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DOUBLE DEGREE MSc PROGRAMME ON

Agricultural Water Management for Arid and Semi-arid Climates (DD-AWMASC)

Handbook 2011 – 2013

HARAMAYA UNIVERISTY
We Build the Basis for Development

UNESCO-IHE
Institute for Water Education

Haramaya University
Institute of Technology
School of Natural Resource and Environmental Engineering
Dire Dawa, Oromia Regional State, Ethiopia
January 2011

and

UNESCO-IHE, Delft, the Netherlands
Water Science and Engineering
Hydraulic Engineering - Land and Water Development
Delft, the Netherlands
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FOREWORD

In the coming decades population growth will take place, in particular, in the emerging and the least developed countries. This implies that these countries will be confronted with the need to increase their food supply by a larger production in their own territory, may be in combination with increased imports. From the point of view of food production there is a common feeling that in the coming decades 80-90% of the required increase will have to be realised on existing cultivated land and 10-20% on newly reclaimed land. From the point of view of sustainable rural development, socio economic and environmental aspects play in particular, crucial roles. With respect to this it is also of importance that the least developed countries in Africa show the largest population growth and have generally developed their available land and water resources to a limited extent.

Another important aspect with respect to agriculture is the increased vulnerability to flooding. This is partly caused by the impacts of climate change, and the increase of value per unit area, due to the requirement of higher yields per ha. Therefore in such areas agricultural water management has to be integrated with flood management and flood protection provisions.

In light of the above the Haramaya University, Oromia Regional National State, Ethiopia and UNESCO-IHE, Delft, the Netherlands, have developed a two years Double Degree Master programme on *Agricultural Water Management for Arid and Semi-arid Climates (DD-AWMASC)*. The target group of the DD-AWMASC programme are young professionals from: Ministries/ Departments/ Authorities in the fields of Water Resources, Agriculture, Environment, Public Works, Planning, River Basin Organisations, Water Users Associations, Universities and Research Institutes that have programmes in the sector, Civil Society Organisations (CSO) and Consultants.

This proposal presents the details of the programme. The programme will start at Haramaya University in September 2011 where they will follow certain courses until early February 2012. In February the students will travel to UNESCO-IHE where they will stay until mid October to follow the modules 5 till 14. In addition to lectures, exercises, laboratory work, fieldwork and fieldtrips these modules include a two weeks European Fieldtrip and a groupwork. In October 2012 the students return to Haramaya University to do data collection and fieldwork for the MSc thesis research. Early Febraury 2013 they return to UNESCO-IHE to complete the MSc thesis research and to defend their thesis in June 2013.

In addition attention is paid to the aspects of quality control, academic facilities, profile of participants, admission criteria, and possibilities of funding.

The annexes give background information on Haramaya University and UNESCO-IHE, the announcement of the programme, the bar chart of implementation and the schedule and content of semesters and modules in Ethiopia and in the Netherlands.

Haramaya, Oromia, Ethiopia

Delft, the Netherlands

January, 2011

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Agricultural water management for arid and semi-arid climates (DD-AWMASC)

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1. GENERAL INFORMATION

1.1 Haramaya University

1.1.1 Introduction

History

Haramaya University was established 1952 as the Imperial Ethiopian College of Agriculture and Mechanical Arts with 14 students through the US and Ethiopia Technical agreement. The contact of establishing and running the college was awarded to Oklahama State University (OSU). The contract ended in 1968 and College's entire budget and management rest on Ethiopian government. Graduate (MSc) program in agriculture was launched in 1978/79 mainly for own staff development. The University was upgraded to Alemaya University of Agriculture on May 27, 1985. It started to be a comprehensive University in 1996 by opening Health Sciences and Education Faculties. It was re-established and renamed as Alemaya University in 1998. It was renamed as Haramaya in 2006. At the moment Haramaya University offers training in wide range of disciplines and at different levels. There are 11 colleges, 50 Departments, 12 PhD, 46 MSc and 80 degree programs (Table 1.1). The student population has risen to over 30000 in all programs, 953 fulltime teaching staff and over 1100 permanent administrative staff are on duty.

Table I.1. Colleges and study programmes

No.	Colleges	Study programmes
1	Agriculture and Environmental Sciences	Plant Sciences, Animal Sciences, Agricultural Economics, Rural Development and Agricultural Extension
2	Education and Behavioural Sciences	Pedagogy, Educational Planning and mgmt, Special Needs
3	Health Sciences	Public Health, Nursing, psychiatry, midwifery
4	Business and Economics	Accounting, Management, Economics, Cooperatives
5	Law	Law
6	Veterinary Medicine	Veterinary Medicine
7	Technology	Civil and Urban Engineering, Electrical and Computer Engineering, Water Resources and Environmental Engineering, Soil and Water Engineering, Agricultural and Biological Engineering.
8	Computing and Informatics	Computer Sciences, Information Technology, Information Systems, Software Engineering, and Statistics
9	Medical Sciences	Medicine, Pharmacy, Laboratory Technology
10	Natural and Computation Sciences	Biology, Chemistry, physics, Mathematics, Sport Sciences
11	Social Sciences and Humanities	Sociology, Geography, History, Gender and Development, Foreign Languages, Afan Ormo

Vision

Haramaya University (HU) strives to be among the leading universities recognized nationally and internationally for excellence in teaching, research and outreach service.

Mission

The mission of Haramaya University is to produce competent graduates in wide spectrum of academic disciplines through quality education; undertake academically rigorous and socially meaningful cutting-edge research; disseminate knowledge and technologies; and provide consultancy services to the public.

The Campuses

Haramaya University runs three campuses: Haramaya campus (main); Harar Campus where the College of Health Sciences, the College of Medical Sciences, and Continuing Education Programs are hosted; and Chiro Campus where the College of Agro-technology and Forestry is recently established.

The Education Programme

Apart from its undergraduate programme, Haramaya holds professional education programmes as presented in Table I.1.

Students, Lecturers, and Alumni

The total number of students enrolled in different programs of the University is 29,896. This is disaggregated as 3,823 regular, 2,334 evening, 7,953 Summer In Service, and 5,786. The profile of the Regular Program Student Population looks like as shown in Table 1.2.

Table 1.2. Total number of fully residential students

EDUCATIONAL LEVEL	MALE	FEMALE	TOTAL
Bachelor	9,994	2,768	12,762
Masters	858	84	942
Doctorate	114	8	122
Total	10,966	2,860	13,826

The national staff profile of the University is shown in Table 1.3. In addition to this, close to 70 senior expatriate staff members (mainly from India) are on duty employed on a two year contract.

The Graduate Programme

The University currently runs 46 Masters and 11 PhD programs. Much of the Programs as shown in Table 1.4 are in Agriculture as the University has a long and strong agricultural heritage.

The objective of Master's Degree at the graduate programme of Haramaya University is to strengthen knowledge of basic education of graduates in order to be independent in doing research, solving problems and being able to be cooperative with other disciplines efficiently and integrated. Master's Degree programme is also aimed to be the fist step to take Doctoral Degree programme as far as the requirements are fulfilled.

Table 1.3. Local staff profile of Haramaya University

College	On Duty	On study Abroad	On study in Country	Female total	On Duty	On study Abroad	On study in Country	Female Total	Grand Total
Agriculture and Environmental Sciences	15	5	3	23	134	23	19	176	199
Business and Economics	2	1	3	6	50	1	28	79	85
Computer and Informatics	1		1	2	37	1	4	42	44
Education and Behavioral Sciences				0	14		2	16	16
Health Sciences	10		1	11	59	3	19	81	92
Medical Sciences	2		4	6	48	3	19	70	76
Natural and Computation Sciences	5		1	6	78	10	12	100	106
Law	1	1	1	3	20	2	3	25	28
Social Science and Humanities	6		1	7	56	2	8	66	73
Vetrinary Medicine	1			1	24	7	1	32	33
Technology	3			3	67	8	11	86	89
Total	46	7	15	68	587	60	126	773	**841**

Administration

- Administration Board (Minsters, State Minsters appointed by the Government in consultation with the University, Senior Scientists, Entrepreneurs, One Local Government Representative)
- President
- Senate (Academic Council)
- Management Council
- Administrative Council
- Vice Presidents (Academics, Research, Administration and Student Affairs, Institutional Development and Community Engagement)
- Deans/Directors
- School or Department Heads

Table I.4. Specialization, Master, and PhD programmes

Colleges	*Specialization*
	Masters Degree Programmes(46)
Technology	Irrigation Engineering; Soil and Water Conservation Engineering
Agriculture	Soils, Agronomy, Protection, Plant Breeding, Horticulture, Animal Breeding, Animal Production, etc
Natural Sciences	Biology, Chemistry, Physics, Mathematics, Sport Sciences
Social Sciences	Sociology, English, Geography, History, Afan Oromo
Education	Educational Planning Management, Vocational Education Leadership and Management
Health Sciences	Emergency Surgery, Public Health, Epidemiology, Reproductive Health

DOCTORAL DEGREE PROGRAMMES (11)
Soil and Water Engineering
Soil Sciences
Plant Breeding
Plant protection
Agronomy
Agric. Economics
Animal Nutrition
Tropical Animal Production
Horticulture
Animal Genetics and Breeding
Public Health

Post Graduate Programme

The School of Gradate Studies, organised with a college status, is tasked in coordinating all post graduate programs in consultation with respective departments and program Owners (for interdisciplinary Programs). It sets and follows programs opening procedures, administers student enrolments, organises open defences for both MSc and PhD programs, approves graduation, etc. The School works through the Council for Graduate Studies which is one the Standing Committee of the Senate.

1.2 The UNESCO-IHE Institute for Water Education

1.2.1 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 13 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.

1.2.2 MSc Degree Programmes

The backbone of the Institute is 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.

1.2.3 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.

1.2.4 Organisation

The Rectorate of the Institute consists of a Director and a Deputy Director. The organisation is structured into nine departments, which are further subdivided into various sections. Within the organisation structure, five academic departments are distinguished:

- Water Engineering;

- Environmental Resources;
- Municipal Infrastructure;
- Management and Institutions;
- Hydro informatics and Knowledge Management.

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. Two supporting departments provide administrative support. The computer service group, the laboratory and the library provide technical and material support to education and research.

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.

1.2.5 Board of Governors

Members Governing Board UNESCO-IHE

- Chair: M. (Margreeth) de Boer
  Former Minister of Housing, Spatial Planning and the Environment of the Netherlands and former member of the Lower House of the national parliament; responsible for Energy, City policy and chair of the Commission for Foreign Affairs
- W. A. (Walid) Abderrahman
  King Fahd University of Petroleum & Minerals, Centre for Environment and Water – Research Institute
- Prof. F. J. (Fransisco Javier) Aparicio Mijares
  Instituto Mexicano de Tecnologia de Agua
- J.L. (Jean-Louis) Blanc
  Senior Vice-President Water Resources of Suez
- L.M.R.A. (Lidia) Brito, PhD
  Former Minister of Higher Education, Research and Technology of Mozambique
- J.G. (Jan) Janssens
  Programme Manager, BNWP Water Supply and Sanitation, Energy and Water Department, The World Bank
- L.H. (Bert) Keijts, MSc
  Director General RWS, Netherlands Ministry of Transport, Public Works and Water Management, and member of the Board of the IHE Foundation
- Dr. K.H. (Kyol-Ho) Kwak
  President of K-Water and alumnus of IHE
- R.A. (Bob) Pietrowsky
  US Army Corps of Engineers, Institute for Water Research
- P. (Paul) Reiter
  International Water Association
- Prof. I.A. (Igor) Shiklomanov
  Director of State Hydrological Institute (SHI)
- (IAN) White
  Australian National University, Centre for Resource and Environmental Studies, Institute for Advanced Studies
- On behalf of UNESCO: Prof. A. Szollosi-Nagy

1.2.6 Honorary Fellows

- Prof. L.J. Mostertman, MSc
- Prof. J.C.I. Dooge
- M.F. Strong, PhD

- Prof. J.W.M. la Rivière, PhD, MSc
- Prof. W.A. Segeren, MSc
- Prof. M.A. Abu Zeid, PhD
- W.J. Cosgrove

1.2.7 Services and Facilities for Students

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.

Student and Educational Affairs

The Student and Educational Affairs office (SEA) provides non-academic support to students. The SEA office takes care of student applications and student registration. The new students are also assisted with formalities such as residence permits, insurance, bank accounts, and fellowship issues. Housing arrangements in one of the hostels are being made immediately upon arrival. Other activities include planning and scheduling of education activities, providing supplemental English language classes and delivery of lecture materials. Throughout their study period, students can contact the SEA staff during office hours for information or questions related to health, religion or other issues related to the student's well being. Personal matters will be dealt with strictly confidential.

During the entire academic year, SEA organizes a number of social and cultural programmes including the weekly movie night, social evenings, the English language theatre night 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 May to November, the Institute arranges accommodation in Delft for such sports as indoor soccer, volleyball, basketball and badminton. The SEA office organizes sports events and tournaments, in which the teams can compete internally, but also against players from other international institutes.

Student Association Board

The Student Association Board (SAB) is composed of class 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 SAB closely co-operates with the Student and Educational Affairs office in organizing social and sporting events. The board also publishes its own magazine *Reflections*, in which the rich variety of contributions are entirely derived from, and produced by, the student community.

Computers in the Hostels

The living units and rooms in the hostels can be equipped with a personal computer and standard Windows software. The service includes free access to the Internet. The e-mail server at the Institute can be accessed from the hostel computers at any time of the day using the web-based e-mail system.

For specific applications during the thesis study, it may be possible to use specialist software packages on the hostel computers. This is 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.

General Facilities in the Building

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.

UNESCO-IHE Library

The Institute has its own dedicated library, containing some 23,000 bound volumes and subscriptions to some 150 technical and scientific journals. The library also maintains a rapidly growing database of electronic text materials and includes a collection of lecture notes and MSc theses. Dictionaries, atlases and other reference works are available for use in the reading room. Otherwise, most books can be borrowed for a period of two weeks.

Students can carry out computer searches for available literature in the library catalogue (Bibis), search on-line for references at other libraries in the Netherlands, or consult bibliographic databases. Through inter-library loan, copies of books and journal articles can be obtained from other academic libraries within a few working days. Access to the Bibis catalogue and on-line access to a number of scientific and technical journals are provided via the Intranet library pages.

The library can be contacted via the e-mail address library@unesco-ihe.org. This address can also be used to make reservations for books that are currently borrowed. When placing a reservation, students should not forget to specify their student registration number.

Delft University of Technology Library

The Library of the Delft University of Technology contains a large scientific and technical literature collection, as well as numerous works of general interest. Students can register for the services of the DUT library using their UNESCO-IHE student card.

Computer Network Facilities

UNESCO-IHE has a high-speed local network connecting a large number of Windows-based computers. Through the network all computers have direct access to the Intranet and the Internet. A variety of peripherals such as printers, scanners, etc. are also accessible through the network. The educational computer facilities are housed in several lecture/study rooms, which are available to students during the opening hours of the UNESCO-IHE building. All students receive a personal network account and e-mail address at the beginning of the academic year.

Besides the standard office software packages, there is a wide range of software available for application and analysis in the specialist fields of the Institute. Programming and software development tools are also available.

A computer assistant is present in the help desk area during the opening hours of the building. The computer helpdesk is located on the first floor near the computer classrooms. The computer section also maintains the Intranet service, which can be consulted for the latest news, question about computer and software facilities, and other issues such as opening hours, telephone numbers, e-mail addresses, etc.

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 programmes, including waste water management using aquatic macrophytes and wetlands, the adsorption and/or (an-)aerobic degradation of micro pollutants, 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.

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. The lecturers in the form of handouts can provide additional material. 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.

1.2.8 Framework of the programmes

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).

Academic Regulations

The *Education and Examination Regulations* 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 *Examination Rules and Guidelines* 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 MSc degree.

Structure of the Programmes

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

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

Within each programme, the following generic components are distinguished:

- Ten taught modules of 5 credit points each;
- Fieldtrips and groupwork, total 10 credit points;
- A special/research topics module of 4 credit points;
- The thesis proposal preparation of 6 credit points;
- The thesis research and examination, 36 credit points.

Curriculum Information

All components of the programme curriculum are described by a syllabus (summary) providing the following information:

- Name and code of the subject;
- Learning objectives;
- Pre-requisite knowledge or skills;
- Study load hours and credit points;
- Lecture, exercise and examination contact hours;
- Nature and weights of the examination parts;
- Responsible lecturers/examiners;
- A concise description of the contents and working methods;
- Required and recommended literature, and other materials.

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.

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.

Working Methods

The programmes are conducted using a combination of lectures, exercises, assignments and examinations.
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;
- Conduct a research or other study.

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.

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 Table I.5.

Planning and Scheduling

Lectures and exercises taking place inside the Institute are, in principle, scheduled into ‘periods’ of two hours each.

Table I.5. (Minimum) study load determination criteria for the various education activities

Activity	Study load / contact time
Lecture, with assignment	≥ 3 hours / hour
Seminar or capita selecta, without assignment	1 hour / hour
Fieldtrip or fieldwork	≥ 8 hours / day
Workshop or exercise, without assignment	1 hour / hour
Workshop or exercise, with assignment	≥ 2 hours / hour
Laboratory session without report	1 hour / hour
Laboratory session with small report	≥ 1.5 hours / hour
Laboratory session with large report	≥ 2 hours / hour
Examination-, individual discussion-, presentation- time	1 hour / hour

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;
- Statements on examination results and study progress.

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.

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.

1.2.9 Organisation of the Programmes

The Academic Board

The master programmes at UNESCO-IHE are carried out on behalf of the Institute under the supervision of the Academic Board. The membership of the Academic Board consists of the Rectorate and the professors of the Institute. The Director of the Institute chairs the Academic Board.

Programme Committee

A programme committee is installed for each master programme. The responsibility of the programme committee is:

- To define the level and the learning objectives of the programme;
- To develop the composition and content of the programme;
- To implement the programme;
- To monitor, evaluate and maintain the quality of the programme;
- To advise on the Education and Examination Regulations.

The programme committee is composed of staff members from the academic cores providing input to the programme and is chaired by a professor. A professor is responsible for one or more concerned specialisations in the programme. The other members, at least one per specialisation, function as programme coordinator or specialisation mentors.

Programme Coordinator

The programme coordinator is in charge of the daily activities of the programme, in particular:
- To supervise the planning and scheduling;
- To supervise the examinations and assessments:
- To conduct the programme evaluations;
- To monitor the progress of the students.

These activities are carried out in close co-operation with the module coordinators, the lecturers and examiners, and the staff of the educational affairs section. The programme coordinator is involved with students on a regular, almost daily basis, and is usually the first point of contact for students with questions or seeking advice in issues directly related to the programme.

Lecturers and Examiners

The lecturers are the persons who are responsible for the execution of the programme. They also serve as examiner for their subject, unless suitable arrangements have been made for substitution. The criteria for assessment of the examinations are laid down in the *Examination Rules and Guidelines*.

The thesis examinations are carried out and assessed by an examination committee, which is composed out of at least three members:
- A professor of the relevant academic core, acting as chair person of the committee;
- A knowledgeable academic staff member, who is normally the mentor responsible for the guidance of the candidate during the thesis research work. In case of the proposed DD-AWMASC this will be a representative of Haramaya;
- An external examiner, who is an independent expert in the field related to the study.

An external examiner with the position of university professor may be invited to chair the thesis examination committee.

Examination Board

The examination board is installed for all programmes. The examination board is responsible for the organisation and assessment of the examinations and appointment of the examiners for the programmes. The examination board meets each month to evaluate study progress of the students and to establish which students have completed the programme and should therefore receive the Master of Science degree.

The evaluation criteria for the examination board are laid down in the *Examination Rules and Guidelines*. The examination board consists of four members of the academic staff, one for each programme, and the head of student and educational affairs as administrative secretary.

The Educational Affairs Section

The educational affairs section administers and records the study results of all students and provides administrative support to the committees involved. In collaboration with the programme coordinator the educational affairs section also conducts the actual planning and scheduling of the programme and informs the students about any unforeseen changes.

Study Supervision and Study Advice

Students can, whenever possible, directly contact the lecturer outside the class hours with questions related to the teaching subject. Guest lecturers can often be reached directly via e-mail.

The programme coordinator or specialisation mentor are the direct contact persons for students with questions or problems related to the programme in general, the programme schedule, their study in general, or their study progress. All personal communication with the programme coordinator or the specialisation mentor is treated strictly confidential.

The programme coordinator or specialisation mentor, or in some cases a module coordinator, will usually closely monitor the students. If the students experience particular difficulty with a part of the programme, they can request to hold a class session with the coordinator or mentor in order to discuss the problems.

Students working on their thesis proposal and subsequently their thesis research are assigned a mentor, who is usually one of the academic staff members from the academic core connected to the programme specialisation of the student. The mentor will regularly meet with the student in order to discuss the progress and give advice for continuation. They can usually be contacted at any time when they are available for specific issues related to the study subject.

1.2.10 Examination Procedures

Master Programme in Water Science and Engineering
Approved by the Academic Board of UNESCO-IHE, 31 July 2008

Article 1 Scope of the regulations

1.1 The present regulations apply to the education and examinations within the master programme in Water Science and Engineering referred to hereafter as 'the programme'. The programme is executed by the UNESCO-IHE Institute for Water Education, Delft, the Netherlands, referred to hereafter as 'the Institute'.

Article 2 Definition of terms

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

a. the Act: the Higher Education and Scientific Research Act (*Wet op Hoger Onderwijs en Wetenschappelijk Onderzoek*).
b. component: a self-contained programme unit with specified learning objectives, as stipulated in article 7.3 of the Act.
c. the Rector: the director of the Institute.
d. ECTS: the European Credit Transfer and Accumulation System.
e. examination: an interim study performance assessment for a component of the programme (in the Act: *tentamen*).
f. examination board: the committee as stipulated in article 7.12 of the Act.
g. 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.

h. programme examination: the formal evaluation of the student performance before graduation (in the Act: *examen*).

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

Article 3 Programme and specialisations

The programme is characterised as a post-initial master programme, as stipulated in article 7.3b of the Act. 3.2 The following specialisations are distinguished within the programme:

a. Hydrology and Water Resources;
b. Hydroinformatics;
c. Hydraulic Engineering and River Basin Development;
d. Hydraulic Engineering – Coastal Engineering and Port Development;
e. Hydraulic Engineering – Land and Water Development.

Article 4 Aim of the programme

4.1 The aim of the programme 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 programme is executed on a full-time basis.

Article 6 Study load of the programme

6.1 The study load of the programme is 106 ECTS credit points, with reference to article 7.4a, paragraph 7 of the Act.

Article 7 Programme examination

7.1 Students in the programme are eligible to sit the programme examination leading to the degree of Master of Science in Water Science and Engineering.

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 2 of the Act.

Academic Admission Requirements

Article 8 Admission to the programme

8.1 Academic admission to the programme 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 UNESCO-IHE Master of Engineering degree graduates who hold the certificate of admission to the Master of Science programme, may be registered on the programme during a period of maximum four years, starting from September in the academic year following that of the graduation. The student will receive allowance for the credit points accumulated until the start of the individual study in the former Master of Engineering programme.

8.3 Academic admission to the programme will be granted on the basis of a decision taken to that effect by the Director, after consultation with the appropriate members of staff.

Content of the Programme

Article 9 Composition of the specialisations

9.1 The composition of each programme specialisation is stated 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.

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 10 and paragraph 1 of this article, successful completion of examinations is not required for sitting subsequent examinations.

Article 12 Periods and frequency of examinations

12.1 Students can sit each examination only two times per academic year, except where indicated in subsequent paragraphs. The date and time allocations for the first sitting are announced in the programme schedules. The date and time allocation of the second sitting (the "re-sit") will be set by the programme co-ordinator.

12.2 The opportunity to take part in groupwork, fieldwork and fieldtrips is offered only once per academic year.

12.3 Students are not allowed to re-sit examinations for which a successful result has been obtained.

12.4 The re-examinations take place during the examination periods 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.

12.5 Students will not be allowed to sit further re-examinations if they have failed more than three re-examinations during the first year of the programme.

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

Article 13 The nature of the examinations

13.1 A programme component (module) has an examination session with a maximum duration of 180 minutes. An examination may further include assignments and presentations.

13.2 The nature of the examinations in the programme is indicated in Appendix C, and is described separately in the syllabus for each component of the curriculum.

13.3 The nature of a repeat examination may deviate from that of the first examination for the same programme component.

13.4 The credits for successful completion of fieldwork and fieldtrips are granted on the basis of active participation, unless stated otherwise in the curriculum syllabi.

13.5 Students who suffer 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 syllabi.

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 favorable recommendation from the programme committee.

Results of Examinations

Article 16 Assessment and notice of examination results

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

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

16.3 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.

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

16.5 For each examination, the student receives a written statement of the examination result obtained for the component and, if successful, the associated credit points granted for that component.

Article 17 Period of validity

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

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

17.3 Paragraph 2 of this article does not apply to students admitted to the programme on the grounds of article 8, paragraph 2.

Article 18 Right to inspection of assessments

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

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

Thesis Examinations

Article 19 Periods and frequency of thesis examinations

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

19.2 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.

19.3 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’.

19.4 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.

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

Quality Control

Article 20 Study progress and study advice

20.1 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.

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

Article 21 Evaluation of the programme

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

21.2 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.

21.3 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.

Article 22 Conduct of examinations

22.1 The examinations and assessment of examinations shall be executed in accordance with the *Examination Procedures* and the *Examination Rules and Guidelines*, as approved by the Academic Board.

Final Articles

Article 23 Amendments

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

23.2 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 24 Unforeseen situations

24.1 Situations which are not foreseen by the present regulations, will be decided on by the Academic Board, where necessary after consultation with programme staff.

Article 25 Publication

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

Article 26 Period of application

26.1 These regulations take effect for the academic year 2008 – 2009. Approved by the Academic Board of UNESCO-IHE on 31 July 2008.

General Rules

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

Written examinations have a maximum duration of 3 hours, oral examinations have a maximum duration of 1 hour. Details about the nature of the examinations are found in the *Education and Examination Regulations* and the programme syllabi.

Written Examinations

The invigilators (examination supervisors) ensure proper conduct of the examination and maintain order in the examination room.

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

Students are required to bring the necessary writing and drawing tools. The use of a printed language dictionary without any additional written annotations is allowed.

The use of a pocket calculator and an electronic language dictionary is 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.

Oral Examinations and Presentations

During oral examinations, only one student at a time is examined in the presence of a second lecturer who acts as independent observer.

For certain subjects, an oral presentation by the student can be part of the examination. Such a presentation may be conducted as a class-activity.

Assignment Reports and Individual Discussions

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

The assessment result shall reflect consensus of opinion of the examination committee, considering the following issues: the content and quality of the written thesis; the performance of the candidate in the presentation and defence of the thesis; and the performance of the candidate during the study period with regard to initiative, planning and execution of the study.

Agricultural Water Management for Arid and Semiarid Climates (DD-AWMASC)

2.1 Introduction

In the coming decades population growth will take place, in particular, in the emerging and the least developed countries. This implies that these countries will be confronted with the need to increase their food supply by a larger production in their own territory, may be in combination with increased imports. From the point of view of food production there is a common feeling that in the coming decades 80-90% of the required increase will have to be realised on existing cultivated land and 10-20% on newly reclaimed land. From the point of view of sustainable rural development, socio economic and environmental aspects play in particular, crucial roles. With respect to this it is also of importance that the least developed countries in Africa show the largest population growth and have generally developed their available land and water resources to a limited extent.

Another important aspect with respect to agriculture is the increased vulnerability to flooding. This is partly caused by the impacts of climate change, and the increase of value per unit area, due to the requirement of higher yields per ha. Therefore in such areas agricultural water management has to be integrated with flood management and flood protection provisions.

In light of the above the Haramaya University, Dire Dawa, Oromia, Ethiopia and UNESCO-IHE, Delft, the Netherlands, have developed a two years Double Degree Master programme on Agricultural water management for arid and semi-arid climates (DD-AWMASC)**.**

The target group of the DD-AWMASC programme are young professionals from: Ministries/Departments/Authorities in the fields of Water Resources, Agriculture, Environment, Public Works, Planning, River Basin Organisations, Water Users Associations, Universities and Research Institutes that have programmes in the sector, Civil Society Organisations (CSO) and Consultants.

This proposal presents the details of the programme. The programme will start at Haramaya University in September 2011 where they will follow certain courses in the until Early February 2012. In February the students will travel to UNESCO-IHE where they will stay until mid October to follow the modules 5 till 14. In addition to lectures, exercises, laboratory work, fieldwork and fieldtrips these modules include a two weeks European Fieldtrip and a groupwork. In October 2012 the students return to Haramaya University to do data collection and fieldwork for the MSc thesis research. Early Febraury 2013 they return to UNESCO-IHE to complete the MSc thesis research and to defend their thesis in June 2013.

In addition attention is paid to the aspects of quality control, academic facilities, profile of participants, admission criteria, and possibilities of funding.

The annexes give background information on Haramaya University and UNESCO-IHE, the announcement of the programme, the bar chart of implementation and the schedule and content of semesters and modules in Ethiopia and in the Netherlands.

2.2 Vision, Mission, Goals and Objectives of DD-AWMASC

The proposed Double Degree MSc programme on *Agricultural water management for arid and semi-arid climates (DD-AWMASC)* is based on the considerations as explained underneath.

Vision

To be a competent and excellent post-graduate programme on agricultural water management for arid and semi-arid climates with well-established university-industry-government-social linkages, and state-of-the art facilities for research and development.

Mission

- to assess and assure a programme strengthened under the DD-AWMASC that runs in line with the accreditation requirements for Haramaya in the Ethiopian university system and for UNESCO-IHE in the Dutch university system;
- to establish an academic education programme based on a teaching, exercises and research (desk, field and laboratory) approach;
- to contribute to the development of the local economy through university, local government, industry and social linkages.

Goals

The goals for the DD-AWMASC programme are the following:

- to become an established post-graduate programme on *Agricultural water management for arid and semi-arid climates* in order to fulfil the needs of government institutions and the private sector by education of qualified MSc graduates in this field. These graduates will have to be able to fulfil the needs of the market (government, business, industry);
- to prepare well-established university-business-government linkages for undertaking collaborative research;
- to improve the capacity and performance of laboratory units;
- to implement a professional and vocational graduate programme.

Objectives

The objectives for the DD-AWMASC programme are the following:

- to establish and support the education of a Master programme on *Agricultural water management for arid and semi-arid climates (DD-AWMASC)*;
- to educate qualified MSc graduates with the following characteristics:
  - duration of the study 2 years;
  - able to compete at the global markets;
- to expand the cooperation between Haramaya University, Ethiopia and UNESCO-IHE, the Netherlands and to link both institutions in order to provide a platform for alumni, staff, students, and other researchers to exchange information through seminars, workshop, ICT, etc.;
- to improve the English capability of the participants up to a professional level.

The agricultural water management for arid and semi-arid climates specialist is concerned with the development, adaptation and management of water management and flood protection provisions. This implies:

- ecosystems and water resources aspects of sustainable water management and flood protection;
- development of integrated land use development and management plans;
- development, operation and maintenance of water management and flood protection schemes;
- preparation and implementation of land reclamation and land consolidation programmes.

Water management and flood protection plans and designs can be based on the management capacity and development constraints. Therefore it is of major importance that prior to the preparation of technical designs, concepts are formulated for the system management, based on which the development of regional development and land use plans, the selection of water management methods, flood protection, development of infrastructure, as well as organisation and financing systems can be determined.

2.3 Description of the DD-AWMASC programme

Aim of the Course

The DD-AWMASC programme deals with post-graduate education in agricultural water management

for arid and semi-arid climates within a hydraulic engineering environment. Given the broad field, the programme aims at conveying the knowledge that is required to fulfil the needs and requirements of users and/or users groups of water management schemes within its physical and non-physical environment. The curriculum of the programme concentrates on the development as well as on the management and adaptation of land and water resources in for the different types of land use, with a main focus on the land use for agriculture. The DD-AWMASC programme aims at civil, agricultural and environmental engineers or equivalent, who are already specialised in water management (irrigation, drainage) and/or flood protection. The programme will also be used to transfer knowledge to the counterpart in Ethiopia.

Approach to the Programme

Given the importance of both technical and non-technical aspects in agricultural water management for arid and semi-arid climates, the DD-AWMASC programme aims at presenting the knowledge and skills following an integrated approach through integration of:

- technology and environment, including social, economic, legal and other aspects;
- technology and management capability, stressing the importance of management in system performance and development;
- agricultural, civil engineering and environmental aspects of integrated lowland development and management.

This approach will be introduced gradually, culminating in the groupwork, in which all aspects of water management and/or flood protection, as presented in the technical and non-technical subjects, will be considered in drafting a concept with alternatives for a specific integrated land development and management plan. The groupwork is followed by individual MSc research in the field of agricultural water management for arid and semi-arid climates, which will have to result in a thesis that has to be presented and defended.

Structure of the Programme

The DD-AWMASC programme offers a 24-month double degree of Master of Science and Master of Science (MSc) to be completed at Haramaya in predominantly the first year and at UNESCO-IHE predominantly in the second year. The first MSc programme will start in September 2011 and be completed in June 2013. This programme will be repeated on an annual basis. Preceding to the programmes a selection procedure has been developed, including administrative and academic screening, a TOEFL test. The academic screening will be jointly done by Haramaya and UNESCO-IHE and be based on their standard admission criteria.

Graduates will obtain an MSc-degree in Irrigation Engineering of Haramaya and in Water Science and Engineering, Specialisation Agricultural water management for arid and semi-arid climates of UNESCO-IHE. These degrees are awarded to participants who have successfully completed both course works and the research-based MSc thesis.

Courses will be offered under various topics concerning the related issues of agricultural water management for arid and semi-arid climates. Users' inputs as suggested during the preparations, courses availability in Haramaya and at UNESCO-IHE have been taken into account. In line with the latest developments in the field integrated agricultural water management for arid and semi-arid climates the DD-AWMASC programme is designed to meet the specific issues, where an interaction between design and management is the prerequisite for sustainable development of suitable areas.

The lectures, exercises, field and laboratory work at Haramaya University are organised in Semesters**.** At UNESCO-IHE there will be time blocks of two times three weeks ('Modules') followed by one week examination period (altogether 7 weeks), while a development from generalist to specialist subjects goes together with increased emphasis on individual activities, culminating in the MSc Research thesis at the end of the programme.

Annex I presents the overview of the scheduling of the semesters and modules in time for the academic year 2010-2012. The corresponding topics (subjects) and their study load hours (SLH) within the semesters and modules are presented in the detailed descriptions. All semesters and modules will be evaluated. Evaluation can take place in the form of exercises, tests and/or examinations (written or oral), and are all compulsory. In the semester system at Haramaya, evaluation takes place during the whole period of each semester, in line with the lecture, in the form of the following components: attendances, assignments, quizzes, laboratory and/or fieldwork reports, papers, midterm exams, and final exams. The final mark of each course will be weighted according to such components and to the number of credit hours of the course. At UNESCO-IHE tests and examinations are scheduled at the end of each 'two module time blocks' (6 weeks) on the 7th, examination week. Every module will finally result in one weighted so called 'module mark'. How a subject is evaluated and the weight that the subject has in the 'module mark' is described in the detailed descriptions that will be explained to the participants in the handbook. During the programme a number of fieldtrips will be organised. In addition there will be an extended fieldtrip through a lowland area that will be example area for the groupwork as well. Other fieldtrips are scheduled during the programme and are organised in the frame of different subjects. For all fieldtrips the participants obtain credit points.

Learning Objectives

The DD-AWMASC programme takes full account of the multi-disciplinary character of human activities dealing with land and water. It also recognises the modern role of professionals involved in the manifold tasks from assessment to implementation and to operation and maintenance in identified areas. In order to operate within an increasing complex kaleidoscope of existing specialities, these professionals are expected to take up the added duty of developing a broader understanding of the social, economic and environmental implications of water and environment related activities.

The general objectives of the DD-AWMASC programme concern the presentation of different scenarios (alternatives) for integrated land development and management including irrigation and drainage infrastructure and flood protection for clearly defined service levels. The objectives also concern the evaluation of the various alternatives on technical, social, financial and economic, managerial and environmental aspects and the skills to develop and conduct research in the field of the specialisation.

Upon completion of the DD-AWMASC programme, the graduates should (Table II.2):

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

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

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

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

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

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

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

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

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

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

Table II.2 Relationship between the DD-AWMASC programme components and learning objectives

	a	b	c	D	e	f	g	h	i	J
Ethiopia										
Semester 1	■	▒	▒							■
1. Soil Plant water Relations	■	▒	▒							■
2. Applied Hydrology	■	▒	▒							■
3. Experimental Design and Analysis	■	▒	▒							■
4. Design of Surface Irrigation Systems	■	▒	▒							■
Semester 2	■	▒	▒							■
5. Design of Pressurised Irrigation Systems	■	▒	▒							■
6. Design of Dams and Hydraulic structures	■	▒	▒							■
7. Drainage Engineering and Salinity Control	■	▒	▒							■
8. Watershed Management	■	▒	▒							■
Netherlands										
9. Water Management Systems & Agronomy II		■	■						▒	■
10. Aspects of Irrigation and Drainage Systems		■	■					▒	■	■
11. Service Oriented Management of Irrigation Systems		■	■	■				▒	■	■
12. Conveyance Systems		■	■	■				▒	■	■
13. Fieldwork		■	■	■		■	■	■	■	■
14. Group-work			■	■		■	■	■	■	
15. MSc research proposal					■	■	■	■	■	
Ethiopia										
12. Data Collection and Fieldwork for MSc Research	■									■
Netherlands										
13. Completion of MSc Research, Thesis writing					■	■	■	■	■	

Key: ■-objectives of primary focus; ▒ -objectives of secondary focus.

2.4 Quality control

The quality control systems as prevailing for the programmes in both institutes will be applicable to this programme as well.

Programme Committees
Responsibility for the up to standard implementation of the DD-AWMASC programme rests within UNESCO-IHE with the programme committee of the Water Science and Engineering Programme. The final responsibility rests with the Academic Board of UNESCO-IHE.

Lecturers
One of the concerns of this DD-AWMASC programme as mentioned in the objectives is to improve the English capability of the participants upon completion of this programme to deal with global market. In order to achieve such objective, during this programme, not only the students will be taught by qualified lecturers but also such lectures be conveyed in English.

2.5 Academic facilities

Facilities provided by Haramaya University for the DD-AWMASC programme to support international classes, will include:
- New libraries with international corners;
- Laboratories;
- Experimental stations (at lowland areas);
- Classes equipped with audio-visual aids;
- Books, software and other references;
- ICT facilities (to support tele-conferences and distance learning activities);
- Hotspots internet connections;
- E-learning facilities;
- Language labs, etc.

Within UNESCO-IHE participants will have free access to:
- The library and the library of Delft University of Technology;
- Hydraulic laboratory facilities;
- Fieldwork facilities;
- Classes equipped with audio-visual aids;
- Books, software and other references;
- ICT facilities (including distant learning and tele-conference facilities);
- Internet connections;
- I-learning facilities

2.6 Profile of Participants and Admission Criteria

Participants for this proposed DD-AWMASC programme are:
- Officials of ministries, provincial, district or city governments working favourably at planning units;
- Hold a bachelor degree of relevant fields that may contribute to the integrated lowlands development and management, e.g. civil, agricultural, or environmental engineering, or an equivalent degree;
- Aged 38 years or younger;
- Have experience in practice for at least 2 years;
- Proposed officially by his/her superior;
- Have a TOEFL score of at least 550 during or after EAP training;
- Willing to work at fields relevant to his/her degree upon completion of the programme.

2.7 Selection procedure

Academic screening will be jointly done by Haramaya University and UNESCO-IHE. Pre-selection will be done by Haramaya University and final selection by Haramaya University and UNESCO-IHE.

2.8 Fellowships

For the academic year 2011-2013, there will be three full MSc fellowships from the IFAD project: Spate Irrigation for Rural Economic Growth and Poverty Alleviation. Thereafter the course will be eligible for NFP fellowships.

Annex 1. Study Programme 2011 – 2013

	Credit points	Year	2011				2012												2013					
Activity		Month	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6
Start of MSc programme			***Period in Ethiopia***																					
Course work Semester I																								
1. Soil Plant Water Relations	2	Haramaya	▪▪▪▪▪▪																					
2. Applied Hydrology	3	Haramaya	▪▪▪▪▪▪	▪▪▪▪▪▪																				
3. Design of Surface Irrigation Systems	3	Haramaya	▪▪▪▪▪▪																					
4. Experimental Design and Analysis	2	Haramaya	▪▪▪▪▪▪																					
Course work Semester II:																								
1. Pressurized Irrigation Systems Design	3	Haramaya			▪▪▪▪▪▪▪▪																			
2. Watershed Management	3	Haramaya	▪▪▪▪▪▪																					
3. Dams and Hydraulic Structures	3	Haramaya			▪▪▪▪▪▪																			
4. Drainage and Salinity Control	3	Haramaya			▪▪▪▪▪▪																			
Period in the Netherlands																								
Water Management Systems and Agronomy II	5	UNESCO-IHE						▪▪▪																
Aspects of Irrigation and Drainage	5	UNESCO-IHE						▪▪▪																
Service Oriented Management of Irrigation Systems	5	UNESCO-IHE							▪▪▪															
Conveyance Systems	5	UNESCO-IHE								▪▪▪														
Field Work and Field Trip in the Netherlands	5	UNESCO-IHE									▪▪▪													
Irrigation and Drainage Structures	5	UNESCO-IHE										▪▪▪												
Advanced Methods	5	UNESCO-IHE											▪▪▪											
Group Work	5	UNESCO-IHE												▪▪▪										
MSc Research Methodology Course/Summer Courses	5	UNESCO-IHE													▪▪▪									
MSc Thesis Proposal Development	7	Haramaya & UNESCO-IHE														▪▪▪								
Period in Ethiopia																								
Field trip	2	Haramaya														▪▪								
MSc Research, inception phase and data collection	12	Haramaya & UNESCO-IHE															▪▪▪▪▪▪▪▪							
Period in the Netherlands																								
MSc thesis writing period	24	Haramaya & UNESCO-IHE																		▪▪▪▪▪▪▪▪▪▪▪▪				
Diploma awarding	112	Haramaya & UNESCO-IHE																						▪▪▪

Annex II. Schedule of Semesters and Modules DD-AWMASC 2011-2013

Course Period	Contact Hours	Credit Points	Course	Course Coordinator
			ETHIOPIA	
Sept 15 - Nov. 15, 2011			***Course work Semester I***	
	36	2	SWEN 621 Soil Plant Water Relations	Tena
	48	3	SWEN 631 Applied Hydrology	Quarashi/Megersa
	48	3	SWEN 641 Surface Irrigation Systems Design	Desalegn/Megersa
	36	2	SWEN 611 Experimental Design and Analysis	Tena
Nov 15, 2011 to Feb. 3. 2012			***Course work Semester II***	
	48	3	SWEN 612 Design of Pressurised Irrigation Systems	Megersa
	48	3	SWEN 622 Dams Hydraulic Structures	Quarashi
	48	3	SWEN 632 Drainage Engineering and Salinity Control	Tena
	48	3	SWEN 642 Watershed Management	Bobe/Kibebew
			February 6 to 9 (week 6), 2012 travel to NETHERLANDS	
Module No.	**Year Week No**	**Credit Points**	**Module**	**Module Coordinator**
5	**2012** 7-9	5	WSE-HELWD05 Water Management Systems and Agronomy II	Mehari Haile
6	10 -12	5	WSE-HELWD06 Aspects of Irrigation and Drainage	Suryadi
	13		*Examination period*	
	14		*Easter Recess*	
7	15-17	5	WSE-HELWD07 & Short Course Service Oriented Management of Irrigation Systems	Prasad
8	18-20	5	WSE-HELWD08 Conveyance Systems	Suryadi
	21		Examination period	
9	22-24	5	WSE09 Field trip/Fieldwork	Mehari Haile/Hayde
10	25 -27	5	WSE-HELWD 10 Irrigation and Drainage Structures	Laszlo
11	28-30	5	WSE-HELWD 11 Advanced Methods and Equipment	Suryadi
	31		Examination period	
12	32 -34	5	WSE-WSE 12 Group work	Core Staff
13	35-37	5	WSE-WSE 13 MSc Research Methodology Course/Summer Courses	Erik de Jong
14	38-40	7	WSE-14 MSc Thesis Proposal Development	Core Staff
	41		*Travel to Ethiopia (October 8 to 12)*	
Course Period	**Contact Hours**	**Credit Points**	**Course**	**Course Coordinator**
Oct.15, 2012 (Week 42) to Jan. 31, 2013 (Week 5)	36	2	Field trip	Haramaya and Core Staff
	192	12	MSc Research, Inception Phase and Data Collection in Ethiopia	
			Travel to the Netherlands in week 6, February 6 to 10, 2013	
Module No.	**Year Week No**	**Credit Points**	**Module**	**Module Coordinator**
15	**2013** 7-26	24	WSE15 MSc Research, Thesis Writing Period and Defence	Core Staff and Haramaya

ANNEX III. List of the DD-AWMASC Course Work at Haramaya and UNESCO-IHE

List of the DD-AWMASC Semesters and lectures at Haramaya

Academic Year: 2011/2013
Specialization: Irrigation Engineering
Coordinator: Tena Alamirew(PhD)

Course Name: Advanced Soil Plant Water Relations	**Module Code: SWEN 621**		**Credit Hour 3 Or 5 ECTs**	
Contact Hour (per week)	Lectures	Tutorial & Seminar	Laboratory & Workshop Practice	Home Study
	1		**0**	**5**
Target Group: SWEN	**Prerequisite: Basic understanding of Soil Plant Water Relations**			

Learning Objectives

At the end of the course, students will be

- able to describe the soil – plant - atmosphere continuum and explain the functions of of water in plants during the process,
- able to explain and measure soil physical properties that affect retention and movement of soil moisture,
- able to solve the soil water dynamics equations and problems,
- able to predict estimate crop water requirement, predict water production function, and effect of moisture stress on yield.

Syllabus

Physical properties of soil: texture, structure, bulk density, porosity , Chemical properties of soil affecting water retention (Clay minerals and their properties; Properties of water affecting the retention and movement of water in soil: hydrogen bond, adhesion, cohesion, surface tension, capillarity; soil moisture retention, movement and measurement, water flow equations, field water regimes such as infiltration and evaporation, evapotranspiration, and crop water requirement, water production and effect of moisture stress on yield.

Didactics

Formal lectures, Laboratory session and report submission, computer exercises (Cropwat or aquacrop)

Lecturing Materials

- Kirkham, M. B., 2005. Principles of Soil Plant Water Relations. Elsevier Academic Press
- Reddy, S. R., 2007. Irrigation Agronomy. Kayyani Publishers, Delhi, India
- Iwata, S., T. Tabuchi, and B. P. Warkentin, 1994. Soil-Water Interactions: Mechanisms and Applications
- Kramer, P J, 1983. Water Relations of Plants. Academic Press. NY
- Carter, M. R.& EG Gregorich, 2008. Soil sampling and Methods of Analysis. CRS Press LLC,

Assessments

- Laboratory Reports - 30%
- Final examination – 70%.

Academic Year: 2011/2013
Specialization: Irrigation Engineering
Coordinator: Tena Alamirew(PhD)

Course Name: Experimental Design and Analysis	**Module Code: SWEN 611**		**Credit Hour 2 Or 5 ECTs**	
Contact Hour (per week)	Lectures	Tutorial & Seminar	Laboratory & Workshop Practice	Home Study
	2	**0**	**0**	**5**
Target Group: SWEN	**Prerequisite: None**			
Learning Objectives				

At the end of the course, students will be

- able apply basic principles of the scientific method and the principles of experimental design (randomization, replication and error control)
- review the basic principles of statistics applied for research (common probability distributions, estimation and hypothesis testing)
- able to design and analyze experiments
- able to differentiate the concept and application of Covariance, Correlation and Regression.
- able to select and use software relevant for the design and analysis of experiments
- able to apply geo-statistics tool in soil and water research

Syllabus

Research and the Scientific Method; Probability distribution - sampling distribution, common probability distribution, F-test, t-test, chi-square test; Estimation and Hypothesis Testing – point and interval estimates of the mean, setting research hypothesis, hypothesis test; Principles of experimental Design – Randomization, Replication and Error Control; Design and Analysis of Experiments: CRD, RCBD, Latin Square, Factorial and Split Plot Designs; Covariance, Correlation, Regression, Multivariate Analysis; Introduction to the concept of geostatistics, variogram analysis and the Kriging techniques.

Didactics

Formal lectures, individual assignments, and Presentations

Lecturing Material

- Ryan, P. T. 2007. Modern Experimental Design. John Wiley & Sons
- Montgomery, D. C., 2001. Design and Analysis of Experiments. 5th Edition. Arizona State University. John Wiley & Sons,
- Ott, R. L. 1993. An Introduction to Statistical Methods and Data Analysis. 4th edit Wadsworth, Inc, USA
- Armstrong, M. 1998. Basic Linear Geostatistics. Springer-Verlag Berlin Heiderg.
- Hudson, N.W., 1993. Field Measurement of Soil Erosion and Runoff. FAO Soils Bulletin 68. FAO, Rome.
- Mettrick, H. 1993. Development Oriented Research in Agriculture. CTA, Wagningen, the Netherlands.

Assessments

- Assignments including softwares outputs – 20%
- Presentation (20%)
- Final examination – 60%.

Academic Year: 2011/2013
Specialization: Irrigation Engineering
Coordinator: Tena Alamirew(PhD)

Course name: Drainage Engineering and Salinity Control	**Module Code: SWEN 612**		**Credit Hour 3 Or 7.5 ECTs**	
Contact Hour (per week)	Lectures	Tutorial & Seminar	Laboratory & Workshop Practice	Home Study
	2		**1**	**6**
Target Group: SWEN	**Prerequisite: Soil Plant Water Relations**			

Learning Objectives

At the end of the course, students will be

- able to explain the challenges associated to drainage and salinity control in Ethiopian context,
- review the concept of water flow in a porous media,
- able to design subsurface drainage systems,
- able to design surface water removal systems, and
- able to predict, manage and control irrigation induced soil salinisation problems in irrigated areas.

Syllabus

Status of drainage related problems in the world and in Ethiopia. Principles of water flow in a porous media – steady and non-steady state solutions, design of subsurface drainage system (selection of drain pipes, envelopes and installation methods), design and construction of surface drainage systems :estimating peak discharges following the ERA procedures, design of canals and grassed waterways; salinity control: sources of irrigation

induced soil salinization, predicting capillary salinisation, salt balance, salinity management options; Experiences in thiopia

Didactics
Formal lectures, individual design reports, written reports and field visit

Lecturing Materials

- Smedema, L. K., Vlotman, W. and Rycroft, D. W., 2004. Modern Land Drainage – Planning, Design and Agricultural Drainage Systems. Batsford Academic and Educational limited.
- Ritzema, H.P. (eds), 1994. Drainage Principles and Applications. ILRI Publications 16. International Institute for Land Reclamation and Improvement, Wageningen.
- Bhattacharay, A. K. and Michael, A. M. 2003. Land Drainage Principles, Methods and Application. Konark Publisher Pvt Ltd., India.
- Skaggs, R. W. and van Schilfgaarde, J (eds), 1999. Agricultural Drainage. Agronomy 38. ASA, CSSA and SSCA, Madison, WI.
- Lal, C. 2004. Horizontal Subsurface Drainage Theories for Agricultural Lands. International Book Distributing Co. UP, India

Assessments

- Two Design Projects - 40%
- Final examination – 60%.

Academic Year: 2011/2012
Specialization: Irrigation Engineering
Co-ordinator: Prof. Shoeb Quraishi

Module Name **Watershed Management**	**Module Code** **SWEN 612**		**Credit Hour 3** **or 5 ECTs**	
Contact Hour (per week)	Lectures	Tutorial & Seminar	Laboratory & Workshop Practice	Home Study
	3	**0**	**3**	**4**
Target Group SWEM	**Prerequisites** • **Soil and Water Conservation Engineering.**			

Learning Objectives

- Students will be able to estimate runoff and soil loss from a watershed by using common models in practice
- Students should be able to design different soil conservation structures in arable as well as non-arable lands and gullied lands.
- They shall also acquire knowledge about making alignment, mode of construction and computation of earth work and area lost for contour bunds and terraces.
- Furthermore, the students will be in a position to go for hydraulic and structural designs of different spillways required in soil conservation and gully plugging.
- Students shall be made aware about the techniques for building of different erosion models used in decision making for soil conservation planning works.
- Students shall be well versed about the sedimentation of reservoir, its ill effects on the life of reservoir and the storage capacities and to adopt the preventive measures to combat the problems of sedimentation in the reservoir.

Syllabus

INTRODUCTION: Concept of watershed development, objectives of watershed development, need for watershed development in India, Integrated and multidisciplinary approach for watershed management.

CHARACTERISTICS OF WATERSHED: size, shape, physiography, slope, climate, drainage, land use, vegetation, geology and soils, hydrology and hydrogeology, socio-economic characteristics, basic data on watersheds.

PRINCIPLES OF EROSION: Types of erosion, factors affecting erosion, effects of erosion on land fertility and land capability, estimation of soil loss due to erosion, Universal soil loss equation.

MEASURES TO CONTROL EROSION: Contour techniques, ploughing, furrowing, trenching, bunding, terracing, gully control, rockfill dams, brushwood dam, Gabion.

SPATE IRRIGATION WITHIN THE CONTEXT OF WATERSHED MANAGEMENT: linkage between spate irrigation and natural resources management within a watershed: Biodiversity and natural vegetation, Catchment degradation and sedimentation, Wadi morphology and flood protection, Groundwater recharge and management, Upstream and downstream water use. Exercise: concepts and practices for developing spate irrigation within a watershedfield water management and.

LAND MANAGEMENT: Land use and Land capability classification, management of forest, agricultural, grassland and wild land. Reclamation of saline and alkaline soils.

ECOSYSTEM MANAGEMENT: Role of Ecosystem, crop husbandry, soil enrichment, inter, mixed and strip cropping, cropping pattern, sustainable agriculture, bio-mass management, dry land agriculture, Silvi pasture, horticulture, social forestry and afforestation.

Planning of watershed management activities, people's participation, preparation of action plan, administrative requirements.

Project Assignments

Everyone will be assigned to watershed project teams of 3-4 students this semester. These groups will function independently during outside of class.

Mid Term Project - Development of a Watershed Plan

Each group will prepare a draft, preliminary watershed plan for a real or hypothetical watershed.
For Project #1, each team will prepare a one-page summary sheet suitable for duplication as a class handout. All written work for the projects must be word-processed (typed, spell-checked, etc. Each team is responsible for a 30 -minute presentation of one project to the class. Students will delineate the watershed on maps using Arc View GIS. Each group will define the problem, i.e. water quality, flooding, etc., and the goals and objectives for addressing the problem. The group will characterize the watershed and provide recommended actions such as best management practices to address the defined problem. The report should be no longer than 10 pages single-spaced with tables and graphs and include at least 2 GIS watershed maps.

Final Term Paper - The Origins of Watershed Management

Students will prepare a 15 - page, double-spaced, term paper researching the origins of watershed management. The paper should be in two parts. The first part should focus on the history and evolution of watershed management. The second part should present a specific watershed demonstrating an application of approaches that you have learned in class. The focus may be on tenets and trends in watershed management in the United States or internationally. The watershed that you choose may be sub-state, state, interstate, or regional.

Didactics

Formal lectures, tutorials and home study

Lecturing Materials

- Hudson, N. W. 1971. Soil Conservation. B. T. Batsford Ltd. London
- Michael, A. M. and Ojha, T. P. Principles of Agricultural Engineering, Vol.II. Jain Brothers, New Delhi, India.
- Ministry of Agriculture, Ethiopia. Soil Conservation in Ethiopia.
- Murty, V. V. N. 1985. Land and Water Management Engineering. Kalyani Publishers. Delhi, India.
- Suresh, R. 2000. Soil and Water Conservation Engineering, Standard Publishers Distributors, Delhi, India.
- Taffa Tulu. Soil and Water Conservation for Sustainable Agriculture. Mega Publishing Enterprise, Addis Ababa, Ethiopia.
- Tripathi, R. P. and Singh, H. P. Soil Erosion and Conservation. New Age International Publishers, New Delhi, India.
- USDA Soil Conservation Service. Spillways. USDA Engineering Hand Book, sections 11 & 14.

Assessments

- Mid examination – 20%;
- Assignments - 40%;
- Final examination – 40%

Academic Year: 2011/2013
Specialization: Irrigation Engineering
Co-ordinator: Prof. Shoeb Quraishi

<table>
<tr><td>Module Name
Applied Hydrology</td><td colspan="2">Module Code
SWEN 631</td><td colspan="2">Credit Hour:
3</td></tr>
<tr><td rowspan="2">Contact Hour (per week)</td><td>Lectures</td><td>Tutorial & Seminar</td><td>Laboratory & Workshop Practice</td><td>Home Study</td></tr>
<tr><td>2</td><td>0</td><td>3</td><td>6</td></tr>
<tr><td>Target Group
SWEM</td><td colspan="4">Prerequisites
• Calculus
• Statistics
• Fluid Mechanics
• Open channel Flow</td></tr>
<tr><td colspan="5">Learning Objectives
• Students will obtain an understanding of hydrologic processes, particularly the processes of precipitation, evaporation, infiltration, and surface water.
• Students will learn about methods of hydrologic analysis, including unit hydrograph, flow routing, statistical methods and frequency analysis in hydrology.
• Students will learn about methods of hydrologic design, including the development of design storms and design flows.
• Students can apply current software to the hydrologic design of small-scale rural or urban watersheds.</td></tr>
<tr><td colspan="5">Syllabus
Definition of Hydrologic Cycle. Precipitation: Types of precipitation, Measurement of rainfall, Analysis and interpretation of precipitation data. Evaporation and Transpiration: Factors controlling evaporation & transpiration process, Measurement of evaporation and estimation of potential evaporation. Infiltration: Factors affecting infiltration, Measurement of infiltration, Infiltration indices. Stream flow: Hydrographs, Computation of excess rainfall and runoff using infiltration indices, Stage-discharge relationship, extension of stage-discharge relationship. Introduction to Hydrologic Models. Catchment Characteristics: Catchment area, catchment shape, catchment relief, linear measurement. Rainfall-runoff Relationship: Rational method (for small catchment), Runoff curve number, Unit Hydrograph, Synthetic Unit Hydrograph, Flood routing, reservoir routing, Channel routing. Statistics in Hydrologic Analysis: Fitting a probability distribution, Frequency analysis: rainfall, low flow, floods and drought. Reservoir: Determination of reservoir capacity, Reservoir operation, Reservoir sedimentation.</td></tr>
<tr><td colspan="5">Projects/Major Assignments
• The course includes about four extended assignments based on realistic data sets supplied by the instructor.
• Typical extended assignments include the estimation of watershed characteristics, hydrograph synthesis, flood frequency analysis, and channel routing.</td></tr>
<tr><td colspan="5">Professional Softwares
• Visual HEC-1
• Hydrologic Modeling System, HEC-HMS
• Water Surface Profile Modeling (HEC-RAS)
• StormCAD</td></tr>
<tr><td colspan="5">Didactics
Formal lectures, individual and group assignments, written reports</td></tr>
<tr><td colspan="5">Lecturing Materials
• Osman Akan and Robert J. Houghtalen, 2003. Urban Hydrology, Hydraulics and Stormwater Quality. John Wiley & Sons, Inc.
• Ned H.C. Hwang and Robert J. Houghtalen, 1996. Fundamentals of Hydraulic Engineering Systems, 3rd Edition. Prentice Hall.
• Linsley, RK; Kohler, MA and Paulhus, JLH, 1988. Hydrology for Engineers. McGraw-Hill.
• Chow, VT; Maidment, DR; Mays, LW, 1988. Applied Hydrology. McGraw-Hill.
• Linsley, RK; Franzini, JB; Freyberg, DL; Tchobanoglous, G., 1992. Water Resources</td></tr>
</table>

Engineering, 4th edition. McGraw-Hill.
- P.B. Bedient, W.C. Huber and B.E. Vieux, 2008. Hydrology and Floodplain Analysis, 4th edition. Prentice-Hall, Upper Saddle River, NJ, ISBN 978-0-13-174589-6.
- Richard H McCuen, 1998. Hydrologic Analysis and Design, 2nd Edition, Prentice Hall.

Assessments
- Assignments: 20%
- Project: 40%
- Written Exam (2): 40%

Academic Year: 2011/2013
Specialization: Irrigation Engineering
Co-ordinator: Prof. Shoeb Quraishi

Module Name **Dams and Hydraulic Structures**	**Module Code** **SWEN**		**Credit Hour 4** **Or 6 ECTs**	
Contact Hour (per week)	Lectures	Tutorial & Seminar	Laboratory & Workshop Practice	Home Study
	3	**3**	**0**	**6**
Target Group SWEM	**Prerequisites** • **Hydraulics I** • **Hydraulics II**			

Learning Objectives
- The purpose of this course is to give knowledge to the students the various kinds of barriers that can be built across streams at convenient locations to impound water by which regulated use of water can be achieved effectively.
- The course will make the students know about design of Over-flow structures, Diversion weirs, Diversion channels etc.
- Students may be able to design small dams for water storage and other hydraulic structures.
- Students should be confident enough to tackle problems pertaining to Hydraulic structures.
- Students will gather the knowledge about the methods to mitigate floods.

Syllabus
Classification of Dams; Theory, Principles of Design, Types of Dams: Earthen dams, Rock fill dams, Buttress Dams, Gravity Dams, and Arch Dams. Safety and Selection of Dams: Analysis for safety of dams, Selection of appropriate type of dam. Foundation: Foundation investigation, Geological features of foundation. Design Principles of: Spillways, Stilling basin and Intake structures, River diversion works, Weirs on permeable foundation and Head works, Locks and Gates. Flood Protection Measures: Problems and consequences of floods, Flood control measures and Moderation of floods.

Didactics
Formal lectures, individual assignments, written reports and field visit

Lecturing Materials
- Punmia, B. C. and Pandey, B. B. L. 1992. Irrigation and Water Power Engineering. Laxmi Publications, Pvt. Ltd. New Delhi, India.
- Suresh, R. 2000. Soil and Water Conservation Engineering. Standard Publishers Distributors. Delhi, India
- Garg, S. K. 1998. Hydrology and Water Resources Engineering. Khanna Publishers, Delhi, India.
- Bhattacharya, P. K. 2003. Water Power Engineering. Khanna Publishers, Delhi, India.
- Murthy, V. V. N. 1998. Land and Water Management Engineering. Kal;yani Publishers, New Delhi, India

Assessments
- Mid examination – 30%
- Assignments – 20%
- Final examination – 50%.

List of the DD-AWMASC Modules at UNESCO-IHE

Academic year: 2011/2013
Specialisation(s): WSE-HELWD, WSE-HELWD Sriwijaya, WSE-HELWD Haramaya
Co-ordinator: A. Mehari Haile, PhD, MSc

Module Name **Water Management Systems & Agronomy II**	**Module Code** **WSE/HELWD/05/s**	**Credit Points** **5**
Target Group HE-LWD participants	**Prerequisites** Irrigation and drainage system design, preliminary teriary unit layout and design, plant water relationships	

Learning Objectives

- Analyse and evaluate and to apply the hydraulic principles for pipe flow in irrigation and drainage engineering.
- Present, process and interpret results of hydraulic laboratory measurements in a technical report.
- Explain the principles of the hydrological cycle, the basic characteristics of precipitation and evaporation, the principles of reservoir operation.
- Apply some statistical tools used in hydrology, rainfall-runoff relations and design floods.
- Have an understanding of water-crop yield relationships, management options under land or water scarcity and water saving techniques, and be able to determine crop water requirements.

Syllabus

Applied Hydraulics of Irrigation Systems II, L.G.Hayde (UNESCO-IHE)

Pipe flow: main dimensionless numbers, theory and application of the momentum principle in pipes, the Moody diagram. Pipe flow equations; Colebrook-White, Chézy, Hazen and Williams. Minor losses in pipes, pipe bends and other components. PROFILE to calculate the basic flow parameters (water depth, discharge, shear stress) in an open channel, namely irrigation and/or drainage canals. CANDES to design the dimensions of irrigation canals in view of erosion and sedimentation. FLOP to calculate gradually varied flow profiles in open (semi) prismatic channels based on either Manning or Chézy. Checking of the design of irrigation and drainage canals under (semi) steady flow conditions.

Hydraulics Laboratory 2, L.G. Hayde (UNESCO-IHE)

Various types of measuring equipment. Various flow types: over a broad crested weir, through a contraction, underneath a gate. Gradually varied flow profiles. Forces due to flowing water. Pipe flow: velocity distribution and friction losses. Discharge-depth relationship.

Irrigation and Drainage Design, A. Mehari Haile (UNESCO-IHE)

Detailed design of water diversion, conveyance and distribution sysyems of surface irrigation systems - spate basin, and furrow. Alternative canal and drainage networks that in the case of spate also allow supply and drainage of large quantity of water within a short period of time, field layout that promote convenient irrigation delivery schedules; requires less water distribution, drainage and road structures, allow furrow length and basin size that deliver good water distribution uniformity (>80%) and good tertiary system efficiency (65 to 75%). The distribution uniformity and efficiency for furrow and basin irrigation systems are evaluated using Furdev and Basdev programmes respectively. Soil Water Accounting Model is used to assess the spate flow diversion and distribution efficiency.

Agronomy, A. Mehari Haile (UNESCO-IHE)

Functions of water in the plant, development of root systems, transpiration, plant factors affecting transpiration, measurement of transpiration, water deficit and plant growth, water yield curves, crop-production functions, determination of optima under land or water scarcity conditions, calculate crop water requirements, select suitable planting dates, calculate yield decreases due to water stress, assess the effects of staggering on irrigation requirements, establish acceptable levels of water stress to reduce irrigation requirements, case studies on deficit irrigation, water use efficiency modification in different irrigation systems, agricultural practices to improve water use efficiency. Exercise CROPWAT.

Didactics

Formal lectures, class exercises, individual and group assignments and discussions, written reports, laboratory works

Lecturing Materials

- Hayde, L.G., 2008. Applied Hydraulics; Synopsis, LN 0378/08/1
- Hayde, L.G., 2007. Applied Hydraulics; Manual Flop, Gradually Varried Flow Profiles, LN0333/07/1
- Hayde, L.G., 2010. Applied Hydraulics; Pipe flow
- Hayde, L.G., 2010. Applied Hydraulics; Manual Hydraulics Laboratory Exercises 2, LN0422/10/3,
- Jaspers and Mehari Haile, 2010. Agronomy and Water deficit in Irrigation, An Agricultural Approach.

Assessments:

- Applied Hydraulics of Irrigation Systems II - written test (37%)
- Hydraulics Laboratory II - assignment (11%),
- Irrigation and Drainage: Tertiary Unit Design II - assignment and oral discussion (29%)
- Agronomy - assignment (23%)

Module WSE/HELWD/05/s: Water Management Systems & Agronomy II

No	Course	Lecture	Exercise	Workshop	Laboratory work	Fieldwork	Fieldtrip	Contact hours	Study load hours	Lecturer
1	Applied Hydraulics of Irrigation Systems II	12	12	0	0	0	0	24	50	L.G. Hayde, PhD, MSc
2	Hydraulics Laboratory 2	0	8	0	0	0	0	8	16	L.G. Hayde, PhD, MSc
3	Irrigation and Drainage - Tertiary Unit Design II	8	8	0	0	0	0	16	40	A. Mehari Haile, PhD, MSc
4	Agronomy	8	5	0	0	0	0	13	34	A. Mehari Haile, PhD, MSc
Totals		28	33	0	0	0	0	32	140	

Academic year: 2011/2013
Specialisation(s): WSE-HELWD, WSE-HELWD Sriwijaya, WSE-HELWD Haramaya
Co-ordinator: F.X. Suryadi, PhD, MSc

Module Name **Aspects of Irrigation and Drainage Systems**	**Module Code** **WSE/HELWD/06/s**	**Credit Points** **5**
Target Group HE-LWD participants	**Prerequisites** Main and tertiary irrigation system design, agronomy, soil plant water relationship	

Learning Objectives

- Select a suitable flow control system, the appurtenant flow control structures and to specify the operation rules of the structures and social implications of applied irrigation techniques for different users.
- Discuss the importance of all environmental and social aspects that complete the determination of the feasibility of any land development project.
- Describe the economic feasibility of land development projects and have a first understanding of financial reporting.

Syllabus

Economic and Financial Analyses, R. Namara (IWMI-Ghana)
Capital, interest and time. Costs and benefits. B/C ratios and the internal rate of return. Unit prices. Evaluation of alternatives. An introduction to financial reporting; balance sheets, profit and loss account, cash flow statements.

Sociological Aspects, L.Ch. Schenk-Sandbergen (Retired from University of Amsterdam)
Interpretation of social effects of irrigation, organisation of irrigation projects. Case studies on central aspects of irrigation schemes, such as governmental or private control; function of irrigation groups (membership and maintenance); applied technology, distribution and control. Case studies based on the participants' experience. Topics: function of sociologists, use requirements and distribution of water.

Flow Control Systems, F.X. Suryadi (UNESCO-IHE)
Introduction on flow control systems: purpose, classification, selection criteria, performance parameters. Proportional control: sensitivity of structures, application. Upstream control: principle, hydraulics, design of system, application. Downstream control: principle, hydraulics, design of system, application. Combined control: upstream and proportional control, mixed control, down- to upstream control, up- to downstream control, night reservoirs, head works. Water level regulators; discharge regulators; discharge measurement structures. Electronic control systems: Bival control, El-flow control, Card control, Dynamic control, step controllers, PID controller. Application of different flow systems: case studies.

Main Drainage Systems and Salinity Control in Field Level, H. P. Ritzema (Alterra) and P. H. J. Hollanders (Principal Waterboard of Delfland)
The need for drainage: water ponding, water logging and salinisation. Components of a surface drainage system. Factors related to drainage: agricultural objectives, environmental aspects, and soil and hydrological conditions. Drainage design criteria and layout. Drainage design equations: principles and applications

Field Trip to North -West Netherlands
Get acquainted with some hydraulic engineering and water management aspects in North West Netherlands. Locks, pumping stations, navigation systems, flood protection.

Didactics
Formal lectures, exercises, individual and group assignments, field visits

Lecturing Materials

- Namara, 2009. Economic and financial analyses.
- Ritzema, 2009. Main drainage systems.

- Schenk-Sandbergen, 2009. Reader sociological aspects of water and land projects.
- Suryadi, 2010. Flow control systems.

Assessments

- Economics and Financial Analysis - assignment (26%)
- Sociological Aspects - assignment (20%)
- Flow Control Systems – assignment (28%)
- Main Drainage Systems and Salinity Control in Field Level – assignment (26%)

Module WSE/HELWD/06/s: Aspects of Irrigation and Drainage

No	Course	Lecture	Exercise	Workshop	Laboratory work	Fieldwork	Fieldtrip	Contact hours	Study load hours	Lecturer
1	Economic and Financial Analysis	8	8	0	0	0	0	16	36	Dr R.E. Namara
2	Sociological Aspects	6	8	0	0	0	0	14	28	Dr. L. Schenk-Sandbergen
3	Flow Control Systems	8	8	0	0	0	0	16	40	F.X. Suryadi, PhD, MSc
4	Main Drainage Systems and Salinity Control in Field Level	8	0	0	0	0	0	8	36	Dr Ir H.P. Ritzema
5	Main Drainage Systems and Salinity Control in Field Level	0	8	0	0	0	0	8	0	Ir P.H.J. Hollanders
6	Field Trip to North-West Netherlands	0	0	0	0	0	8	8	0	-
Totals		30	32	0	0	0	8	70	140	

Academic year: 2011/2013
Specialisation(s): WSE-HELWD, WSE-HELWD Sriwijaya, WSE-HELWD Haramaya
Co-ordinator: K.C. Prasad, PhD, MSc

Module Name **Service Oriented Management of Irrigation Systems**	**Module Code** **WSE/HELWD/07/s**	**Credit Points** **5**
Target Group Prospective Water Science and Engineering experts, particularly those specializing in Land and Water Development	**Prerequisites** Agronomy, irrigation methods, management and socio-economic aspects of irrigation systems, irrigation flow control and conveyance systems	

Learning Objectives

- Upon completion of the course, the participants will be able to:
- Formulate policy objectives for irrigation development and management;
- Have a basic insight in the need and format of laws pertaining to the development and use of water resources and have a general understanding of law, legislation, common law and traditions;
- Identify water delivery arrangements including suitable flow control amenable to objectives;
- Comprehend different levels of water delivery service and associated costs;
- Conceptualize legislative, organisational and financial attributes of service oriented management of irrigation systems;
- Draw up service agreements considering cost recovery and accountability;
- Design asset management programs and action plans for implementation; and
- Devise monitoring & evaluation and benchmarking systems for assessing system performance.

Syllabus

Management of Irrigation Systems, K. Prasad (UNESCO-IHE) and H. Malano (University of Melbourne)

Terminology and definitions, management cycle, objectives in irrigation, interest groups, conflicting objectives. Activities in irrigation management. Water delivery policies: entitlement to water, operational objectives (adequacy, equity, reliability), cropping policies. Water delivery systems: arranged, on request, on-demand supplies, irrigation scheduling. Monitoring & Evaluation and benchmarking for performance assessment, related parameters, targets, standards.
Concept of service oriented management, typology of goods and services, clients and stakeholders, service determining factors, levels of service, infrastructure, flow control and service potential, cost of service, maintenance, financial arrangements, service agreements, specification and conditions of service, organisational structures, cost recovery, farmers' participation, role of other institutions and accountability mechanisms in water management institutions.

Water Law, J. Gupta (UNESCO-IHE)

Origin, evolution, sources, elements and history of national water law and the later influence of environmental law including elaboration of irrigation law. Influence of local, regional, national laws and regulations on irrigation and drainage plans.

Asset Management, M. Kok (UNESCO-IHE)

Defining asset management; Asset management concepts: types of assets, life cycle, economic life, useful life, residual life; Asset register; Asset management functions, asset planning strategies, asset creation/acquisition, asset O&M, performance monitoring, rehabilitation, modernisation, replacement, disposal, rationalisation; Asset economics, investment profiles, service cost; Asset audit and renewal, risk assessment and renewal decision making, value engineering; Development and implementation of asset management programmes, related organisational aspects, Management Information System.

Field Trip, K. Prasad (UNESCO-IHE)

Visit to the Association of Water boards (Unie van Waterschappen); Kinderdijk and its; and Greenhouse for pepper/paprika production.

Didactics

Formal lectures, case studies, group assignments, individual and group exercises, written reports

Lecturing Materials

- Malano and van Hofwegen, 2006. Management of Irrigation and Drainage Systems - A Service Approach, IHE Monograph 3.
- Kok, 2000. Asset Management.
- Gupta, 2005. Water and Environmental Law and Institutions.
- Van Hofwegen and Jaspers, 2005. Analytical Framework for Integrated Water Resources Management - Guidelines for Assessment of Institutional Frameworks, IHE Monograph 2. (Optional)

Assessments:

- Management of Irrigation Systems - assignment and oral discussion (70%)
- Asset Management - assignment (30%)

Module WSE/HELWD/07/s: Service Oriented Management of Irrigation Systems

No	Course	Lecture	Exercise	Workshop	Laboratory work	Fieldwork	Fieldtrip	Contact hours	Study load hours	Lecturer
1	Management of Irrigation Systems	10	14	0	0	0	0	16	88	K.C. Prasad, PhD, MSc Prof. H. Malano
3	Water Law	4	0	0	0	0	0	4	8	Prof. J. Gupta, PhD
4	Asset Management	10	8	0	0	0	0	18	36	Dr.Ir. M. Kok
5	Fieldtrip	0	0	0	0	0	8	8	8	K.C. Prasad, PhD, MSc
Totals		24	22	0	0	0	8	46	140	

Academic year: 2011/2013
Specialisation(s): WSE-HELWD, WSE-HELWD Sriwijaya, WSE-HELWD Haramaya, WSE-HECEPD, WSE-HERBD, WSE-HWR, WSE-HI, WSE-HECEPD Hohai, WSE-HELWD AIT, WSE-HI Ain Shams, WSE-HI Cali,WSE-HWR Hohai
Co-ordinator: F.X. Suryadi, PhD, MSc

Module Name **Conveyance Systems**	**Module Code** **WSE/HELWD/08/e**	**Credit Points** **5**
Target Group	**Prerequisites** For Fieldwork: A general knowledge about irrigation and drainage systems and , flow measurements	

Learning Objectives

- Make simple unsteady flow computations for open channels and closed conduits.
- Apply Duflow for non-steady flow phenomena in open irrigation and drainage networks; to evaluate the results and to assess the advantages and disadvantages of the model for solving surface flow problems.
- Assess the advantages and disadvantages of various numerical schemes for solving sets of equations in surface flow modelling and to select the appropriate models for stationary and non-stationary flow in open channels and in pipes and to evaluate the results.
- Determine the requirements for water table and salinity control in irrigated areas; Understand the factors that influence the functioning of a surface drainage system; Design a surface drainage system.
- Explain the use of modern tools as RS and GIS in combination with the use of computer models.
- Have a basic insight in the need and format of laws pertaining to the development and use of water resources and have a general understanding of law, legislation, common law and traditions.

Syllabus

Unsteady flow / DUFLOW, F.X. Suryadi (UNESCO-IHE)
Basic equations of unsteady flow and their numerical treatment; development of the St.Venant equations; solutions to these equations; applications to rectangular channels; simple wave theory; surge formation; rapidly varied unsteady flow; method of characteristics in open channels, flood waves in rivers.
Introduction on hydrodynamic models and the general structure of the DUFLOW model; application of Duflow for water quantity analysis in irrigation and drainage networks; a/o. propagation of waves through canals, effect of response time on operation, effect of maintenance on water levels and operation of off takes; exercises on the operation of an irrigation network with control structures.

Sediment Transport in Irrigation Canals, N. Mendez (Retired from Universidad Centro Occidental Lisandro Alvarado, Venezuela)
Properties of transported material and of water; initiation of particle motion; transportation mechanics, bed forms, alluvial roughness; examples of computation of sediment transport in irrigation canals.

Water Management System Modelling and GIS, F.X. Suryadi (UNESCO-IHE)
Water management system of land and water development, modelling, related to design, operation and maintenance (including hydraulic control structures, pumping stations, etc.); calibration, verification and sensitivity analysis, and hydraulic performance of the water management system.
With the application of GIS, land suitability, drainability and irrigability of an area will be modelled analysed and evaluated.

Groundwater Flow, C. van den Akker (Retired from Delft University of Technology)
Characteristics of subsurface flow systems; Physical properties of porous media, homogeneity, isotropy; Fundamental equation of flow, 1–3D Darcy equation; Continuity, 1–3D mass and volume balances; Steady state confined/unconfined aquifer and radial flow; Unsteady state confined/unconfined aquifer and radial flow; Seepage flow.

Didactics
Formal lectures, exercise, individual and group discussions, modelling, written reports

Lecturing Materials

- Reference Manual DUFLOW, 2002.
- Suryadi, 2010. Modelling of water management systems.
- Suryadi, 2010. GIS and computer modelling of Water Management Systems.

- DUFLOW, 2003. User's guide
- Van den Akker, 1994. Groundwater flow. (Abraham, please take care that next year we have an update of this lecture note)

Assessments

- Unsteady Flow / Duflow (32%)
- Sediment Transport in Irrigation Canals (17%)
- Water Management System Modelling and GIS (30%)
- Groundwater Flow (21%)

Module WSE/HELWD/08/e: Conveyance Systems

No	Course	Lecture	Exercise	Workshop	Laboratory work	Fieldwork	Fieldtrip	Contact hours	Study load hours	Lecturer
1	Unsteady Flow / Duflow	10	12	0	0	0	0	22	50	F.X. Suryadi, PhD, MSc
2	Sediment Transport in Irrigation Canals	6	6	0	0	0	0	12	24	Dr. N.V. Mendez
3	Water Management System Modelling and GIS	8	12	0	0	0	0	20	36	F.X. Suryadi, PhD, MSc
4	Groundwater Flow	8	4	0	0	0	0	12	30	Prof. C. van den Akker, PhD, MSc
Totals		32	34	0	0	0	0	66	140	

Academic year: 2011/2013
Specialisation(s): WSE-HELWD, WSE-HELWD Sriwijaya, WSE-HELWD Haramaya, WSE-HWR, WSE-HECEPD, WSE-HERBD, WSE-HI, WSE-HECEPD Hohai, WSE-HELWD AIT, WSE-HI Ain Shams, WSE-HI Cali, WSE-HWR Hohai
Co-ordinator: A. Mehari Haile, PhD, MSc/L.Hayde, PhD, MSc.

Module Name **Fieldtrip and Fieldwork WSE**	**Module Code** **WSE/09/c**	**Credit Points** **5**
Target Group All WSE Participants	**Prerequisites** A general knowledge about water management, hydraulic engineering, hydrology and water and environment	

Learning Objectives

- Have a multidisciplinary overview of actual technical, research and organizational activities in the field of water management, hydraulic engineering, hydrology and the aquatic environment.
- To be able to report detailed technical information received succinctly.
- To be able to select and apply different, appropriate field instrumentation and measurement methods in practice and organise the measurement.
- To be able to critically analyse field results, and identify/recognise possible areas of error or uncertainty.
- To be able to integrate quantitative measurements with qualitative terrain observations and prior information to evaluate and analyse the relevant predominant processes in a study area.
- Be able to apply this assimilation of data to engineering considerations.
- To be capable of presenting, reporting and discussing an overview of the results, findings and recommendations.

Syllabus

Fieldtrip (Various staff UNESCO-IHE)

One or two week study tour in Europe(specializations HWR, HERBD, HECEPD, HELWD)
Visits to organizations and institutions active in hydraulic engineering and/or hydrology, for instance contractors, consultancy offices, governmental institutions, research laboratories, water resources and hydraulic engineering projects in development and operation.
The students take part in the compilation of a full report presenting an account of each visit. After completion, each student receives a printed copy of the report.
Depending on the number of participants of the specializations within the Water Engineering Department, the fieldtrip will be multidisciplinary with the aim of integrating specializations within the department and enabling a holistic view of Water Engineering.
In general countries in the “Schengen”agreement will be visited for easy trans-border travel.
Travel is by coach and the accommodation is hotel (shared rooms) with breakfast.

Two week study tour in Florida, USA (B. Bhattacharya) (specialisation HI)
Exposure tour with "on site" explanations of hydrological, hydraulic and environmental projects, particularly the Everglades Comprehensive Restoration project. Specific supplements to the taught part of the programme are the visits to projects with implemented Hydroinformatics components, or various centres involved in Hydroinformatics research.

Fieldwork (Various staff UNESCO-IHE):

HWR specialization: (J.W. Foppen, J.C. Nonner, J. Wenninger)
Two week fieldwork in southeast France focuses on integrating field observations of geology, geomorphology and physiography with surface and subsurface water data collection. Training in field instruments and measurement techniques is an integral part of the activities. ICT facilities for field data processing are provided. Small groups of students work partly under supervision but also carry out independent field assignments. At the end, each group will prepare a fieldwork report

HERBD specialization: (L. Brandimarte, M. Werner)
The course focuses on developing field observation/measurement skills and integrating this with engineering knowledge. Measurements, observation, assimilation and critical analysis will be of key importance. Training in field instruments and techniques will be an integral part of the activities, followed by a period of group work where students will study a stretch of river in more depth with the purpose of gathering information to input into engineering designs.

HECEPD specialization: (D. Roelvink, M van der Wegen)
Field measurements will be focusing on getting hands-on experience with the execution of measurements in a coastal environment: flow velocity, bottom profiles, sediment transport, drifter measurements. Introduction to combined use of field data and modelling.

HELWD specialization: Field Experiments in Irrigation (L.G. Hayde)
Various types of measuring equipment. Hydraulic characteristics of field channels. Soil characteristics. Various irrigation methods. Water balance measurements. Discharge-depth relationship for measuring structures. Measurement of pump characteristics and of head losses in pipe systems. Hydrometric measurements, current metering, salt dilution method and slope-area method. Discharge calculations by various methods; mean and mid-section method.

Didactics
Field visits and measurements, and in-situ lectures/explanations and discussions, individual and group exercises, written reports

Lecturing Materials
- Fieldtrip Information and Documentation, (handout)
- HWR and HERBD: Foppen, Nonner, Beevers : *Hydro(geo)logical Fieldwork Dignes-les-Bains* Field manual
- A variety of existing data, thematic maps and aerial photographs of the fieldwork area.
- HELWD: Hayde, 2008. Manual Field Experiments in Irrigation.

Assessments: Written report (100%)

Module WSE/09/c: Fieldtrip and Fieldwork WSE

No	Course	Lecture	Exercise	Workshop	Laboratory work	Fieldwork	Fieldtrip	Contact hours	Study load hours	Lecturer
1	Fieldtrip and fieldwork (WE)	0	0	0	0	0	0	120	140	H.J.M., MSc
2	Fieldtrip (HI)	0	0	0	0	0	0	80	112	B. Bhattacharya, PhD, MSc
Totals		0	0	0	0	0	0	200	252	

Academic year: 2011/2013
Specialisation(s): WSE-HELWD, WSE-HELWD Haramaya, WSE-HECEPD, WSE-HI, WSE-HERBD, WSE-HWR, WSE-HECEPD Hohai, WSE-HELWD AIT, WSE-HI Ain Shams,WSE-HI Cali,WSE-HWR Hohai
Co-ordinator: L.G. Hayde, PhD, MSc

Module Name **Irrigation and Drainage Structures**	**Module Code** **WSE/HELWD/10/e**	**Credit Points** **5**
Target Group All WSE participants	**Prerequisites** A basic understanding of irrigation and drainage systems design as well as general knowledge about different types of pumps used for irrigation purposes	

Learning Objectives

- Select the appropriate type of structure for irrigation and drainage networks, to establish the boundary conditions and to prepare a preliminary hydraulic design;
- Understand and analyse environmental aspects of land and water development projects, identify environmental impacts, and to identify measures to alleviate or mitigate the negative impacts;
- Identify the suitability of various types of pumps in specific situations, to define the boundary conditions for the application of pumps and lifting devices, to assess the requirements for operation and maintenance

Syllabus

Irrigation Structures, A. J. Clemmens (US Department of Agriculture-Agricultural Research Service) and L.G. Hayde (UNESCO-IHE)

Overview of the boundary conditions for design. Hydraulic background: sub-critical and critical flow over a weir. Calculation methods. Construction related aspects. Hydraulic characteristics of conveyance structures under various flow conditions: culverts, drop structures, aqueducts, siphons and inverted siphons, cross regulators and drainage structures, transitions, canal lining. Spatially varied non-uniform flow. Basic equations and their application to side channel spillways, side weirs and bottom withdrawal. Design of spillways, stilling basins, and weirs in irrigation and drainage canals. FLUME is a computer programme to design long-throated (measuring) flumes and to evaluate the water flow through them. Case studies on structure/controller design. Modern irrigation systems. Automated control systems: aspects of design, operation and maintenance.

Environmental Impact Assessment of Irrigation and Drainage, W. Buydens (Royal Haskoning, Belgium)

Environment as a system; environmental impacts. Examples; Environmental impact assessment (EIA); social process; legal requirements and the environmental impact statement (EIS); assessment methodologies and procedures. Description of the irrigation environment. Sustainable water resources management: definitions, integrating environment and development, case study Uzbekistan, environment and integrated water resources planning. Selected environmental issues: irrigation induced salinity, impact on water quality and quantity of receiving waters, moisture management in semi-arid temperate regions, irrigation and health hazards, equity and sustainability. Environment and project appraisal: the ICID environmental checklist, a simulation-optimisation model, economic appraisal of environmental impacts, case study wetlands in Nigeria.

Pumps and Lifting Devices, M. Kay (RTSC Ltd. United Kingdom)

Introduction, classification of pumps, pumps with a free water surface, positive displacement pumps, injection pumps, roto-dynamic pumps. Elaboration of roto-dynamic pumps, pump characteristics, efficiency, static, manometric and suction head, cavitation. Impeller design. Performance of pumps running alone or in combination with other pumps. Design of pumping stations; situation, mechanical and electrical installations, driving devices, transmissions. Civil engineering aspects. Inflow conditions. Pressure mains. Tube wells and low-lift pumps. Costs of installations, calculation of annual costs.

Didactics

Formal lecturers, indivdual and group assignments, written reports

Lecturing Materials

- Hayde, 2010. Irrigation Structures; Hydraulic Aspects.
- Manual Flume.
- Clemmens, 2009. Irrigation Structures

- Clemmens, 2008. Irrigation Structures, References
- Buydens, 2008. Environmental Aspects of Irrigation and Drainage.
- Buydens, 2006. Environmental Aspects of Irrigation and Drainage, selected readings.
- Buydens, 2001. Environmental Effects of Irrigation and Drainage: the Upper Penganga Project.
- International Commission on Irrigation and Drainage, 1993. ICID checklist of possible environmental effects.
- Kay, 2010. Pumps and Lifting Devices (Hand-out)

Assessments:

- Irrigation Structures (43%)
- EIA of Irrigation and Drainage (31%)
- Pumps and Lifting Devices (26%)

Module WSE/HELWD/10/e: Irrigation and Drainage Structures

No	Course	Lecture	Exercise	Workshop	Laboratory work	Fieldwork	Fieldtrip	Contact hours	Study load hours	Lecturer
1	Irrigation Structures	0	20	0	0	0	0	18	60	A.J. Clemmens, PhD, MSc
2	Irrigation Structures	8	0	0	0	0	0	0	0	L.G. Hayde, PhD, MSc
3	Environmental Impact Assessment of Irrigation and Drainage	10	8	0	0	0	0	18	44	Ir W.J.R. Buydens, PhD
4	Pumps and Lifting Devices	8	6	0	0	0	0	8	36	M. Kay
Totals		26	34	0	0	0	0	44	140	

Academic year: 2011/2013
Specialisation(s): WSE-HELWD, WSE-HELWD Haramaya, WSE-HECEPD, WSE-HI, WSE-HERBD, WSE-HWR, WSE-HECEPD Hohai, WSE-HELWD AIT, WSE-HI Ain Shams,WSE-HI Cali,WSE-HWR Hohai
Co-ordinator: F.X. Suryadi, PhD, MSc

Module Name **Advanced Methods and Equipment**	**Module Code** **WSE/HELWD/11/e**	**Credit Points** **5**
Target Group All WSE	**Prerequisites** General knowledge about drip and sprinkler irrigation systems as well as GIS and remote sensing.	

Learning Objectives

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

Syllabus

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

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

Remote Sensing for Irrigation and Drainage, Z. Vekerdy (ITC)
Introduction to the principles of remote sensing and their applications in the field of irrigation and drainage.

Reuse of Low Water Quality, P. van der Steen (UNESCO-IHE)
Sources of pollution: domestic, industrial and agricultural pollution. Types of pollution: chemical, mechanical and biological pollution. Parameters used to describe the degree of pollution: Salinity, BOD, COD, Dissolved oxygen, TSS, faecal coli, heavy metals. Reuse of water: criteria for reuse for agriculture, cattle watering and water supply. Measures for improvement of water quality: water treatment.

Land Use and Water in Flood Prone Areas, B. Schultz (UNESCO-IHE)
Historical and recent developments of land use and flood prone areas. The importance of land use zoning. Interactions between land use, water management and flood control. Future outlook.

Didactics
Formal lecturers, indivdual assignments, written reports, oral discussion

Lecturing Materials

- Reinders, 2010. Determining pipe sizes (hand-out).
- Reinders, 2009. Sprinkler and drip (hand-out).
- Ritzema, 2007. Subsurface drainage.

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

Assessments:

- Sprinkler and Drip - assignment (40%)
- Subsurface Drainage - assignment/oral discussion (60%)

Module WSE/HELWD/11/e: Advanced Methods and Equipment

No	Course	Lecture	Exercise	Workshop	Laboratory work	Fieldwork	Fieldtrip	Contact hours	Study load hours	Lecturer
1	Sprinkler and Drip	8	12	0	0	0	0	20	38	Prof. F.B. Reinders
2	Subsurface Drainage	12	10	0	0	0	0	22	56	Dr Ir H.P. Ritzema
3	Remote Sensing for Irrigation and Drainage	6	6	0	0	0	0	12	18	Dr. Z. Vekerdy
4	Reuse of Low Water Quality	8	0	0	0	0	0	8	16	N.P. van der Steen, PhD, MSc
5	Land Use and Water in Flood Prone Areas	6	0	0	0	0	0	6	12	Prof. E. Schultz, PhD, MSc
Totals		40	28	0	0	0	0	68	140	

Academic year: 2011/2013
Specialisation(s): WSE-HELWD, WSE-HELWD Haramaya, WSE-HECEPD, WSE-HI, WSE-HERBD, WSE-HWR, WSE-HECEPD Hohai, WSE-HELWD AIT, WSE-HI Ain Shams,WSE-HI Cali,WSE-HWR Hohai
Co-ordinator: Core Staff

Module Name **Groupwork WSE**	**Module Code** **WSE/12/c**	**Credit Points** **5**
Target Group All WSE Participants	**Prerequisites** All relevant topics of previous modules	

Learning Objectives

- Training the participants in multi-disciplinary development of a Master Plan for Water Resources Management.
- Training the participants in working out a research or design study in their own discipline as a part of the pre-feasibility study for the proposed Master Plan.
- Train the participants in using an engineering approach based on suitable technical considerations.
- Acquiring working experience in the development of multi-disciplinary project activities in integrated teams.

Syllabus

Group work (J. Nonner, Y. Xuan, B. Schultz, D. Roelvink, L. Brandimarte, A. Mehari Haile, J. Wenninger, A. Dastgheib, A. Sanchez Torres)

The group work project consists of the multidisciplinary preparation of (alternatives for) a rough Master Plan for Water Resources Management in (parts of) a river basin, taking into account given and imaginable threats and opportunities. In multidisciplinary or monodisciplinary subgroups the group members will work out a technical research or design study to support the proposed Master Plan. Based on the results of the various technical supporting studies, the feasibility of the Master Plan will be reviewed.

The project involves: data collection and analysis; proposals to develop the water resources potential in the area; proposals to decrease water-related risks like flooding, pollution or erosion; development of engineering components in the areas of rivers and river basin development, coasts and ports and land and water development, including economic considerations.

The group work will be carried out within the framework of a team effort and includes: showing a clear engineering approach within the frame work of a multidisciplinary project; organizing the work flow efficiently an keeping to the time planning; preparing readable well-structured reports of the required quality; presentation of the results of a study or design work orally in a short period for a technical audience, making adequate use of presentation tools.

Didactics

Field work, presentations, group and individual assignments, written reports

Lecturing Materials

- Handouts group work, information and data

Assessments: Report, Presentation, Individual Contribution (100%)

Module WSE/12/c: Groupwork WSE

No	Course	Lecture	Exercise	Workshop	Laboratory work	Fieldwork	Fieldtrip	Contact hours	Study load hours	Lecturer
1	Groupwork	2	0	30	0	0	0	32	140	-
Totals		2	0	30	0	0	0	32	140	

Academic year: 2011/2013
Specialisation(s): WSE-HELWD, WSE-HELWD Haramaya, WSE-HECEPD, WSE-HI, WSE-HERBD, WSE-HWR, WSE-HECEPD Hohai, WSE-HELWD AIT, WSE-HI Ain Shams,WSE-HI Cali,WSE-HWR Hohai
Co-ordinator: E.A. de Jong, MA

Module Name **Research Methodology and Summer Courses for WSE**	**Module Code** **WSE/13/c**	**Credit Points** **3**
Target Group This module is available to all participants of the Institute.	**Prerequisites** The successful completion of at least 7 of the first 12 modules For research methodology: Introduction to library and referencing, report (assignment) writing skills	

Learning Objectives

Upon completion of the research methodology course, the participant will:

- Understand the main thrusts, knowledge themes and key drivers of research agendas of UNESCO-IHE;
- Have a good knowledge of various research types and research methodologies applied in water science and engineering;
- Comprehend suitable ways for doing integrated research as well as reporting and communicating research results;
- Formulate clear and scientifically testable MSc-level research questions that can potentially lead to new insights in advancing the frontier within Water Science and Engineering and addressing some practical and societal problems;
- Demonstrate his/her expertise and competency through the formulation of well structured and content rich literature review, problem statement as well as logical and analytical research methodology;
- Acquire some skills to critically judge and evaluate the relevance of certain findings in the selected scientific topics;
- Develop search strategies using Boolean operators (e.g., nesting, proximity, truncation, NOT, AND NOT, OR, adjacency, wildcard); distinguish among various categories of information resources (e.g., scholarly, primary sources, technical reports);
- Distinguish between catalogs, databases, indexes, and the internet as examples of the complex nature of the information environment; and
- Identify controlled vocabulary when appropriate; conduct a refined search appropriate for the data bases selected and advanced search on the WWW.

Syllabus

Research Methodologies: Conceptual and Theoretical Aspects (S. Uhlenbrook)

Definition and characterisation of various types of research; the role of scientific and engineering related research in advancing the knowledge and skill horizons within the field of Water Science Engineering; approaches and techniques for data acquisition, processing, analyses and synthesis; research cycles; reporting, different ways of communication and dissemination of research results.

Thematic thrusts, knowledge themes and main drivers of research agendas at UNESCO-IHE. Overview of UNESCO-IHE past research achievements, current and future research activities. The UNESCO-IHE standards and key evaluation criteria for high quality MSc and PhD research as well as other types of research activities.

Research Methodology: A Practical Guide (A. Mehari Haile)

Discussion, with illustrative examples, on how to select an interesting, attractive and at the same time a content-relevant title; articulate the approaches to arrive at challenging yet answerable research questions that lay the foundation for excellent MSc thesis. Discussion with regard to the level of content and analyses required in a 'problem description', 'literature review', and 'research methodology' for a thesis to demonstrate high level of 'competency' and 'expertise' of the respective participant. With illustrative examples, keys steps are discussed focusing on how to avoid generalities and aggregation in analyses and hence arrive at concrete conclusions and recommendations.

Research and Information Literacy Skills (L.P. Darvis)

The Research Skills and Information Literacy lectures incorporate various teaching strategies such as research and referencing exercises, individual or in group form**.** The purpose of the lectures is to assist participants with

developing information-seeking abilities appropriate for their individual levels of scholarship and to support their research. The key skills on which the lectures will focus include: Identifying key concepts and terms that describe the information need, understanding how information is designed, stored, and organized; select the most appropriate investigative methods or information retrieval systems and accordingly locate and retrieve information.

Research Methodology: Group Exercise (**guided by one staff from each specialization**)
The main objective of this group exercise is to give the participants the opportunity to collectively discuss and use some of the knowledge they acquired from the lectures. The core activities are: participants will first critically read recent three to four journal articles within the broader field of their respective specializations. From the articles, they will identify research and knowledge gabs and accordingly formulate specific research questions. Using the research questions as the basis, the participants will retrieve additional relevant information and prepare well articulated and content rich (half to one page) introductory, problem description as well as research methodology notes.

Summer Courses (various staff)
The summer courses are open to all programmes at UNESCO-IHE. The actually offered summer courses depend on the availability of the lecturer and the economy of numbers of participants for a subject. During the course-year the final subjects to be selected will be announced. The participants need to choose a number of topics (at least 2) that accumulate to 4 credit points. These topics are not subject to examination. Course work reports will be required for earning the credits.

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

Lecturing Materials

- Douben, N. Uhlenbrook, S. and Abraham Mehari, 2010. Theoretical and practical guide for preparing a good MSc research proposal
- L.P. Darvis, 2010. Research and Information Literacy Skills
- Holtom, D. & E. Fisher, 1999. Enjoy Writing Your Science Thesis; A Step by Step Guide to Planning and Writing Dissertations and Theses for Undergraduate and Graduate Science Students. Imperial College Press. ISBN 1-86094-207-5. London, UK.
- Sturrock, W.J., 2007. MSc Thesis Writing; Guidelines and Advise. UNESCOIHE

Assessments: Written assignment (100%)

Module WSE/13/c: Research Methodology and Summer Courses for WSE

No	Course	Lecture	Exercise	Workshop	Laboratory work	Fieldwork	Fieldtrip	Contact hours	Study load hours	Lecturer
1	Research Methodologies	8	6	0	0	0	0	14	44	E.A. de Jong, MA
2	Summer Courses	0	0	0	0	0	0	0	68	E.A. de Jong, MA
3	Fieldtrip	0	0	0	0	0	8	0	8	-
Totals		8	6	0	0	0	8	14	120	

Academic year: 2011/2013
Specialisation(s): WSE-HELWD, WSE-HELWD Sriwijaya, WSE-HELWD Haramaya, WSE-HWR, WSE-HECEPD, WSE-HERBD, WSE-HI, WSE-HECEPD Hohai, WSE-HELWD AIT, WSE-HI Ain Shams, WSE-HI Cali, WSE-HWR Hohai
Co-ordinator: Core Staff

Module Name **MSc Research Proposal Development for WSE**	**Module Code** **WSE/14/c**	**Credit Points** **7**
Target Group This module is available to all participants of the Institute.	**Prerequisites** The successful completion of the relevant course work/mdules	

Learning Objectives

At the end of the module, the participant will be able to:

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

Syllabus: See didactics

Didactics

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

Lecturing Materials

- Douben, N. Uhlenbrook, S. and Abraham Mehari, 2010. Theoretical and practical guide for preparing a good MSc research proposal
- L.P. Darvis, 2010. Research and Information Literacy Skills
- Sturrock, W.J., 2007. MSc Thesis Writing; Guidelines and Advise. UNESCOIHE

Assessments: MSc Research Proposal Document (70%), Presentation and discussion of the Proposal (30%)

Module WSE/14/c: MSc Research Proposal Development for WSE

No	Course	Lecture	Exercise	Workshop	Laboratory work	Fieldwork	Fieldtrip	Contact hours	Study load hours	Lecturer
1	Preparation MSc proposal	0	0	0	0	0	0	0	139	-
2	Presentation	0	0	0	0	0	0	0	1	-
Totals		0	0	0	0	0	0	0	140	

Academic year: 2011/2013
Specialisation(s): WSE-HELWD, WSE-HELWD Sriwijaya, WSE-HELWD Haramaya, WSE-HWR, WSE-HECEPD, WSE-HERBD, WSE-HI, WSE-HECEPD Hohai, WSE-HELWD AIT, WSE-HI Ain Shams, WSE-HI Cali, WSE-HWR HohaiAll WSE specializations
Co-ordinator: Core staff

Module Name **MSc Research, MSc Thesis Writing Period**	**Module Code** **WSE/15/c**	**Credit Points** **5**
Target Group Prospective Water Science Engineering experts	**Prerequisites** Modules 1 to 14 or comparative modules from other institutes and universities	

Upon completion of the thesis the participants should be able to

- Carry out a comparative literature review on the selected research problem
- Carry out independent research, using the relevant knowledge, methodologies and techniques, and other skills achieved in the study programme;
- Make a critical assessment of prior research findings by others on similar or related problems;
- Make a critical assessment of the results obtained in this research, and to derive appropriate conclusions and recommendations;
- Successfully present and defend individual research work and cross-reference it to contemporary thinking in a specific field of study.

Syllabus

The thesis research, which takes place over a period of six months, is based on the proposal formulated in module WSE14 and is carried out by the student mostly independently, under direct supervision of a staff member. During the entire thesis research period the student is expected to meet with the supervisor regularly, approximately once per week, to discuss progress, results and directions for further work.

The problem, approach, results and findings of the study are described in a thesis report, which is presented by the student and discussed with an examination panel during the examination. The oral presentation and discussion are open to public attendance and take approximately one hour total time. The public, which is usually composed of fellow students and possibly interested staff and outside persons, is also invited to take part in the discussion.

Assessment of the examination is carried out by the examination panel, which is composed of the core professor (chairman), a core staff member (usually the supervisor) and an (external) expert in the field of study. The assessment is based on both the content and quality of the thesis report and the performance of the candidate during the presentation and discussion.

Lecturing Materials: As per the research need

Didactics: individual work and presentation; one-to-one discussion with Supervisors

Assessments

Thesis report writing, presentation (Evaluation by the Examination committee composed of the supervisors and an external examiner

Module WSE/15/c: MSc Research, MSc Thesis Writing Period for WSE

No	Course	Lecture	Exercise	Workshop	Laboratory work	Fieldwork	Fieldtrip	Contact hours	Study load hours	Lecturer
1	MSc Research, MSc Thesis Writing Period	0	0	0	0	0	0	0	1008	Core staff
Totals		0	0	0	0	0	0	0	1008	