to the education and training of professionals and to build the capacity of sector organisations, knowledge centres and other institutions active in the fields of water, the environment and infrastructure, in developing countries and countries in transition.

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

1.2 MSc Degree Programmes

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

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

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

1.3 Research and PhD Programmes

UNESCO-IHE carries out scientific research, often in co-operation with universities and research institutes in developing countries. A number of positions are available for PhD research. The PhD programme has a nominal duration of 4 years and can be carried out either in Delft or in a sandwich construction. The PhD degrees are awarded by UNESCO-IHE together with a Dutch university. Candidates should preferably hold a UNESCO-IHE MSc degree, but an equivalent degree from another reputed university may also be acceptable.

1.4 Organisation

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

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

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

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

2 Programme framework

2.1 Introduction

The Master of Science Degree Programmes

The Institute provides the following Master of Science degree programmes:

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

These programmes have a nominal duration of 18 months and are leading towards a Master of Science (MSc) degree in the respective field upon successful completion. Each programme has several distinct specialisations, in which students follow a programme curriculum best suited to their preference.
The study load of the programmes is 106 credit points, expressed in units defined by the European Credit Transfer and Accumulation System (ECTS).

2.2 Academic Regulations

The *Education and Examination Regulations* (separately included in this handbook) provide the basic data of the programme, including the major rules around the examinations and the rights of students to inspect the results of the examination assessment.
The regulations describe the precise details of how examinations are assessed and marked, the procedures and rules for re-examinations, procedures for appeal, and which results are required for awarding the Master of Science degree.
Students are strongly advised to familiarise themselves with these procedures at an early stage during their study.

2.3 Structure of the Programmes

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

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 4 credit points;
- the thesis proposal preparation of 6 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;
- 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. The (minimum) study load determination criteria for the various education activities are shown in the following table.

Activity	**Study load / contact time**
Lecture, with assignment	≥ 3 hours / hour
Assignment	1 hour / hour
Workshop	1-2 hours / hour
Fieldtrip	≥ 8 hours / day
Fieldwork	≥ 8 hours / day
Laboratory session	≥ 1-2 hours / hour

2.9 Planning and Scheduling

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

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

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

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

2.10 Participation

Active participation and attendance by students is required for all curricular activities on the schedule. Students have to inform their programme coordinator as early as possible when they are not able to attend a scheduled programme activity.

2.11 Evaluation of the Programme by Students

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

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

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

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

3 Exam regulations

Education and Examination Regulations 2011– 2012

For the Master Programmes in:

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

Approved by the Academic Board of UNESCO-IHE, 29 September 2011

3.1 General Information

Article 1 Scope of the regulations

1.1 The present regulations apply to the education and examinations within the above mentioned master programmes referred to hereafter as 'the programmes'. The programmes are executed by the UNESCO-IHE Institute for Water Education, Delft, the Netherlands, referred to hereafter as 'the Institute' and several partner institutes in various countries.

1.2 In case of joint specialisations (see art. 3.2) the present regulations also apply for the part of the programmes offered by UNESCO-IHE.

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

Article 2 Definition of terms

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

Act : the Higher Education and Scientific Research Act (*Wet op Hoger Onderwijs en Wetenschappelijk Onderzoek*);

Module : a self-contained programme unit with specified learning

objectives, as stipulated in article 7.3 of the Act;

Rector : the rector of the Institute;

ECTS : the European Credit Transfer and Accumulation System;

Examination : an interim study performance assessment for a component of the programme (in the Act: *tentamen*);

Constitutent examination : an examination consisting of a number of different

parts (e.g. assignments, written or oral exams, presentations)

Examination board : the committee as stipulated in article 7.12 of the Act;

Practical: a practical educational activity as stipulated in article 7.13,

paragraph 2, clause d of the Act, taking one of the following forms:

• the writing of a report or thesis;

• producing a report, study assignment or design;

• conducting a test or experiment;

• performing an oral presentation;

• participating in groupwork, fieldwork or a fieldtrip;

• conducting a research assignment; or

• participation in other educational activities that aim to develop

specific skills.

Programme examination : the formal evaluation of the student performance

before graduation (in the Act: *examen*);

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

examinations.

Article 3 Programme and specialisations

3.1 The programmes are characterised as post-initial master programmes in scientific education, as stipulated in article 7.3b of the Act.

3.2 The following specialisations are distinguished within the programmes:

Municipal Water and Infrastructure programme:

1. Water Supply Engineering;

2. Sanitary Engineering;

3. Joint specialisation in Water Supply Engineering with Kwame Nkrumah University of Science & Technology, Ghana;

4. Joint specialisation in Sanitary Engineering with Kwame Nkrumah University of Science & Technology, Ghana;

5. Joint specialisation in Water Supply Engineering with Universidad del Valle, Colombia;

6. Joint specialisation in Sanitary Engineering with Universidad del Valle, Colombia; and

7. Joint specialisation in Urban Water and Management with Asian Institute of Technology, Thailand.

Environmental Science programme:

1. Environmental Science and Technology;

2. Environmental Planning and Management;

3. Water Quality Management;

4. Joint specialisation in Limnology and Wetland Ecosystems with Institute of Limnology, Austria and Egerton University, Kenya;

5. Joint specialisation in Environmental Technology for Sustainable Development with Asian Institute of Technology, Thailand; and

6. Environmental Technology and Engineering (Erasmus Mundus programme).

Water Management programme:

1. Water Resources Management;

2. Water Services Management;

3. Water Quality Management; and

4. Water Conflict Management.

Water Science and Engineering programme:

1. Hydrology and Water Resources;

2. Joint specialisation in Hydrology and Water Resources with Hohai University, China P.R.;

3. River Basin Development;

4. Coastal Engineering and Port Development;

5. Joint specialisation in Coastal Engineering and Port Development, with Hohai University, China P.R.;

6. Land and Water development;

7. Joint specialisation on Land and Water development with Sriwijaija University, Palembang, Indonesia;

8. Joint specialisation on Agricultural Water Management for Enhanced Land and Water Productivity with Asian Institute of Technology Thailand;

9. Agricultural Water Management for Arid and Semi-Arid Climates with Haramaya University, Ethiopia;

10. Hydroinformatics;

11. Joint specialisation in Hydroinformatics with Hohai University, China P.R.;

12. Joint specialisation in Hydroinformatics with Universidad del Valle, Colombia;

13. Joint specialisation in Hydroinformatics with Ain Shams University, Egypt;

14. Ecohydrology (Erasmus Mundus programme); and

15. Flood Risk Management (Erasmus Mundus programme).

Article 4 Aim of the programme

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

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

Article 5 Full-time/part-time

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

Article 6 Study load of the programme

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

Article 7 Programme examination

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

7.2 The programme examination is passed if all designated examinations in the programme curriculum have been successfully completed, as stipulated in article 7.10, paragraph 1 of the Act.

3.2 Academic Admission Requirements

Article 8 Admission to the programmes

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

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

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

c. a good command of the English language, if this is not the first language. This is measured by a minimum IELTS score of 6.0, a minimum paper-based TOEFL score of 550,

or a minimum computer-based TOEFL score of 213. For other tests, the results will be interpreted to show alignment with the Council of Europe's Common European Framework (CEF) levels C1 or C2.

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

3.3 Content of the Programme

Article 9 Composition of the specialisations and joint specialisations

9.1 The composition of each programme specialisation is defined in Appendix C.

Article 10 Practicals and participation

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

3.4 Examinations

Article 11 Sequence of the examinations

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

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

Article 12 Periods and frequency of examinations

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

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

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

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

12.5 Written re-examinations normally take place during the next examination period indicated in the academic calendar. The students involved are notified sufficiently in advance in writing about the date and time allocation for re-examinations. All students will take the re-sit at the same time.

12.6 Students will not be allowed to sit for further re-examinations and -assignments if they failed more than three re-examinations for the first 13 modules of the programme.

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

Article 13 The nature of the examinations

13.1 The constituent parts of a module are assessed via a combination of written and or oral examinations, assignments and presentations as indicated in the module descriptions.

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

13.3 A written examination has to take place in a period of max. 3 hours during a morning or afternoon session. A break of 15 minutes is allowed.

13.4 The nature of the examinations for each module in each programme is indicated in Appendix C, and is described separately in the in each module sheet.

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

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

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

13.8 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.

Article 14 Oral examinations

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

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

Article 15 Exemptions and transfer of credit points

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

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

Article 16 Absence from examinations

16.1 Absence from an examination must be reported by the student to the programme coordinator as early as possible. Absence is only allowed if the student missed a substantial part of the education relevant for the examination and/or the examination itself due to:

a. medical reasons, to be confirmed by a medical note stating the inability to participate; or

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

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

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

Article 17 Fraud

17.1 If a student is caught in an attempt to take unfair advantage during an examination, the invigilators or examiners will inform the Academic Registrar who will submit a written report to the examination board after investigation of the incident, and after having had a discussion with the student.

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

17.3 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.

3.5 Results of Examinations

Article 18 Assessment and notice of examination results

18.1 Examination assessment results (including the thesis examination) are represented on a scale of 1.0 to 10.0, with one decimal of accuracy. Marks 6.0 and higher indicate a successful result.

The following grading scale is used:

- 9.1-10 outstanding
- 8.6-9.0 very excellent
- 8.1-8.5 excellent
- 7.5-8.0 very good
- 7.0-7.4 good
- 6.0-6.9 sufficient
- 5.9- and below insufficient - fail

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

18.3 The examiner shall assess a written examination or practical paper within a period of 14 days after the date of the examination.

18.4 All written examination work of the students will be blind corrected by the examiners involved.

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

18.6 The examination committee for the thesis examination shall determine the result after the defence. The mark shall be communicated to the student before the diploma awarding.

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

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

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

Article 19 Period of validity

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

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

Article 20 Right to inspection of assessments

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

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

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

3.6 Thesis Examinations

Article 21 Periods and frequency of thesis examinations

21.1 The thesis will be assessed by a thesis examination committee, consisting normally of 3 members (or in special circumstances of maximum 4 members); (at UNESCO-IHE) a professor as chairman, the mentor and one or two external examiners.

In case a PhD fellow, who is mentoring MSc students in his/her own research, is proposed as member of the committee, a fourth additional staff member is compulsory.
External examiners are normally from outside the institute or in incidental cases from a chair group not involved in the supervision of the research work.

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

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

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

21.5 In exceptional cases, when the outcome of the thesis examination, including the defence, was negative, the examination can be repeated once. The supervisor and mentor will detail the reasons for the failure in writing and clarify what is required to pass the exam. The re-sit shall be taken within three months of the first attempt.

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

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

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

Article 22 Study progress and study advice

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

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

3.7 Examination Board

Article 23 Examination board procedures

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

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

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

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

Article 24 Assessment of the programme examination

24.1 The student has fulfilled the requirements for the programme examination if (s)he has successfully completed all examinations of the programme.

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

Article 25 Degree awarding

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

25.2 The degree will be awarded with distinction if the candidate obtained a mark of 8.5 or higher for the thesis examination, and an arithmetic average mark of 8.0 or higher for all other examinations in the programme that are assessed on a numerical scale, conform article 2.1.

Article 26 Diploma and supplement

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

26.2 In addition to the diploma, the graduate receives a diploma supplement stating the results achieved and credit points for each component of the programme.

Article 27 Programme certificate

27.1 Students who fail to meet the programme examination requirements, or who suspend or terminate their registration, will be issued a certificate stating the result achieved and credit points for each successfully completed component of the programme, and the period of registration.

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

3.8 Appeals

Article 28 Grounds for appeal

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

a. the performance of the student suffered through illness or other factors;

b. a material administrative error in the conduct of an examination or assessment had occurred;

c. the examination or evaluation was not conducted in accordance with the regulations; or

d. some other material irregularity had occurred.

Article 29 Procedure for appeal

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

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

29.3 After consultations, 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.

Article 30 Evaluation of the programme

30.1 All taught components of the programme are routinely evaluated via a standardised questionnaire, which is completed by the students during a class session.

30.2 The evaluation class session for a programme component is held after students have submitted all examination material, and before the examination results are being notified to the students.

30.3 Upon explicit request by the students or a student representative, an oral evaluation discussion may be organised at any time. The purpose of such a discussion is entirely to obtain specific information or suggestions for improvement of a programme component.

3.9 Final Articles

Article 31 Amendments

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

31.2 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 32 Unforeseen situations

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

Article 33 Publication

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

Article 34 Period of application

34.1 These regulations take effect for the academic year 2011– 2012. Approved by the Academic Board of UNESCO-IHE on 29 September 2011

3.10 Appendix A Qualifications of Graduates ES

- [1] Knowledge and understanding:
- Knowledge of current theory and contemporary developments in Environmental Science.
- Knowledge of physical, chemical and biological processes of the environment.
- Understanding of what is meant by “sustainability” and “wise use” of natural resources.
- The ability to describe the rationale for an integrated and interdisciplinary approach for managing the environment.
- Understanding the broader scientific, engineering and socio-economic context and the role of other disciplines required for Environmental Science.

Environmental Science and Technology

- To list concepts, instruments and technologies for pollution prevention, treatment and remedial action.

Environmental Planning and Management

- Knowledge of economic, institutional and legal principles, approaches and instruments relating to the environment.
- To list and explain legislative, institutional and management principles and arrangements.

Water Quality Management

- The ability to recognize the pollution impacts on water quality and identify remedial actions.
- To list and explain legislative, institutional and management principles and arrangements.

Limnology and Wetland Ecosystems

- The ability to recognize the pollution impacts on water quality and identify remedial actions.

[2] Applying knowledge and understanding:

- The ability to contribute to theoretical, methodological or applied developments in environmental science.
- The ability to prepare and implement a sound plan for environmental research.
- The ability to collect, analyse and organise relevant information and to draw sound conclusions on environmental issues.

Environmental Science and Technology

- To select and apply instruments and technologies for pollution prevention, treatment and remedial action.

Environmental Planning and Management

- To contribute to managing environmental systems and organisations and to the development of the institutional arrangements of the latter.

- To design and apply models for institutional development in water policy.
- To design and facilitate stakeholder involvement in decision-making processes.
- To formulate environmental policy strategies.

Water Quality Management

- To apply experimental, statistical and modelling tools for interpreting and designing water quality management programmes.

Limnology and Wetland Ecosystems

- To apply experimental and modelling tools for managing freshwater ecosystems.
- To apply knowledge of processes and functions of freshwater ecosystems in their management and protection.

[3] Making judgements:

- The ability to decide between different environmental ideas and approaches independently, based on available information, and to assess the potential for their application, integration and further development.
- The ability to select and apply a variety of techniques, tools and procedures in order to evaluate the environmental consequences of different development and intervention scenarios.
- The ability to reflect critically on the impacts of different activities on the environment.

Environmental Science and Technology

- To develop technological solutions for environmental problems based scientific knowledge.

Environmental Planning and Management

- To enumerate ecological and socio-economic functions and values of an environmental system and related, competing stakeholder interests.
- To design environmental policies that incorporate technical, administrative and financial aspects.

Water Quality Management

- To develop on the basis of scientific knowledge, technical and managerial solutions for water quality problems.

Limnology and Wetland Ecosystems

- To develop on the basis of scientific knowledge, technical and managerial solutions for problems in freshwater ecosystems.

[4] Communication:

- The ability to report and communicate environmental results clearly, and to explain and defend the reasoning, knowledge and assumptions to a variety of audiences.
- The ability to function effectively in a multi-disciplinary team.

Environmental Planning and Management, Water Quality Management

- The capability to assess interests among different stakeholders and to facilitate decision-making processes.

[5] Learning skills:

- The ability to extend and enhance one's own knowledge, insight and skills in a largely autonomous manner.

3.11 Appendix A Qualifications of Graduates MWI

[1] Knowledge and understanding:

- Knowledge of relevant theory and the contemporary developments in the field of study;
- Understanding of the required basic physical, applied mathematical and computing principles and the capability to integrate these within the appropriate discipline;
- Appreciation of the broader scientific, engineering and socio-economic framework, and recognition of the relevant disciplines and sub-disciplines that are related to the own discipline.

[2] Applying knowledge and understanding:

- The ability to apply disciplinary knowledge, academic capabilities and engineering skills independently and within a multidisciplinary context:
- The ability to select and apply suitable techniques and methods for analysis, assessment, planning, design, operation, rehabilitation and maintenance;
- The ability to independently formulate the appropriate questions, to identify and formulate appropriate approaches, and to pose original models, tests and/or engineering solutions;
- The ability to collect, analyse and structure required data and information and to recognise relations in them.
- The ability to prepare a research plan, including the description of the approach, the realisation of the research and the evaluation of the results.
- The attitude and the ability to contribute to theoretical, methodological or application development within the respective discipline.

[3] Making judgements:

- The ability to critically assess own investigation results, implementation feasibility and risks, and the ability to reflect on the ethical and socio-economic aspects connected with application;
- The ability to identify original ideas and approaches from the literature or other sources and assess the potential for application, integration or further development.

[4] Communication:

- The competence to clearly report and orally communicate results, the underpinning reasoning, knowledge and assumptions.

[5] Learning skills:

- The ability to extend and enhance the own knowledge, insight and skills in an autonomous manner.
- The ability to conduct independent academic research in a subsequent post-graduate (i.e., PhD) programme.

3.12 Appendix A Qualifications of Graduates WM

[1] Knowledge and understanding:

- Knowledge of current theory and contemporary developments in Water Management;
- The ability to describe the rationale for an integrated and interdisciplinary approach for managing water systems.
- Knowledge of biological, physical and chemical principles of water systems.
- Knowledge of economic, institutional and legal principles, approaches and instruments in water management.
- Understanding the broader scientific, engineering and socio-economic context and the role of other disciplines required for Water Management.

[2] Applying knowledge and understanding:

- The ability to apply the knowledge and academic capabilities acquired, in management and engineering contexts.
- The ability to contribute to managing water systems and organisations and to the development of institutional arrangements.
- The ability to collect, analyse and organise relevant information and to draw sound conclusions.
- The ability to prepare and implement a scientific research plan.
- The ability to contribute to theoretical, methodological or applied developments within the field of study.

[3] Making judgements:

- The ability to decide between different ideas and approaches independently, based on available information, and assess the potential for application, integration and further development.
- The ability to select and apply a variety of techniques, tools and procedures in order to evaluate the consequences of different development and intervention scenarios.
- The ability to reflect critically on how different activities impact on the wise use of water.

[4] Communication:

- The ability to report and communicate results clearly, and to explain and defend the reasoning, knowledge and assumptions to a variety of audiences.
- The ability to function effectively in a multi-disciplinary team.
- The capability to assess interests among different stakeholders and to facilitate decision-making processes.

[5] Learning skills:

- The ability to extend and enhance one’s own knowledge, insight and skills in an autonomous manner.

3.13 Appendix A Qualifications of Graduates WSE

[1] Knowledge and understanding:

- Knowledge of current disciplinary theory and the contemporary developments in the field of study within the context of water science and engineering;
- Understanding of the required basic physical, applied mathematical and computing principles and the capability to integrate these within the appropriate discipline;
- Appreciation of the broader scientific, engineering and socio-economic framework, and recognition of the relevant disciplines and sub-disciplines that are related to the own discipline.

[2] Applying knowledge and understanding:

- The ability to apply disciplinary knowledge, academic capabilities and engineering skills independently and within the multidisciplinary context of water science and engineering;
- The ability to select and apply suitable techniques and methods for analysis, assessment, planning, and where appropriate, design, construction, operation and maintenance;
- The ability to independently formulate the appropriate questions, to identify and formulate appropriate and approaches, to pose original models, tests and/or engineering solutions;
- The ability to collect, analyse and structure required information and to recognise relations in that information;
- The ability to prepare a research plan, including descriptions of the approach, the realisation of the research and the evaluation of the results, and the time planning for the research;
- The attitude and the ability to contribute to theoretical, methodological or application development within the respective discipline.

[3] Making judgements:

- The ability to critically assess own investigation results, implementation feasibility and risks, and the ability to reflect on the ethical and social aspects connected with application;
- The ability to identify original ideas and approaches from the literature or other sources and assess the potential for application, integration or further development.

[4] Communication:

- The adequacy to clearly report and orally communicate results, the underpinning reasoning, knowledge and assumptions, and where appropriate, to ensure the practical implementation of scientific or engineering solutions.

[5] Learning skills:

- The ability academic attitude to extend and enhance the own knowledge, insight and skills in an autonomous manner.

3.14 Appendix B Eligible Bachelor's Degrees for Academic admission

The specialisation in Water Supply Engineering accepts applicants with a BSc degree in civil, chemical, environmental, hydraulic or mechanical engineering.

The specialisation in Sanitary Engineering accepts applicants with a BSc degree in civil, environmental or chemical engineering, or in microbiology.

The specialisation in Integrated Urban Engineering accepts applicants with a BSc degree in civil engineering.

The specialisation in Hydrology and Water Resources accepts applicants with a Bachelor of Science degree in civil or agricultural engineering, earth sciences, environmental sciences, or physics.

The specialisation in Hydroinformatics accepts applicants with a Bachelor of Science degree in civil, agricultural or systems engineering, earth sciences, environmental sciences or physics.

The specialisations in Hydraulic Engineering and River Basin Development, and Hydraulic Engineering - Coastal Engineering and Port Development accept applicants with a Bachelor of Science degree in civil engineering or related field with a hydraulic engineering background.

The specialisation in Hydraulic Engineering - Land and Water Development accepts applicants with a Bachelor of Science degree in civil or agricultural engineering, or a related field.

The Water Management programme accepts applicants with a good Bachelor's degree in the fields of engineering, natural sciences, economics and the social sciences.

For the Water Resources Management specialisation, affinity with quantitative methods is essential. Similarly, for the Water Quality Management specialisation, affinity with chemistry and biology is desired. For the Water Services Management specialisation a professional background in the water utility sector is desired. And for the Water Conflict Management specialisation interest in local, national and international water management is desired.

The specialisation in Environmental Science and Technology accepts applicants with a BSc degree in civil, chemical, agricultural or environmental engineering, natural sciences, chemistry, environmental science, agriculture, or in geology.

The specialisation in Environmental Planning and Management accepts applicants with a BSc degree in civil, chemical, agricultural or environmental engineering, natural sciences, chemistry, environmental science, agriculture, geology, geography, or in environmental economics.

The specialisation in Water Quality Management accepts applicants with a BSc degree in civil, chemical, agricultural or environmental engineering, natural sciences, chemistry, environmental science, agriculture, or in geology.

The specialisation in Limnology and Wetland Ecosystems accepts applicants with a BSc degree in civil, chemical, agricultural or environmental engineering, natural sciences, chemistry, environmental Science, agriculture, or in geology.

3.15 Appendix D Examination Procedures

General Rules

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

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

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

Written Examinations

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

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

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

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

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

Exam paper: Each student has an allocated table with a set of answer and scratch papers with their student number printed on the cover sheet. Additional paper can be obtained from the invigilators upon request.

Students provide the answers in clearly readable English, with proper indication of the question label. All answer papers must carry the student number and locker number of the student. Unreadable answers or unidentified answer papers may be discarded for assessment by the examiner.

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

Dictionary: The use of a printed language dictionary without any additional written annotations is allowed (all languages are allowed) . Invigilators are allowed to check the dictionaries for hand-written annotations during the exam (spot checks while they are walking around).

Calculators: Only self contained calculators with a single-line display or dual-line display and an electronic language dictionary 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 and language translation purposes only and do not have internet access.

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

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

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

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

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

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

Assignment Reports and Individual Discussions

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

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

Thesis Proposal and Research Examinations

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

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

3.16 Appendix E Result form MSC research proposal

Date:_____

The supervisor and the mentor of Mr./Ms. _____

of programme _____ with specialization _____

consider the result of the MSc Research Proposal as being:

SATISFACTORY/UNSATISFACTORY*

Title MSc Research Proposal:

_____

_____

_____

Further remarks:

_____

_____

Name and signature supervisor: Name and signature mentor:

* delete what is not applicable

3.17 Appendix F Criteria for the MSc thesis evaluation

Approved by the Academic Board (05.03.2009).
To be used by the MSc Examination committees and the participants as a guide.
(Does not replace the standard evaluation form.)

Participant's name	
Topic	
Mentor	
Supervisor	
Date	

Criteria	**possible comments**
1. THESIS	
Abstract • Are motivation and objectives presented correctly? • Are own contribution, results and conclusions presented? • Is it clearly written?	
Introduction • Does it really introduce the work? • Does it logically lead to research questions and objectives? • Are objectives and goals (specific objectives) clearly formulated?	
Background/literature review • Are enough sources covered? • Is literature relevant and up-to-date?	
Materials & methods • Are methods explained clearly enough to understand their relevance and use? • Is quality assurance/quality control adequately addressed in experimental work?	
Discussion • Is discussion systematic and comprehensive? • Does it lead to conclusions?	
Conclusions • Are objectives achieved? • Are conclusions formulated concisely? • Are recommendations for future work given?	

Criteria	possible comments
1. THESIS *(continue)*	
Tables and figures • Do captions clearly explain contents of the Figures? • Are formatting and quality adequate?	
References, proper citation • Is material from other publications properly attributed and/or cited? • Are references and citations properly formatted?	
Editorial aspects • Is structure clear and logical? • Is spelling and grammar adequate? • Are text, headings, graphs and tables understandable? • Is layout appropriate?	
2. WORK PROCESS	
Creativity • Was participant generating new ideas, critical to the results published elsewhere? • Was participant creative, what is his/her own scientific contribution?	
Critical capacity • Are the limitations of the study understood and explained? • Does the participant show a capacity for self-criticism? • Are their clear suggestions for further research priorities?	
Other aspects • Was the participant really committed to work? • Was the participant working independently? • Were comments of the supervisors and reviewers taken into account?	
3. PRESENTATION	
• Is presentation properly structured? • Is timing good? • Is the balance of material on slides appropriate (not too much / too little)? • Are all major aspects of work presented? • Are all questions answered well?	

4 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.

5 Code of Conduct

THE RECTORATE OF UNESCO-IHE

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

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

Having heard the Student Association Board;

RESOLVES

To establish the following Regulations:

Article 1 Definitions

1.1 WHW

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

1.2 the Director

The director of UNESCO-IHE

1.3 the Rectorate

The director and the deputy director

1.4 Central services department

The central services department of UNESCO-IHE

1.5 Facilities

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

1.6 Buildings

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

1.7 Student

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

1.8 Visitor

Anyone who is not a student nor is employed by IHE-Delft as referred to in article 1.1 of

the Collective Labour Agreement (CAO) for Dutch Universities.

Article 2 Compliance requirement for rules, guidelines and instructions

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

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

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

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

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

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

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

Article 3 Disciplinary Measures

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

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

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

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

d. issuing a written reprimand;

e. retribution for damages to properties and or facilities.

Article 4 Exclusion Order by the Rectorate

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

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

4.3 The exclusion order will contain at least the following:

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

b. the duration of the exclusion order;

c. the reasons for the exclusion order;

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

Article 5 Termination of the exclusion order

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

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

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

Article 6 Entry into force

These Regulations enter into force on October 1st 2007

Article 7 Method of Citation

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

Approved in the rectorate meeting of September 25th 2007

6 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 four specialisations that lead to a Master of Science (MSc) Degree.

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[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.

6.1 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.

6.2 Specialization

The Environmental Science programme has the following specialisations:

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

6.3 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

6.4 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.

6.5 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.

6.6 LWE

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 Ecosystems

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.

6.7 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.

7 Facilities

7.1 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

7.2 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.

7.3 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.

7.4 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.

7.5 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. A photocopy service near the entrance is available to students at all times. 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, using the chip-card.

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.

7.6 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

7.7 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.

7.8 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.

7.9 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.

MASTERS PROGRAMME ES 2011-2013 - PART 2

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ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

Academic Year: 2011-2013
Specialization: Core Programme
Module Coordinator: H.J. Lubberding, PhD, MSc

Module Sheet

Module Name Introduction to Environmental Science	Module Code ES01	Credits 5

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;
- Apply the principles of the scientific method to the design and development of a research project and to develop and present the background, problem statement, research objectives and methodology for a research project.
- Identify and describe the major global, regional and local environmental problems;
- Explain the concept of sustainable development.

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.

Methodology

Methodology pays attention to "what is science", to ethics in science and the design of a research project.

Learning Activities:

The methodology is given in the form of introductory lectures by /debate between experts in four themes. Subsequently, there is an assignment per group of three: read a number of relevant papers in one theme, prepare brief review papers concluded with a number of recommendations for action. Finally, there is a presentation and debate among participants and experts

Key environmental problems

In key environmental problems relevant environmental issues will be assessed in discussion with the participants

Learning Activities:

Key environmental problems are in the form of a group discussion and an excursion.

Principles of sustainable development

The subject of sustainable development is introduced by involving the students in four major ongoing debates in the field: (1) "Limits to Growth", about resource limits and its implications for development; (2) "Tragedy of the Commons", about the unwise use of public resources; (3) "Spread of Pollutants", about the impacts of wastes and options for closing nutrient cycles at different scales and about the three stages of pollution prevention and control; and (4) "Global Trade and the Environment", about the positive and negative impacts of global trade.

Learning Activities:

Lectures, discussion

Case study environmental problem: eutrophication

Learning Activities:

The case study eutrophication consists of laboratory activities.

Group dynamics

Group Dynamics will provide some tools and techniques for having in-depth debates.

Lecturing Material

• Lecture notes, laboratory notes

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

Assessment
- **75%: Written Exam (closed book)**
- **25%: Assignment**

UNESCO-IHE - MSc Module 2011/2013-ES01: Introduction to Environmental Science											
Nr	**Course/Topic**	**lecture**	**exercise**	**workshop**	**labwork**	**fieldwork**	**fieldtrip**	**selfstudy**	**contact hours**	**studyload hours**	**Lecturer(s)**
	Water, environment, sustainability	20	20						20	40	
	Environmental quality	10				4			10	30	van Bruggen
	Sustainable development	6							6	18	Irvine
	Methodology	10							10	20	Irvine, Schwartz
	Lab eutrophication				12				12	12	Rousseau, Kelderman, De Ruyter
	Group dynamics			2					2	2	Sturrock
	Exam								2	2	
	Total	**46**	**20**	**2**	**12**	**4**			**62**	**124**	

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

Academic Year: 2011-2013
Specialization: Core Programme
Module Coordinator: H.J. Lubberding, PhD, MSc

Module Sheet

Module Name Environmental change, causes and effects	Module Code ES02	Credits 5

Target Group	Prerequisites
Programme target group	Programme prerequisites

Learning Objectives

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

- identify and describe the basic hydrological, chemical and toxicological processes in relation to the environment;
- identify and describe the basic socio-economic processes in relation to the environment;
- explain basic environmental concepts, such as ecological footprint.

Topics and Learning Activities

Hydrology

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

Learning Activities:

Lectures

(Environmental) chemistry

(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:

The lectures in chemistry are supported by laboratory sessions.
Cunningham & Cunningham, Environmental Science, a global concern. 11th ed.

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

Environmental toxicology

In environmental toxicology the toxic effects of pollution on human health are made visible.
Cunningham & Cunningham, Environmental Science, a global concern. 11th ed.

Lecturing Material

- Lecture notes Hydrology
- Lecture + laboratory notes (Environmental) chemistry
- Lecture notes Environmental economics
- Lecture notes Toxicology

Assessment

- **100%: Written Exam (closed book)**

UNESCO-IHE - MSc Module 2011/2013-ES02: Environmental change, causes and effects											
Nr	**Course/Topic**	**lecture**	**exercise**	**workshop**	**labwork**	**fieldwork**	**fieldtrip**	**selfstudy**	**contact hours**	**studyload hours**	**Lecturer(s)**
	Hydrology	10								30	Wenninger, Nonner
	Chemistry	12			12				24	48	Slokar, Kelderman
	Economy, natural resources	11	8						19	41	Bijlsma
	Toxicology	4	4						8	16	van Gestel
	Fieldtrip						6	6	6	6	
	Exam									3	
	Total	**37**	**12**		**12**		**6**		**57**	**144**	

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

Academic Year: **2011-2013**
Specialization: **Core Programme**
Module Coordinator: **H.J. Lubberding, PhD, MSc**

Module Sheet

Module Name Fundamental processes in Environmental Science	Module Code ES03	Credits 5

Target Group	Prerequisites
Programme target group	Programme prerequisites

Learning Objectives

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

- Identify and describe the basic natural processes in relation to the environment;
- Understand and explain the relations between physical, chemical and biological processes in the environment;
- Explain basic environmental concepts, such as feedback mechanisms, ecosystem dynamics, carrying capacity, nutrient cycling;
- Analyse dynamic interactions between human development and environmental changes.

Topics and Learning Activities

Microbiology

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

Learning Activities:

Lecture and laboratory sessions

Ecology

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

Soil science

Basic aspects of soil science are discussed

Learning Activities:

Lectures + excursion

Demography

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

Learning Activities:

Demography consists of lectures and group discussions, culminating in an assignment (analysis and presentation of gathered information).

Public health

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

Learning Activities:

Public health consists of lectures and group discussions, culminating in an assignment (analysis and presentation of gathered information).

Lecturing Material

- Lecture notes
- Laboratory notes
- Cunningham & Cunningham, Environmental Science, a global concern. 11th ed.
-

Assessment

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

UNESCO-IHE - MSc Module 2011/2013-ES03: Fundamental processes in Environmental Science											
Nr	**Course/Topic**	**lecture**	**exercise**	**workshop**	**labwork**	**fieldwork**	**fieldtrip**	**selfstudy**	**contact hours**	**studyload hours**	**Lecturer(s)**
	Microbiology	12			12				24	44	Lubberding
	Ecology	10							10	30	De Ruyter
	Soil science	6					4	4	6	22	Kauffman
	Demography	8	4						12	20	Visser
	Public health	8	8						16	24	Hamel
	Exam									3	
	Total	**44**	**12**		**12**		**4**		**68**	**143**	

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

Academic Year: 2011-2013
Specialization: Core Programme
Module Coordinator: J.J.A. van Bruggen, PhD, MSc

Module Sheet

Module Name Analytical Tools in Environmental Science	Module Code ES04	Credits 5
Target Group Programme target group	**Prerequisites** Programme prerequisites	

Learning Objectives

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

- process scientific data in a statistically sound way by applying basic statistics;
- apply basic environmental tools, such as GIS and modelling.

Topics and Learning Activities

Data analysis and statistics

Data processing and presentation using standard software packages; statistical analysis and hypothesis testing.
Learning Activities:
Lectures and exercises

Environmental modelling

Development of models of lakes, streams, algal growth, eutrophication and organic pollution will be discussed. Equilibria, stability and feedback in model systems are discussed.
Learning Activities:
Lectures, selfstudy, computer exercises

GIS

GIS is approached as a practical tool for entering, storing, analysing and visualising data with geographical attributes.
Learning Activities:
Lectures, selfstudy, computer exercises

Lecturing Material

- Lecture notes

Assessment

- **50%: Written Exam (closed book)**
- **30%: Assignment**
- **20%: Assignment**

UNESCO-IHE - MSc Module 2011/2013-ES04: Analytical Tools in Environmental Science											
Nr	**Course/Topic**	**lecture**	**exercise**	**workshop**	**labwork**	**fieldwork**	**fieldtrip**	**selfstudy**	**contact hours**	**studyload hours**	**Lecturer(s)**
1	**Data analysis, Statistics**	18	16						34	54	Singer / Karwautz
2	**GIS**	2	20						22	22	?
3	**Environmental Modelling**	18							18	54	van Dam / Hooijmans
4	**Presentation skills**		8						8	8	Sturrock
5	**Retrieving of literature**	2	2						4	4	Darvis
6	**Exam**									2	
	Total	**40**	**46**						**86**	**144**	

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

Academic Year: 2011-2013
Specialization: Core Programme
Module Coordinator: J.J.A. van Bruggen, PhD, MSc

Module Sheet

Module Name Lake Ecology	Module Code ES05L	Credits 5

Target Group	Prerequisites
Programme target group	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**

UNESCO-IHE - MSc Module 2011/2013-ES05L: Lake Ecology											
Nr	**Course/Topic**	**lecture**	**exercise**	**workshop**	**labwork**	**fieldwork**	**fieldtrip**	**selfstudy**	**contact hours**	**studyload hours**	**Lecturer(s)**
1	**Physico -chemical and Limnochemistry**	7							7	21	Kitaka / Omondi
2	**Fieldwork to Lake Naivasha**				14	4			13	21	Omondi / Kitaka / Pauline / Outa
3	**Phytoplankton ecology**	4			6				7	18	Omondi / Kotut / Pauline
4	**Zooplankton ecology**	3			45				5	13	Mengistou / Yasindi / Reuben / Mungai
5	**Lake production**	3			5		2	2	7	16	Omondi / Pauline / Yasindi
6	**Climate change, Anthropogenic Impacts on lakes**	4			20		8	8	25	43	Omondi / Kitaka / Yasindi / Pauline / Outa Kipkemboi /
7	**Examination**								3	3	
	Total	**21**			**90**	**4**	**10**		**67**	**135**	

Merimba

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

Academic Year: 2011-2013
Specialization: Core Programme
Module Coordinator: A.A. van Dam, PhD, MSc

Module Sheet

Module Name Environmental Systems Analysis	Module Code ES05TM	Credits 5

Target Group	Prerequisites
Participants in the Environmental Science MSc-programme at UNESCO-IHE	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

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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)**
- **40%: Assignment**
- **20%: Presentation**

UNESCO-IHE - MSc Module 2011/2013-ES05TM: Environmental Systems Analysis											
Nr	**Course/Topic**	**lecture**	**exercise**	**workshop**	**labwork**	**fieldwork**	**fieldtrip**	**selfstudy**	**contact hours**	**studyload hours**	**Lecturer(s)**
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	8	Hes
7	**Stakeholder analysis**		4						4	8	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	4	4	Kelderman/van Dam
11	**Exercise ESA**		8						8	16	van Dam
12	**Group work (case study)**	4		42					12	48	van Dam/Hes/Gettel
	Total	**22**	**16**	**42**			**4**	**8**	**50**	**138**	

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

Academic Year: **2011-2013**
Specialization: **Water quality management**
Module Coordinator: **P. Kelderman, PhD, MSc**

Module Sheet

Module Name Water Quality Assessment	Module Code ES05W	Credits 5

Target Group	Prerequisites
Young and mid-career professionals (scientists, consultants, decision makers) with a background in Water management or Environmental science.	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 the different water pollutant groups and their risks and fates
- Describe and apply the different criteria for succesful monitoring of lakes, rivers and groundwaters
- Describe and apply a number of water quality models as a tool in Water management
- Design sustainable water quality monitoring programmes for river and lake basins

Topics and Learning Activities

Water quality and 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.
Case study: design of a sustainable water quality monitoring programme in an African river basin.
Practical field&lab work: sampling, preservation, field analyses; Quality control in the laboratory.
Groundwater monitoring: principles and case studies. Data reporting and presentation.
Learning Activities:
Lectures, exercises, groupwork, lab and fieldwork

Data analysis and presentation

Use of statistics in water quality monitoring. Statistical tests: t-test, confidence intervals, Q-test etc.; regression analysis.
Applications: minimum sampling frequency; significant differences between two data sets, etc.
Introduction to more advanced techniques such as ANOVA and FACTOR analysis.
Hands-on computer exercises
Learning Activities:
Lectures, exercises

Aquatic Ecotoxicology

Ecoxicological tests. Environmental characteristics of pollutants. Sources, transport and fate of micropollutants. Modelling and monitoring. Risk assessment and evaluation.
Learning Activities:
Lectures

Water quality modelling

Mathematical concepts; water and mass balances. Types and construction of water quality models. Simple In/Out lake models: set up and exact solutions. Finite-difference approximations. BOD-DO modelling in a river system. Modelling of micropollutants. Example: the Rhine and Danube alarm models.Good modelling practice.
Hands-on exercises with mass balances, and with the SOBEK model, for BOD-DO modelling.
Learning Activities:
Lectures, exercises

Fieldtrips

(Liable to changes, e.g. due to constraints at the side of the hosts): half-whole day visits are planned to water quality monitoring and modelling 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.
• P. Kelderman, H.A.M. de Kruijf and M. Mul (2011). Handout - Case study Water Quality Monitoring Network for the Inkomati River Basin in Mozambique. Febr. 2011.

• P. Kelderman (2010) - Handout data handling and presentation. Febr. 2010.
• H.A.M de Kruijf (2011). Handout Aquatic Ecotoxicology. Febr. 2011.
• E.M. Meyers (2011). Handout Water quality modelling. Febr 2011.
• E.M. Meyers and R.S. Penailillo Burgos (2009). Water quality modelling: Introduction SOBEK Exercise.
• Compiled powerpoint slides on Groundwater monitoring; powerpoint slides on all above topics; additional materials: relevant info, fieldtrips materials, etc.

Assessment

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

UNESCO-IHE - MSc Module 2011/2013-ES05W: Water Quality Assessment											
Nr	**Course/Topic**	**lecture**	**exercise**	**workshop**	**labwork**	**fieldwork**	**fieldtrip**	**selfstudy**	**contact hours**	**studyload hours**	**Lecturer(s)**
1	**Water Quality and Monitoring**										
1.1.	Introduction on Water quality	2							2	2	Kelderman
1.2.	Water quality monitoring and assessment	8			5	5			18	39	Kelderman, Kruis
1.3.	Groundwater monitoring	4							4	4	Foppen
1.4.	Case study water quality monitoring			3					3	12	De Kruijf, Kelderman
2	**Data analysis and presentation**	6	4						10	18	Kelderman, van Dam
3	**Aquatic Ecotoxicology**										De Kruijf
3.1.	Principles of Aquatic Ecotoxicology	4							4	8	
3.2.	Environmental fate of micropollutants	4							4	4	
3.3.	Monitoring, modelling and risk assessment	4							4	12	
4	**Water quality modelling**	10	4						14	26	Meijers
5	**Fieldtrips**						12	12	12	12	
6.	Examination								3	3	
	Total	**42**	**8**	**3**	**5**	**5**	**12**	**6**	**78**	**140**	

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

Academic Year: 2011-2013
Specialization: Core Programme
Module Coordinator: J.J.A. van Bruggen, PhD, MSc

Module Sheet

Module Name Stream and River Ecology	Module Code ES06L	Credits 5

Target Group	Prerequisites
Programme target group	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.
- â€¢ Distinguish the main stream ecosystem boundaries at watershed, ecosystem and stream segment scales;
- â€¢ Characterize the bio-geophysical components of watersheds;
- â€¢ Relate and conceptualize the inter connectedness between riverine and other ecosystems;
- â€¢ Analyse, identify and discriminate the various riparian vegetation in terms of their importance as sources of energy to streams;
- â€¢ Assess water quality using physical and biological characteristics of the stream;
  â€¢ Evaluate the importance of socio-economics in sustainable management of watersheds (riverine ecosystems);
  â€¢ 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**

UNESCO-IHE - MSc Module 2011/2013-ES06L: Stream and River Ecology											
Nr	**Course/Topic**	**lecture**	**exercise**	**workshop**	**labwork**	**fieldwork**	**fieldtrip**	**selfstudy**	**contact hours**	**studyload hours**	**Lecturer(s)**
	Introduction	1							1	1	
	Watershed ecology	1				3			4	7	
	Geomorphology and landuse	2							2	2	
	Stream characterization, morphometry, ecosystems theories and concepts	3				3			6	12	
	Riparian vegetation	3				3			6	12	
	Organic matter, biofilms and nutrient dynamics	4				1			5	13	
	Stream hydrology & Physico-chemical parameters				2	3			5	5	
	Invertebrate ecology	3			3	6			12	18	
	Stream integrity	3							3	9	
	Floodplain, regulated rivers in tropics	2							2	6	
	Socioeconomics, water and gender	2							2	6	
	Group work/lab		1		6	6			13	13	
	Excursion (Naromoru River)						7	7	7	7	
	Sample processing, Data analysis, presentations, and discussion				23				23	23	
	Exam									2	
	Total	**24**	**1**		**34**	**25**	**7**		**91**	**136**	

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

Academic Year: 2011-2013
Specialization: Core Programme
Module Coordinator: Prof. J. Leentvaar, PhD, MSc

Module Sheet

Module Name Environmental Policy Making	Module Code ES06M	Credits 5

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

Learning Objectives

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

Topics and Learning Activities

Lecturing Material

Assessment

UNESCO-IHE - MSc Module 2011/2013-ES06M: Environmental Policy Making											
Nr	Course/Topic	lecture	exercise	workshop	labwork	fieldwork	fieldtrip	selfstudy	contact hours	studyload hours	Lecturer(s)
	Total										

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

Academic Year: **2011-2013**
Specialization: **Core Programme**
Module Coordinator: **H.J. Lubberding, PhD, MSc**

Module Sheet

Module Name Environmental Engineering	Module Code ES06T	Credits 5

Target Group	Prerequisites
Programme target group	Programme prerequisites

Learning Objectives

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

- Describe the basic chemical and biological processes and their engineering in water and wastewater treatment;
- Evaluate different approaches to wastewater treatment and select the best option for local conditions.

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

Learning Activities:

Lectures, workshop, fieldtrip

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 given in wastewater treatment

Learning Activities:

Lectures, laboratory.

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

Learning Activities:

Lectures, workshop

Lecturing Material

- Lecture notes Water treatment
- Lecture notes + laboratory notes wastewater treatment
- Lecture notes EPT

Assessment

- **50%: Written Exam (closed book)**
- **25%: Assignment**
- **25%: Assignment**

UNESCO-IHE - MSc Module 2011/2013-ES06T: Environmental Engineering											
Nr	**Course/Topic**	**lecture**	**exercise**	**workshop**	**labwork**	**fieldwork**	**fieldtrip**	**selfstudy**	**contact hours**	**studyload hours**	**Lecturer(s)**
	Water treatment	8	20						8	28	Buiteman
	Wastewater treatment, natural processes	16			16				16	64	van Bruggen, van der Steen, Lubberding, Kelderman
	Environmental process technology	16	20						16	36	Bijlsma
	Fieldtrip						4	4		4	
	Exam									2	
	Total	**40**	**40**		**16**		**4**		**40**	**134**	

Kelderman

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

Academic Year: 2011-2013
Specialization: Core Programme
Module Coordinator: J.J.A. van Bruggen, PhD, MSc

Module Sheet

Module Name Wetlands for Water Quality	Module Code ES06W	Credits 5

Target Group	Prerequisites
Programme target group	Programme prerequisites

Learning Objectives

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

- â€¢ assess the value of wetlands and explain the use of natural and constructed wetlands for the treatment of wastewater;
- â€¢ describe the concept of wastewater treatment by wetlands;
- â€¢ 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**

UNESCO-IHE - MSc Module 2011/2013-ES06W: Wetlands for Water Quality											
Nr	**Course/Topic**	**lecture**	**exercise**	**workshop**	**labwork**	**fieldwork**	**fieldtrip**	**selfstudy**	**contact hours**	**studyload hours**	**Lecturer(s)**
1	**Â Introduction into the module**	1							1	1	
2	**Wetlands**	8	2						10	24	
3	**Wastewater treatment aspects**	6							6	18	
4	**Natural wetlands for water treatment**	4							4	4	
5	**Constructed wetlands**	14							16	58	
6	**Integrated production systems**	6							6	18	
7	**Fieldtrip**						16	16	16	16	
8	**Exam**									3	
	Total	**39**	**2**				**16**	**16**	**59**	**142**	

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

Academic Year: 2011-2013
Specialization: Core Programme
Module Coordinator: J.J.A. van Bruggen, PhD, MSc

Module Sheet

Module Name East-African Wetlands for Water Quality	Module Code ES07L	Credits 5

Target Group	Prerequisites
Programme target group	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**

UNESCO-IHE - MSc Module 2011/2013-ES07L: East-African Wetlands for Water Quality											
Nr	**Course/Topic**	**lecture**	**exercise**	**workshop**	**labwork**	**fieldwork**	**fieldtrip**	**selfstudy**	**contact hours**	**studyload hours**	**Lecturer(s)**
1	**Introduction**			1							
2	**Natural wetlands**	8	3	1	8	6			1	1	Kipkemboi
3	**Wastewater and treatment options**	3		1		8			25	39	Kipkemboi
4	**Natural wetlands for WWT**	5		2					12	18	Muchiri/Abira
5	**Constructed wetlands for WWT**	8	13	6	8	8			7	17	Kansiime/Ngirigacha
	Examination								43	63	Kimwaga/Abira
	Total	**24**	**16**	**11**	**16**	**22**			**88**	**138**	

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME
Academic Year: 2011-2013
Specialization: Core Programme
Module Coordinator: H. Clouting, PhD

Module Sheet

Module Name Environmental Planning and Implementation	Module Code ES07MW	Credits 5

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

Learning Objectives

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

Topics and Learning Activities

Lecturing Material

Assessment

UNESCO-IHE - MSc Module 2011/2013-ES07MW: Environmental Planning and Implementation											
Nr	Course/Topic	lecture	exercise	workshop	labwork	fieldwork	fieldtrip	selfstudy	contact hours	studyload hours	Lecturer(s)
	Total										

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

Academic Year: **2011-2013**
Specialization: **Environmental Science and Technology**
Module Coordinator: **P. Kelderman, PhD, MSc**

Module Sheet

Module Name Environmental Monitoring and Modelling	Module Code ES07T	Credits 5

Target Group	Prerequisites
Young and mid-career professionals (scientists, consultants, decision makers) with a background in Water management or Environmental science	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 and 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 and modelling

Basics of Hydrogeology. Main groundwater pollutants. Groundwater monitoring: objectives, surveys, design and installation; monitoring in the EU-WFD. Groundwater modelling: concepts and mathematical background; MODFLOW and PMWIN.

Learning Activities:

Lectures, exercises

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 modesl: 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

Some mathematical concepts; water and mass balances. Types and construction of water quality models. Finite-difference approximations. BOD-DO modelling in a river system. Modelling of micropollutants. Example: the Rhine and Danube alarm models.Good modelling practice. Hands-on exercises with mass balances, and with the SOBEK model, for BOD-DO modelling.

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 changes, e.g. due to constraints at the side of the hosts): A whole-day visit is planned to water and air quality monitoring/modelling 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 (2010). Air quality monitoring and modelling. UIHE lecture notes LN63/10/1
• E.M. Meyers (2011). Handout Water quality modelling. Febr 2011.
• E.M. Meyers and R.S. Penailillo Burgos (2009). Water quality modelling: Introduction SOBEK Exercise.UIHE lecture notes LN415/9/1
• Compiled powerpoint slides on Groundwater monitoring; EIA; powerpoint slides on all above topics; additional materials: relevant info, fieldtrips materials, etc.

Assessment

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

UNESCO-IHE - MSc Module 2011/2013-ES07T: Environmental Monitoring and Modelling											
Nr	**Course/Topic**	**lecture**	**exercise**	**workshop**	**labwork**	**fieldwork**	**fieldtrip**	**selfstudy**	**contact hours**	**studyload hours**	**Lecturer(s)**
1	**Water quality and monitoring**										
1.1.	Introduction on Environmental monitoring	2							2	2	McClain
1.2.	Water quality monitoring	8			5	5			18	35	Kelderman, Kruis
2	**Groundwater monitoring and modelling**	6							6	18	Foppen
3	**Air quality monitoring and modelling**	6	6						12	24	Keuken
4	**Water quality modelling**	6	4						10	22	Meijers
5	**Environmental Impact assessment**	6	4						10	18	Vis, Clouting
6	**Laboratory Environmental monitoring**				8				8	8	Kruis
7	**Fieldtrip**						8	8	8	8	
	Exam									3	
	Total	**34**	**14**		**13**	**5**	**8**	**2**	**74**	**138**	

WATER MANAGEMENT

MASTERS PROGRAMME

Academic Year: 2011-2013
Specialization: Core Programme
Module Coordinator: Prof. P. van der Zaag, PhD, MSc /J.Kemerink, MSc

Module Sheet

Module Name Water and Environmental Law	Module Code ES08MW	Credits 5

Target Group	Prerequisites
Young and mid-career professionals and middle level decision-makers dealing with water management.	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..

- to describe and understand the fundamentals of national and international water and environmental law and legislation.
- to perceive and apply accepted and desired legal and institutional arrangements for applying principles of Integrated Water Resources and Environmental Management.
- to describe and apply legal instruments for the application of IWRM with the emphasis on functional decentralization, river basin organizations, planning and decision-making through water allocation criteria, systems of water rights, water (effluent) permit systems etc.
- to perceive and appraise concepts of customary water rights.
- to get insight in to processes of international water allocation.
- to explain the concept of multi-level governance and the relationship between national and international legal and policy systems.

  to be able to persuasively argue a case for international water conflict resolution.

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- Legal Arrangements for Water Governance, 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

- **100%: Written Exam (closed book)**

UNESCO-IHE - MSc Module 2011/2013-ES08MW: Water and Environmental Law											
Nr	**Course/Topic**	**lecture**	**exercise**	**workshop**	**labwork**	**fieldwork**	**fieldtrip**	**selfstudy**	**contact hours**	**studyload hours**	**Lecturer(s)**
1	**Water Law**								32	76	
1.1	Introduction to Water Law	2									Jaspers
1.2	Conflict Resolution			4							Gupta
1.3	International Environmental Law	12									Gupta
1.4	Contract Management	4		2							Jaspers
1.5	Regulations Water Quality Management	4									Hendry
1.6	EU Water Framework Directive			4							Hendry
2	**Legal Arrangements**								24	64	
2.1	River Basin Organization (Intro)	4		4							Jaspers
2.2	Legal Instruments	4									Jaspers
2.3	Water Rights and Allocation	4									Jaspers
2.4	International Water Sharing	4									van der Zaag
2.5	Customary Water Rights	4		6							van der Zaag
3	**Role Play International Rivers**								6	6	Jaspers
4	**Electives* (may not be offered every year)**										
4.1	Workshop Sector Reform			6							Jaspers
4.2	Case Studies			4							To be announced
5	**Fieldtrip**										Jaspers
	Exam									3	
	Total	**42**		**30**					**62**	**149**	

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

Academic Year: 2011-2013
Specialization: Core Programme
Module Coordinator: J.J.A. van Bruggen, PhD, MSc

Module Sheet

Module Name Fisheries and Aquaculture	Module Code ES08L	Credits 5

Target Group	Prerequisites
Programme target group	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. â€“ 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**

UNESCO-IHE - MSc Module 2011/2013-ES08L: Fisheries and Aquaculture											
Nr	**Course/Topic**	**lecture**	**exercise**	**workshop**	**labwork**	**fieldwork**	**fieldtrip**	**selfstudy**	**contact hours**	**studyload hours**	**Lecturer(s)**
1.0	Fisheries and management	4		2	6				4	20	Njiru, Manyala, Jembe
1.1	Socio-economics: fish & people	2		2					2	8	Muhia
2.1	Fish ecology	4		2	6				4	20	Njiru , Manyala
2.2	Fish diseases and parasites	2		2	8				2	16	Mbuthia, Wathuta
2.3	Aquaculture & ecology of fishponds	12		4	21				12	61	Liti, Munguti, Lokoruka, Charo
2.4	Data analysis			12					6	12	All resource persons
3.0	Excursion						13	13	6	13	Munguti, Kitaka
4.0	Exam								3	3	
	Total	**24**		**24**	**41**		**13**		**39**	**153**	

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

Academic Year: 2011-2013
Specialization: Core Programme
Module Coordinator: M.A. Siebel, PhD, MSc, PE

Module Sheet

Module Name	Module Code	Credits
Cleaner Production & the Water Cycle	ES08T	5

Target Group
The module 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;
- suggest methods for the management of wastewater nutrients using a three steps approach;
- make basic calculations related to life cycle analysis.

Topics and Learning Activities

Introduction to the field of Cleaner Production

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, Eco Design and Material Flow Analysis

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

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 studie, group exercises, calculation examples

Urban Water Management

What is Urban Water Management (UWM)? What is the role of CP in UWS? What practical benefit can be achieved when CP is applied to UWM?

Learning Activities:

Lectures, movie, discussion, learning by practice, designing your own urban water saving system

Industrial Water Management

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

Nutrient Management

What is nutrient management? How does it relate to water management? What are the benefits of managing nutrients in the water phase? What are consequences?

Learning Activities:
Lectures, movie, calculation exercises, group discussion, application exercises to own conditions

Lecturing Material

- Lecture notes in electronic form
- Reading materials published by others
- Case studies
- Movies
- Group work, group discussions, role play

Assessment

- **60%: Written Exam (open book)**
- **35%: Assignment**
- **5%: Presentation**

UNESCO-IHE - MSc Module 2011/2013-ES08T: Cleaner Production & the Water Cycle											
Nr	**Course/Topic**	**lecture**	**exercise**	**workshop**	**labwork**	**fieldwork**	**fieldtrip**	**selfstudy**	**contact hours**	**studyload hours**	**Lecturer(s)**
	Introduction to the field of Cleaner Production	4		8			8	8		30	
	Life Cycle Analysis	1	4	3						20	
	Environmental Management Systems	2		4						20	
	Urban Water Management	2		4						22	
	Industrial Water Management	4	4	6						30	
	Nutrient Management	2	2	2						20	
	Total	**15**	**10**	**27**			**8**	**10**		**142**	

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

Academic Year: 2011-2013
Specialization: Core Programme
Module Coordinator: J.J.A. van Bruggen, PhD, MSc

Module Sheet

Module Name Microbial Communities & Ecosystem Functioning	Module Code ES09L	Credits 5

Target Group	Prerequisites
Programme target group	Programme prerequisites

Learning Objectives

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

- determine the abundance, biomass, and growth rates of bacteria and protozoans
- analyse and describe microbial communities and their functional and phylogenetic composition in freshwater ecosystems
- evaluate the role of microbial communities mitigating ecosystem functions and ecosystem services

Topics and Learning Activities

Diversity and ecology of microorganisms

classification according to function (functional groups) and phylogeny (taxonomy); diversity and phylogeny of Bacteria, Archaea and Protists the functional group concept; introduction to viruses.

Learning Activities:
lectures, laboratory work, field-work, sample processing and data analysis

Organismic key interactions I: predator prey interactions & food selection

principles of predator prey interactions and food selection; functional response; numerical response; growth and mortality; viral/phage-induced mortality.

Learning Activities:
lectures, laboratory work, field-work, sample processing and data analysis

Organismic key interactions II: microbial food webs

microbial food webs in rivers, lakes and groundwater ecosystems; biofilm formation and biofilms as microenvironments; specifics of groundwater communities; DOC / POC transfer; physiological and metabolic key functions (photosynthesis & respiration, oxic/anoxic metabolic pathways, phagotrophy, osmotrophy & mixotrophy);

Learning Activities:
lectures, laboratory work, field-work, sample processing and data analysis

Microbial interactions with abiotic environment and ecosystem services

biogeochemical key processes; interaction of abiotic factors and microbial communities; ecosystem productivity; biodegradation - microbially mediated reactions; ecosystem services steered by microbial communities (N & C re/cycling, water purification, detoxification).

Learning Activities:
lectures, laboratory work, field-work, sample processing and data analysis

Lecturing Material

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

Assessment
- **60%: Written Exam (closed book)**
- **30%: Presentation**
- **10%: Lab Report**

UNESCO-IHE - MSc Module 2011/2013-ES09L: Microbial Communities & Ecosystem Functioning											
Nr	**Course/Topic**	**lecture**	**exercise**	**workshop**	**labwork**	**fieldwork**	**fieldtrip**	**selfstudy**	**contact hours**	**studyload hours**	**Lecturer(s)**
1.1	Phylogeny and classification of bacteria, protists and archea	3							3	9	Hahn
1.2	Diversity of microorganisms: functional groups	2							2	5	Simek
1.3	Ecology of microorganisms	2							2	6	Hahn, Simek
2.1	Food selection and predator-prey interactions	2							2	6	Boenigk, Simek
2.2	Growth and mortality of bacteria and protists	1							1	3	Hahn
3.1	Microbial food webs in rivers, lakes and groundwater	4							4	12	Simek, Hahn, Singer Griebler
3.2	Physiological and metabolic key functions of bacteria & protists	3								9	Hahn, Griebler
3.3	Biofilm formation and biofilms as microenvironment	1							1	3	Battin
4.1	Biogeochemical key processes	2							2	7	Griebler, Singer
4.2	Functioning of groundwater ecosystems	2							2	5	Griebler
4.3	Biodegradation - microbially mediated reactions	1							1	4	Griebler
4.4	Field sampling and laboratory-work: abundance, growth of		36				10	10	32	46	Hahn, Simek, Besemer, Singer, Hoedl, Griebler
4.5	Data analysis & preparation of presentations		20						9	20	Hahn, Simek, Besemer, Singer, Hoedl, Griebler
5.0	Presentation of results obtained from laboratory work		5						5	5	Hahn, Simek, Besemer, Singer, Hoedl, Griebler,
6	**Written exam**		3							3	
	Total	**23**	**64**				**10**		**66**	**143**	
											Singer, Hoedl, Griebler,
											Winkler

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

Academic Year: 2011-2013
Specialization: Core Programme
Module Coordinator: J.J.A. van Bruggen, PhD, MSc

Module Sheet

Module Name	Module Code	Credits
Foreign Fieldtrip & Fieldwork ES	ES09TMW	5

Target Group	Prerequisites
Programme target group	Programme prerequisites

Learning Objectives

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

- The international fieldtrip is an exposure tour to interesting sites in Europe and is aimed to become familiar with environment-related organisations and companies in Western Europe.
- After completion of the fieldwork participants will be able to conduct experimental fieldwork.

Topics and Learning Activities

International Fieldtrip

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

Learning Activities:
Excursions

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

- Practical and field guides

Assessment

- **100%: Integrated in modules**

UNESCO-IHE - MSc Module 2011/2013-ES09TMW: Foreign Fieldtrip & Fieldwork ES											
Nr	**Course/Topic**	**lecture**	**exercise**	**workshop**	**labwork**	**fieldwork**	**fieldtrip**	**selfstudy**	**contact hours**	**studyload hours**	**Lecturer(s)**
1.0	International fieldtrip						88	88	88	88	van Bruggen
2	**Fieldwork**										
2.1	Introduction	1					4	4	5	5	deRuyter, Venneker
2.2	Land use and soil quality	6				4	4	4	26		Hartemink
2.3	Chemical & biological water quality					4			4	4	deRuyter, Kruis
2.4	GIS					4			4	4	vandeVeer
2.5	Biomonitoring	1							1	3	Rousseau
3.0	Data analysis		8						2	8	deRuyter, vandeVeer
	Total	**8**	**8**			**12**	**96**		**130**	**112**	

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

Academic Year: 2011-2013
Specialization: Core Programme
Module Coordinator: J.J.A. van Bruggen, PhD, MSc

Module Sheet

Module Name Conservation and Restoration Ecology	Module Code ES10L	Credits 5

Target Group	Prerequisites
Programme target group	Programme prerequisites

Learning Objectives

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

- assess the ecological integrity and biodiversity of freshwater ecosystems
- integrate conservation aspects into management programmes for freshwater ecosystems
- apply knowledge to evaluate, monitor and provide advice for the design of ecological restoration programmes of freshwater ecosystems

Topics and Learning Activities

Assessing biodiversity of freshwater ecosystems

evolutionary biology; methods for assessing biodiversity; genetic diversity; species/population dispersal, migration, demographics and effective population size; endangered and alien species.

Learning Activities:

lectures, field-work, laboratory/computer sessions and excursions. Case-studies are visited, evaluated by small student groups and conclusions/recommendations are discussed in a workshop set-up.

Conservation ecology

field surveys; sampling design and statistics; GIS; remote sensing; landscape ecology approach.

Learning Activities:

lectures, field-work, laboratory/computer sessions and excursions. Case-studies are visited, evaluated by small student groups and conclusions/recommendations are discussed in a workshop set-up.

Ecological survey methods

ecological integrity of rivers and floodplains; biodiversity and conservation genetics; principles in conservation ecology; habitat, species and population management; case examples of conservation programmes.

Learning Activities:

lectures, field-work, laboratory/computer sessions and excursions. Case-studies are visited, evaluated by small student groups and conclusions/recommendations are discussed in a workshop set-up.

Restoration ecology

fundamentals in restoration ecology; restoring ecological functioning of freshwater ecosystems; human dimension in restoration programmes; bio-indicators; monitoring concepts; adaptive management approach (participatory collaboration to integrate research, policy and practice) and multicriteria approach; workshop on evaluation, design and monitoring of restoration programmes.

Learning Activities:

lectures, field-work, laboratory/computer sessions and excursions. Case-studies are visited, evaluated by small student groups and conclusions/recommendations are discussed in a workshop set-up.

Lecturing Material

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

Assessment
- **60%: Written Exam (closed book)**
- **30%: Presentation**
- **10%: Lab Report**

UNESCO-IHE - MSc Module 2011/2013-ES10L: Conservation and Restoration Ecology											
Nr	**Course/Topic**	**lecture**	**exercise**	**workshop**	**labwork**	**fieldwork**	**fieldtrip**	**selfstudy**	**contact hours**	**studyload hours**	**Lecturer(s)**
1.1	River and wetland management: the ecological perspective	1							1	4	Hein
1.2	Biodiversity & conservation genetics	2							2	6	Weisse, Weiss
1.3	Methods for assessing biodiversity of freshwater ecosystems	2							2	6	Schmutz, Schinegger, Pinter, Pokorny
2.1	Conservation ecology and ecological functioning of freshwater ecosystems	2							2	6	Hein, Muhar, Schmutz, Welti Schmutz, Schinegger, Pinter,
2.2	Habitat, species and population management	1							1	3	Schmutz, Muhar
3.1	Remote sensing	3							2	9	Hesslerova
3.2	Landscape ecology	2							2	6	Pokorny
3.3	Ecological field surveys (excursions & field visits)		12				40	40	30	52	Hein, Reckendorfer, Zitek, Muhar, Schinegger, Pinter,
4.1	Restoration ecology	2							2	6	Hein, Schmutz
4.2	Human dimension in restoration programmes	2							2	6	Sendzimir, Pokorny
4.3	Adaptive management approach (participatory collaboration to integrate research, policy and practice	2							2	6	Sendzimir Muhar, Schinegger, Pinter,
4.4	Group work on case studies		20						8	20	Hein, Welti, Sendzimir, Pokorny, Hesslerova
4.5	Workshop on case studies and evaluation, design and monitoring of restoration programmes		7						7	7	Hein, Welti, Pokorny, Winkler Hein, Welti, Sendzimir,
5	**Written exam**									3	
	Total	**19**	**39**				**40**		**63**	**140**	

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

Academic Year: 2011-2013
Specialization: Core Programme
Module Coordinator: G.M. Gettel, PhD, MSc

Module Sheet

Module Name Aquatic Ecosystems: Processes and Applications	Module Code ES10TW	Credits 5

Target Group	Prerequisites
Programme target group (Participants in the programmes at IHE) and qualified short course participants	Programme prerequisites (BSc in a topic appropriate to UNESCO-IHE programme) and basic knowledge of 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**
- **10%: Assignment**
- **10%: Presentation**

UNESCO-IHE - MSc Module 2011/2013-ES10TW: Aquatic Ecosystems: Processes and Applications											
Nr	**Course/Topic**	**lecture**	**exercise**	**workshop**	**labwork**	**fieldwork**	**fieldtrip**	**selfstudy**	**contact hours**	**studyload hours**	**Lecturer(s)**
	Lecture	14							14	42	Gettel, de Ruyter, Irvine
	Laboratory Work				12				12	12	Gettel, de Ruyter, Irvine
	In-class activity (data analysis, group work)			44					44	64	Gettel, de Ruyter, Irvine
	Paper Writing and Review		11						11	22	Gettel, de Ruyter, Irvine
	Total	**14**	**11**	**44**	**12**			**11**	**81**	**140**	

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

Academic Year: 2011-2013
Specialization: Core Programme
Module Coordinator: J.J.A. van Bruggen, PhD, MSc

Module Sheet

Module Name	Module Code	Credits
Groupwork: IWRM & Management of Aquatic Ecosystems	ES11L	5

Target Group	Prerequisites
Programme target group	Programme prerequisites

Learning Objectives

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

- describe and assess main natural and anthropogenic interactions at the watershed scale;
- evaluate quantitative and qualitative aspects of water needs/availability, with regard to different water use patterns;
- integrate knowledge of preceding modules for identifying sustainable water resource management strategies;
- synthesize information and making decisions within team-work for the development of water management solutions.

Topics and Learning Activities

Fundamentals on water resource availability and constraints

hydrology (surface- and ground waters); hygiene, chemical water quality; need and consumption pattern for various usage; water distribution and collection issues; linking human demands and environmental protection.

Learning Activities:

lectures, role-plays, discussion rounds and group work on case studies

Water resource management strategies, policies and tools

IWRM approaches; WHO â€œwater safety plan - managing drinking-water quality from catchment to consumerâ€•; EU-WFD; technical solutions in drinking water and waste-water technology; intersectoral collaboration; environmental impacts; participatory tools; socio-economic aspects; assessment of water demands.

Learning Activities:

lectures, role-plays, discussion rounds and group work on case studies

Case studies

case studies are analyzed in group-work, including Eastern African case studies; applied and integrated are techniques and knowledge obtained in current and preceding course modules; students develop sustainable water resource management options for the case study scenarios.

Learning Activities:

Groupwork, lectures

Lecturing Material

Assessment

- **100%: ..**

UNESCO-IHE - MSc Module 2011/2013-ES11L: Groupwork: IWRM & Management of Aquatic Ecosystems											
Nr	**Course/Topic**	**lecture**	**exercise**	**workshop**	**labwork**	**fieldwork**	**fieldtrip**	**selfstudy**	**contact hours**	**studyload hours**	**Lecturer(s)**
1.1	Water resource availability	2							2	4	
1.2	Natural and anthropogenic interactions at watershed scale	2							2	4	
1.3	Ecological sustainability and environmental impacts	2							2	4	
2	**Rural and urban water cycle**	2							2	4	
3.1	Water resource management frameworks	2							2	4	
3.2	WRM approaches and tools	2							2	4	
3.3	Technical solutions and tools	2							2	4	
3.4	Participatory approaches	1							1	2	
3.5	African case studies	1							1	2	
3.6	Group work on case studies and report writing		54			18			18	99	
3.7	Presentation/discussion and evaluation of case studies		12						12	12	
	Total	**16**	**66**			**18**			**46**	**143**	

WATER MANAGEMENT

MASTERS PROGRAMME

Academic Year: 2011-2013
Specialization: Water Resources Management & Water Quality Management
Module Coordinator: M. Mul and M. Hamdard

Module Sheet

Module Name	Module Code	Credits
Watershed & River Basin Management	ES11MW	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 bachelorâ€™s degree or equivalent) and preferably experience in watershed and / or river basin management. Good command of English.

Learning Objectives

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

- describe and assess the main natural and anthropogenic interactions at a watershed scale; and how they can be aggregated to rive basin scale
- describe the role of water in sustaining different land uses, including ecosystems
- familiar with the watershed planning and management approaches, specifically in terms of soil and water management
- explain temporal and spatial scales issues in hydrology
- familiar with economic instruments used for water management at watershed and river basin scales

Topics and Learning Activities

Introduction to river basin and watershed management
Soil and water management in agriculture
Water and ecosystems
Watershed economics
Watershed planning and management approaches
Role play- ShaRiva

Lecturing Material

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

Assessment

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

UNESCO-IHE - MSc Module 2011/2013-ES11MW: Watershed & River Basin Management											
Nr	**Course/Topic**	**lecture**	**exercise**	**workshop**	**labwork**	**fieldwork**	**fieldtrip**	**selfstudy**	**contact hours**	**studyload hours**	**Lecturer(s)**
1	**Introduction**	2							2	4	Mul/Hamdard
2	**Biophysical processes and anthropogenic interactions**								12	40	
2.1	Soil & Water Management	4									Van der Zaag
2.2	Watershed hydrology and human interventions	4									Mul
2.3	Environmental flow allocation	4									Mc. Clain
3	**Watershed and river basin planning**								12	36	
3.1	Planning processes	2									Douven
3.2	Technical tools to support planning processes	2									Mohamed
3.3	Participatory tools to support planning processes	2									Kemerink
3.4	Watershed economics	6									Hellegers (WUR)
4	**Watershed and river basin management**								16	48	
4.1	Institutional aspects in watershed and river basin management	4									Leentvaar
4.2	Agreements and Frameworks for transboundary cooperation	4									Leentvaar
4.3	Transboundary Interdependencies	4									Hamdard
4.4	Implementation of national policies at watershed scale	4									Mul
5	**Role-Play SHA-RIVA**		20						20	20	Mul & Hamdard
6	**Field trip**						4	4	4	4	Mul & Hamdard
	Exam									3	
	Total	**42**	**20**				**4**		**66**	**155**	

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

Academic Year: 2011-2013
Specialization: Core Programme
Module Coordinator: M.A. Siebel, PhD, MSc, PE

Module Sheet

Module Name Solid Waste Management	Module Code ES11T	Credits 5

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

Learning Objectives

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

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

Topics and Learning Activities

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

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

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

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

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

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

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

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

Lecturing Material

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

Assessment

- **60%: Written Exam (open book)**
- **35%: Assignment**
- **5%: Presentation**

UNESCO-IHE - MSc Module 2011/2013-ES11T: Solid Waste Management											
Nr	**Course/Topic**	**lecture**	**exercise**	**workshop**	**labwork**	**fieldwork**	**fieldtrip**	**selfstudy**	**contact hours**	**studyload hours**	**Lecturer(s)**
1	**Introduction & stakeholders**	2								8	Maarten Siebel
1.1	Stakeholder analysis										
1.2	SWM calculations										
2	**Generation, collection & separation**	2	4	4			2	2	4	24	
2.1	Waste generation, collection, source separation of waste										
3	**Biological processes, composting, digestion**	3	4	6						21	
3.1	Biological processes: (an-)aerobic degradation, reaction equations										
4	**Landfill technology, CDM, MBT and Incineration**	3	4	4			4	4		25	
4.1	Design, siting, filling, env\\\'l impacts, post care of landfills, CDM										
4.2	Mechanical Biological Treatment										
4.3	Incineration										
5	**Transboundary issues in SWM**	2	4	4						18	
5.1	Basel Convention, transboundary waste transport,										
5.2	Waste processing and storage										
5.3	Env\\\'l, social and economic impacts										
6	**Prevention and recycling: methods, policies, tools**	2	4						4	16	
7	**SWM planning and financing and examination**		10	8					8	28	
	Total	**14**	**30**	**26**			**6**	**2**	**16**	**140**	

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

Academic Year: 2011-2013
Specialization: Core Programme
Module Coordinator: Dr E. de Ruyter van Steveninck

Module Sheet

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

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

Learning Objectives

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

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

Topics and Learning Activities

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

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
Learning Activities:
Lectures

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

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

Assessment

UNESCO-IHE - MSc Module 2011/2013-ES11X: IWRM as a tool for adaptation to climate change											
Nr	Course/Topic	lecture	exercise	workshop	labwork	fieldwork	fieldtrip	selfstudy	contact hours	studyload hours	Lecturer(s)
	Total										

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

Academic Year: 2011-2013
Specialization: Core Programme
Module Coordinator: J.J.A. van Bruggen, PhD, MSc

Module Sheet

Module Name	Module Code	Credits
Water Quality Monitoring & Bio-indicators	ES12L	5

Target Group	Prerequisites
Programme target group	Programme prerequisites

Learning Objectives

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

- â€¢ identify potential sources of water pollution and their effects on ecosystems and humans;
- â€¢ appraise the ecological status of rivers and to assess health risks for humans;
- â€¢ evaluate water quality criteria concerning the suitability for different water use;
- â€¢ develop water-quality monitoring programmes based on international guidelines (drinking water, irrigation, bathing, EU-WFD, WHO etc.).

Topics and Learning Activities

Sources and effects of water pollution

overview about sources of water pollution and the effect on both humans and the structure and functioning of freshwater ecosystems.

Learning Activities:

lecture

Applying methods and techniques for assessing water quality

â€¢ physico-chemical (O2, T, pH, Cond, Alkalinity, Hardness and nutrients; NH4-N, NO2-N, NO3-N, Ntot, Ptot, PO4-P, SS, Anions, SO4- and Cl- , DOC, SAC-254 and BOD-5),

â€¢ microbiological (HPC, TC, FC, Enterococci, E. coli, pour plate and membrane filtration technique dilution series, demonstration of colilert detection system, preparation of pure cultures MPN-technique, Clostridium perfringens, API, PCR and gel-electrophoresis, microbial saprobity, HPC, Bacteria abundance & bacteria production, 3H leucine incorporation, epiflourescence microscopy),

â€¢ biological methods (macrozoobenthos: sampling design, relative purity/pollution index, saprobity index, abundance, species richness/diversity/eveness, similarity index, presence/absence data).

Learning Activities:

lectures, laboratory/field-work, excursions and sample processing.

International water-quality guidelines and design/implementation of water quality monitoring programmes

European Water Framework Directive (EU-WFD); WHO standards/recommendations; Austrian water law; drinking water; bathing water; water for irrigation; standards in laboratory safety & quality assurance; water quality assessment and monitoring in the tropics.

Learning Activities:

lectures

Lecturing Material

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

Assessment

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

UNESCO-IHE - MSc Module 2011/2013-ES12L: Water Quality Monitoring & Bio-indicators											
Nr	**Course/Topic**	**lecture**	**exercise**	**workshop**	**labwork**	**fieldwork**	**fieldtrip**	**selfstudy**	**contact hours**	**studyload hours**	**Lecturer(s)**
1.1	Catchment of River Schwechat	1	2						2	2	Ruzicka, Kreuzinger
1.2	Pollution microbiology and risk assessment	1							1	3	Farnleiter
2.1	Ecological integrity and bio-indicators	2							2	4	Moog
2.2	Sampling River Schwechat	1				8			6	8	Moog et al.
2.3	Chemical parameters/methods	2	20						20	26	Kreuzinger, Ruzicka, Yillia
2.4	Macroinvertebrates as indicators of water quality	2							2	6	Moog, Graf, Stubauer
2.5	Methods for assessing ecological integrity and water quality	2	20						18	21	Moog et al
2.6	Methods in pollution microbiology	2	20						23	26	Farnleitner et al
2.7	Microbial indicators in the tropics	2							2	6	Mushi
3.1	Water quality standards, guidelines	3							3	9	Farnleitner, Kavka, Kreuzinger
3.2	European Water Framework Directive	3							3	9	Graf, Ruzicka, Farnleitner
4.1	Data analysis, interpretation and development of water quality monitoring programme		18						5	15	Moog et al Kreuzinger
4.2	Final presentations/ discussion		5						5	5	
5	**Exam**									3	
	Total	**21**	**85**			**8**			**92**	**143**	

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME
Academic Year: 2011-2013
Specialization: Core Programme
Module Coordinator: H.J. Lubberding, PhD, MSc

Module Sheet

Module Name Groupwork ES	Module Code ES12TMW	Credits 5

Target Group	Prerequisites
Programme target group	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**

UNESCO-IHE - MSc Module 2011/2013-ES12TMW: Groupwork ES												
Nr	**Course/Topic**	**lecture**	**exercise**	**workshop**	**labwork**	**fieldwork**	**fieldtrip**	**selfstudy**	**contact hours**	**studyload hours**	**Lecturer(s)**
	Introduction	2							2	2	
	Discussions								10	10	
	Presentations		16						16	16	
	Selfstudy, report writing		160							160	
	Total	**2**	**176**						**28**	**188**	

MUNICIPAL WATER AND INFRASTRUCTURE

MASTERS PROGRAMME

Academic Year: 2011-2013
Specialization: Core Programme
Module Coordinator: H.J. Lubberding, PhD, MSc / E.A. de Jong, MA..

Module Sheet

Module Name Research methodology for ES	Module Code ES13	Credits 3

Target Group	Prerequisites
All participants of the programme	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:
â€¢ Water and Climate
â€¢ Environmental Flows
â€¢ Conflict Resolution
â€¢ Flood resilient planning and building

Learning Activities:

Lectures, workshops, assignments

Lecturing Material

- To be announced

Assessment

- **100%: Assignment**

UNESCO-IHE - MSc Module 2011/2013-ES13: Research methodology for ES											
Nr	**Course/Topic**	**lecture**	**exercise**	**workshop**	**labwork**	**fieldwork**	**fieldtrip**	**selfstudy**	**contact hours**	**studyload hours**	**Lecturer(s)**
	Research Methodology									28	Various
	Summer Course									56	Various
	Total									**84**	

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

Academic Year: 2011-2013
Specialization: Core Programme
Module Coordinator: H.J. Lubberding, PhD, MSc / E.A. de Jong, MA

Module Sheet

Module Name MSc research proposal Development for ES	Module Code ES14	Credits 7

Target Group	Prerequisites
All students of the Environmental Science programme	The successful completion of at least 8 of the first 11 modules

Learning Objectives

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

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

UNESCO-IHE - MSc Module 2011/2013-ES14: MSc research proposal Development for ES											
Nr	**Course/Topic**	**lecture**	**exercise**	**workshop**	**labwork**	**fieldwork**	**fieldtrip**	**selfstudy**	**contact hours**	**studyload hours**	**Lecturer(s)**
	MSc research proposal drafting										
	MSC research proposal presentation										Mentor and professor
	Total							**1**			

ENVIRONMENTAL SCIENCE

MASTERS PROGRAMME

Academic Year: 2011-2013
Specialization: Core Programme
Module Coordinator: H.J. Lubberding, PhD, MSc

Module Sheet

Module Name MSc research	Module Code ES15	Credits 36

Target Group	Prerequisites
Programme target group	Programme prerequisites

Learning Objectives

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

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

Topics and Learning Activities

Lecturing Material

Assessment

- **100%: Assignment**

UNESCO-IHE - MSc Module 2011/2013-ES15: MSc research											
Nr	**Course/Topic**	**lecture**	**exercise**	**workshop**	**labwork**	**fieldwork**	**fieldtrip**	**selfstudy**	**contact hours**	**studyload hours**	**Lecturer(s)**
	Â MSc Research									1008	de Jong
	Total									**1008**	