

## **Academic programme at Rhodes University within AWARMN**

### **Masters of Science in Water Resource Science**

The main objectives of the degree are to produce students with excellent knowledge of water resources challenges such as water quality, aquatic ecology, environmental impact assessment, water governance and sustainable water resource management and utilisation. Being a research-based Master's degree, students are expected to demonstrate a thorough grasp of relevant international literature and appropriate methods. The research need not be original, but in IWR it usually is. A Master's thesis is publishable in the peer-reviewed literature. The cutting edge of the IWR Master's is the capacity to work across disciplines, learning framing theories that allow excellent application of both quantitative and qualitative data (science, social science, humanities). The challenge is combining methodological rigor, theoretical coherence and articulate synthesis. In addition, engaged transdisciplinary research focusses on real world issues. So, students engage with the challenges and complexity of real-world research and its ethical implications.

#### **Structure and content**

This degree is currently offered by research thesis only. The student will identify a specific topic that is guided by the research currently being conducted within the Institute. After identifying a supervisor and co-supervisor (ideally, the supervisor should be based in the hosting institution, whereas the co-supervisor may be located in a partner institution), the student will first produce a research proposal, which articulates the research questions and a preliminary research plan. After approval, the student reads and then writes a critical literature review relevant to the research question/s and aims. A conceptual framing is part of the review. The student will collect data, through field-, laboratory- or computer-based study. The student analyses these data appropriately and presents and discusses the results in relation to addressing the research question/s. Although there is some flexibility to the thesis structure, the student will typically produce a thesis containing a literature review, an introductory chapter that sets the context of the study and the research questions, a methodology chapter, a results chapter and a discussion/conclusion chapter. After approval by the supervisors, the dissertation goes through a review process by two external examiners. Required corrections are completed before graduation.

Although this degree is offered by thesis, students have access to a set of relevant skills-development courses and support groups, offered either by the Institute or Rhodes University, including introductory eco-hydrology; experimental ecotoxicology; environmental water quality; water resource protection; water law, policy, governance and institutional arrangements; statistics, thesis and paper writing with participation in a writing support group; and participation in a seminar series.

There is a certain degree of flexibility in the research topics available to students that is dependent on the staff research interests and funding available. Broadly, these topics involve applied research related to sustainable management of water resources, including the effects of toxicants on aquatic biota and ecosystems, using biota in aquatic health assessments and integrating the biological response data with environmental water quality in the application of this research for water resource management. There is a strong emphasis on transdisciplinary approaches to integrated water resource management - and the use of different knowledge sources to address what seem to be intractable water related issues. There is a strong research focus on water governance and institutional analysis; aquatic toxicology and ecology and water quality. Other research foci are available.

### **Doctor of Philosophy (PhD) in Water Resource Science**

Students must make original contribution to the field of study, particularly in the area of research focus: water quality, ecotoxicology, ecology, ecosystem science, water governance, water resource management and protection, and integrated water resource management (IWRM). A doctoral thesis will support the publication of at least four papers, to be published in the peer reviewed international literature. The cutting edge of the IWR doctoral programme is the capacity to work across disciplines, learning framing theories that allow excellent application of both quantitative and qualitative data (science, social science humanities). The student will combine methodological rigor, theoretical coherence, and articulate synthesis in answering the research questions. In addition, engaged, transdisciplinary research focusses on real world issues. So students engage with the challenges and complexity of real-world research and its ethical implications.

### **Structure and content**

The structure of a doctorate in Water Resources Science is similar to that for the Masters. The student would be required to identify a research topic supported by the research interests of available supervisors and available funding. However, these research questions are based on internationally-relevant gaps in existing knowledge. Generally, although a doctorate is similar in structure to a Master's, it is more comprehensive, and students would have to demonstrate that they are able to produce novel knowledge and to defend this knowledge amongst established peers within the specific research field. Similar to an MSc, the student will produce a thesis at the end of the study period. After approval by the supervisors and the university, the dissertation goes through an examination process by three external examiners, of which two must be international. Upon completion of the examination, the Dean appoint a committee of Internal Assessors, to evaluate the examiners' reports and make a recommendation as to whether or not the degree be awarded. The dean's recommendation, goes to the Vice Chancellor for decision on behalf of Senate. Doctoral students have access to the same skills-development courses and support groups as the Master's students. Specific topics of research depend on the research interests of available supervisors and the funding available, and broadly include research into the effects of toxicants on aquatic biota and ecosystems, using biota in aquatic health assessments and integrating the biological response data with environmental water quality in the application of this research for water resource management. Research may also broadly fall within the topics of climate change adaptation and decision-support systems, grass land ecology, water quality monitoring and modelling.

Although this degree is offered by research, students have access to a set of relevant skills-development courses and support groups, offered either by the Institute or Rhodes University, including: introductory eco-hydrology; experimental ecotoxicology; environmental water quality; biomonitoring, water resource protection; water law, policy, governance and institutional arrangements; thesis and paper writing through participation in a writing support group; statistics and participation in a seminar series.

There is a strong emphasis on transdisciplinary approaches to integrated water resource management - and the use of different knowledge sources to address what seem to be potentially intractable water related challenges. There is a strong research focus on water governance, institutional analysis, aquatic ecology and water quality.

### **Masters of Science in Hydrology**

The Master's degree requires students to demonstrate a thorough grasp of relevant international literature and appropriate methods. At a minimum, the student needs to demonstrate that he/she has mastered the skills required to conduct research in one of the research fields specific to

Hydrology mentioned below, and while the research produced by the student need not be original, Master's students at the IWR usually do produce novel research that results in publications. The Hydrology degree focuses on surface water hydrology, hydrological modelling, ground water hydrology and surface-ground water interactions. There is emphasis on uncertainty analysis and environmental flows.

### **Structure and content**

The structure of the Masters in Hydrology is essentially the same as that for the Masters in Water Resources Science. However, the research topic and research questions relate specifically to hydrology, and may therefore be more specific and technical. Generally speaking, research questions may fall within the broad categories of hydrological models and software, rainfall-runoff modelling, water resource assessment uncertainty analysis, and surface water-ground water interactions.

### **Doctor of Philosophy in Hydrology**

The main objective of this degree is to produce original and novel knowledge in specific area of hydrology including ground water hydrology, hydrological models and software, surface water hydrology, surface-ground water interaction and environmental flows. Students must be highly critical, analytical, who are able to synthesise the literature after being critically familiar with all the relevant international literature, as well as the selection and application of appropriate methods for data collection and analysis. The student should produce sufficient new knowledge in a hydrology-specific research field that is internationally relevant. A doctoral thesis will support the publication of at least four papers, to be published in the peer reviewed international literature.

### **Structure and content**

The Doctorate in Hydrology is similar in structure to the Masters in Hydrology, and the student would be required to identify a research topic supported by the research interests of available supervisors. Although generally a doctorate is similar in structure to a masters, it is more comprehensive, and the student would have to identify research questions that are based on internationally-relevant gaps in existing knowledge. Students would have to demonstrate that they are able to produce novel knowledge and to defend this knowledge amongst established peers within a hydrology-specific research field. Similar to a masters, the student will produce a dissertation at the end of the study period. After approval by the supervisors, the dissertation goes through an examination process by external examiners, which must include international examiners. Two of the three examiners must be international. Upon completion of the examination, the Dean appoint a committee of Internal Assessors, to evaluate the examiners' reports and make a recommendation as to whether or not the degree be awarded. Doctoral students have access to the same skills-development courses and support groups as the Master's students. Specific topics of research depend on the research interests of available supervisors and the funding available, and broadly include research into the broad categories of hydrological models and software, rainfall-runoff modelling, water resource assessment uncertainty analysis, and surface water-ground water interactions.

Read more, visit: <https://www.ru.ac.za/iwr/>

## **Programme at FUTMINA**

### **Master of Technology in Applied Hydrobiology**

The programme M. Tech Applied Hydrobiology provides a strong academic base for a broad understanding of the fundamental principles of Biology, especially recent developments in water Biology education. To provide sufficient intellectual motivation for academically minded biologists to pursue further deeper studies in Water and environment, including climate change (Ecology, Water Quality and Water linked food security e.g. Fisheries and Aquaculture). The M Tech programme in Applied Hydrobiology is designed in such a way as to arm students with basic skills that will allow them to apply principles of Aquatic Ecology to solve water pollution and related problems.

### **Structure and content**

The programme covers a variety of topics in advanced laboratory and field skills, and postgraduate students can choose from units that cover marine ecology/Oceanography, aquaculture, ecotoxicology and pollution, and dynamics and exploitation of Fish population. A large amount of time is spent on a research project that will enable the students to apply the skills and knowledge that they have gained.

On completion, all graduates of the programme will have an in-depth knowledge and understanding of the diversity and biology of the organisms that inhabit aquatic environments and the ways in which aquatic resources can be exploited and managed for human and wildlife benefit. The skills to carry out essential practical laboratory and field skills relevant to aquatic biology. The graduate would demonstrate skills in the evaluation and interpretation of laboratory and field data; plan and design experimental projects. Critically evaluate scientific information in written and/or oral form and engage in debate and argue effectively and rationally in oral and written discourses. Monitor and review own progress in relation to academic and personal development. Employment opportunities for graduates of the programme in Hydrobiology include a range of environmental organisations such as the Environment Agencies, government ministries, multilateral organizations and consultancies.

### **Doctor of Applied Hydrobiology**

The programme PhD Applied Hydrobiology provides a strong academic base for a broad understanding of the fundamental principles of Biology, especially recent developments in water Biology education. To provide sufficient intellectual motivation for academically minded biologists to pursue further deeper studies in Water and environment, including climate change (Ecology, Water Quality and Water linked food security e.g. Fisheries and Aquaculture). The PhD programme in Applied Hydrobiology is designed in such a way as to arm students with basic skills that will allow them to apply principles of Aquatic Ecology to solve water pollution and related problems.

### **Structure and content**

Research Project:

The main student selects a research project in the broad field of hydrobiology. During the project students are expected to write literature reviews and develop skills in data analysis and presentation. Students who already have a M.S. in Biology (or related areas) are admitted directly into the Ph.D. program and will be expected to conduct original research culminating in a dissertation. We expect these students to complete the Ph.D. in 3 years.

### **Master of Technology in Hydrogeology**

The programme MTech Hydrogeology provides a strong academic base for a broad understanding of the fundamental principles of Hydrology, especially recent developments in Water-Geology education. The programmes are designed to provide advanced and modern training in geosciences that adequately prepare the graduates for employment in government, private sector and self-entrepreneurship.

### **Structure and content**

The MTech Hydrogeology covers areas such as hydrogeological principles & Techniques, Groundwater Flow Theory, Hydrogeological Environments, Groundwater Engineering, Water Quality and Environmental Geology, Economics Of Water Resources Development And Management, Photogeology And Remote Sensing, Structural Geology, Applied Geophysics, Engineering Geology  
Engineering Geology II.

### **Doctor of Hydrogeology**

The programme PhD Hydrogeology provides a strong academic base for a broad understanding of the fundamental principles of Hydrology, especially recent developments in Water-Geology education. The programme is designed to provide advanced and modern training in geosciences that adequately prepare the graduates for employment in government, private sector and self-entrepreneurship. To empower the graduates to be capable of embarking on ventures that can explore for and effectively transform the natural resources of their environment into goods and services.

#### Structure and Content

Research Project: The student's final project will allow each person to select from a range of water projects provided by staff within the School and Hydrogeology, Hydrogeochemistry, Water Quality Monitoring and Modeling, Water Resources Management, Medical Hydrogeology (Water and Health) projects. During the project, students are expected to write literature reviews and develop skills in data analysis and presentation. Students who already have a M.S. in Geology (or related areas) are admitted directly into the Ph.D. program and will be expected to conduct original research culminating in a dissertation. We expect these students to complete the Ph.D. in 3 years.

Read more, visit: [www.futminna.edu.ng](http://www.futminna.edu.ng)

Programme at Makerere University

### **Masters of Science in Chemistry**

The main objectives of the program are:

- (a) To provide advanced knowledge in chemistry and applied chemistry to first degree holders.
- (b) To develop researchers in chemistry and applied chemistry and nurture a quality assurance-conscious group of scientists in order to safeguard users of chemicals.

### **Structure and content**

The duration of the program is two calendar years or four semesters. Each semester consists of 17 weeks of teaching and three weeks of examinations. The program requires students to enroll full-time. The program consists of two parts; part I (Course Work) and part II (Research and Dissertation).

Part I of the program is completed in two semesters and consists of course work with nine courses. One course unit is equivalent to one contact hour per week per semester. A one-hour lecture is equivalent to one contact hour.

The four compulsory courses which shall be completed in the first semester. The four courses taught is designed to give candidates a broad background knowledge on relevant topical issues in chemistry.

Five courses shall be completed in the second semester. One compulsory course; and four other courses to be selected from any of the given areas in consultation with the supervisor(s), with at least three of the four from the area of specialization.

-In part II of the program, candidates will undertake individual research projects in their areas of specialization which will form the subject of a concise dissertation.

The areas of specialization are:

Inorganic Chemistry

Organic Chemistry

Physical Chemistry

Applied Chemistry

### **Doctor of Philosophy in Chemistry**

The PhD in Chemistry degree program is designed to train students broadly in water resources while maintaining an intellectual affiliation with a secondary field. Allied fields include ecology, geology, oceanography, atmospheric sciences, climatology, geomorphology, soil physics, geochemistry, public health, and microbiology. Increasing knowledge of connections between the biosphere and the hydrosphere are driving the emergence of the field of water quality. Problems in global change are increasingly recognized as linked to the land surface through freshwater runoff into the world's oceans and evapotranspiration. Many environmental problems require training in areas of science. Students completing this degree program will meet the research requirements to attain the award.

### **Structure and Content**

Seminar 1: Present a research proposal and plan of work

Seminar2: Present a critical literature review, setting the project within the current body of knowledge and clearly identifying the knowledge gap to be addressed by the research.

Seminar 3: Method development and validation: Present methods to be used and methods to validate results that show that student has knowledge to successfully conduct a research project in the field of study. The method may not be entirely new but the student should demonstrate that the method will work under his conditions of research.

Seminar 4: Prepare & Present a poster. The student should demonstrate that he can present a poster of the work he will have achieved and demonstrate that he is capable of defending his work at international for a.

Seminar 5: As much as possible, this seminar should come near to, or at the end of, the student's laboratory work. The presentation should be to the department as well as to the doctoral committee. The seminar should be aimed at assessing the candidate's readiness to start writing a thesis and readiness to make a public defense of his thesis.

More information here: <http://chemistry.mak.ac.ug/>

**University of Kinshasa**

**Masters of Science in Water Resources**

The program focuses on understanding the processes that determine flows (water quantity and contaminants) within the terrestrial hydrosphere, characterization (data acquisition and processing), and predictive modelling for optimal management of the water resources. It also allows students to acquire in-depth knowledge that is useful and necessary to undertake possible training in the field. The program also aims at the following specific objectives:

- High level training in human resources water resources management, capable of responding to current challenges, and more precisely capable of understanding and managing water resources in an integrated and transversal way, taking into account climate and sustainable development issues;
- Introduction to scientific research in the field of water;
- Development of knowledge on water resources management in order to maximize the resulting economic and social well-being in an equitable manner, without compromising the sustainability of vital ecosystems.

### **Structure and content**

This degree is offered through course work and dissertation. It is designed to provide students with an in-depth knowledge and application of skills in the different aspects of water resources management. It exposes students to the hydrological cycle and the dynamics of the water balance, hydrological data collection, processing and analysis, methods of analysis in Hydrology, water resources economics and development, prediction in ungauged catchments, key water management issues and the context of water use in developing countries, problem analysis, analytical framework, water resources planning; water quality and quantity, water use efficiency, stakeholder analysis and participation.

### **Doctor of Philosophy Water Resources**

The PhD degree in Water Resources aims at producing researchers and trainers with a deep knowledge, analytical skills and innovative capacities in the area of water resources, including atmosphere and land surface water resources. The degree is based on research.

### **Structure and content**

The PhD programme is undertaken by attendance, full time, and comprises of seminars, at least three per year. A supervision committee is composed of at least two specialists in the field of research including the PhD supervisor, and one committee member who could be in another field of research. The assessment process is made of seminars, at least three per year, participation at conferences, and at least two publications in international journals. The thesis is defended publicly before a jury whose composition is proposed by the Research Director and validated by the Department and Faculty Councils. The members of the jury are thus appointed by the Rector of the University of Kinshasa. The defense is public and other learners can attend. This oral test makes it possible to assess the learner's ability to pose a research problem, to carry out quality bibliographic work, to use methodological tools and to understand the field of the sub-discipline in which his work is carried out.

Read more, visit: <https://www.unikin.ac.cd/>

### **Programmes at Ecole Nationale Supérieure d'Hydraulique (ENSH)**

## Masters in Hydraulics

The master degree in Hydraulics is considered as a complement to the engineer courses to complete a lack in research skills, for this reason 206 hours were added to the ten (10) semesters of the engineer program to prepare student for the Doctorate level.

For an additional information; engineers have nine (09) theoretical semesters subdivided into two levels; Primary one (04 semesters) with 1800 hours and speciality (5 semesters) with 1900 hours and the 10<sup>th</sup> semester is for the final project.

The Master course is organized in two parts:

- Theoretical one: 206 hours of seminars and conferences around some research themes.
- Practical one: preparation on a master document on a chosen research theme, considered as an initiation to research during 16 weeks, after that it must be presented and defended in front of a jury.

The Master degree focuses on research methodology around several themes, especially: Sediments transport, Stochastic hydrology and Advanced Hydraulics (turbulence). The course helps students to develop research problematic starting from their practical background obtained during the Engineer degree. Problematic are from various fields; Urban water management, environment, surface and ground water hydrology and fluid mechanics and hydraulics.

### Structure and content

#### **Structure and content (max. 400 words):**

The theoretical course (206 h) is articulated on the following courses:

- 1- Turbulence and Mixtures.
- 2- Sediment transport.
- 3- Stochastic and deterministic Hydrology.
- 4- Research methodology.

The research component covers a practical research problematic from the main research axes of the two laboratories of the School. Student have 16 weeks to finish and to defend their work in front of a jury.

## **Doctor of Philosophy in Hydraulics**

A Doctorate degree in Hydraulics (following three options) has for objective to prepare high qualification researchers in hydraulics, including environmental aspects and technologies related to water resources. Doctorate degree in Hydraulics helps students to improve their skills in several environmental and earth sciences fields. The Training is meant to enhance both teaching and research skills of graduates.

#### **Structure and content (max. 400 words):**

The PhD in Hydraulics programme has both course work and research components – divided into theoretical and research semesters as follows:

### **Theoretical semesters:**

- 1- Sediment transport: This course constitutes one of the bases of the research of the domains related to the study of the physical processes of the sedimentary transport and it covers aspects such as mechanisms of sedimentary transport in fluvial environment.
- 2- Turbulence and Mixtures: it provides the fundamental of turbulent hydrodynamics.
- 3- Stochastic and deterministic Hydrology: This course covers hydrological modelling and tools.
- 4- Research methodology: It prepares the students for research.
- 5- English: improve the language skills of the students.
- 6- ICTs; information and communication technologies: Helps students to work more easily with IT tools.

### **Research semesters**

The student in consultation with their supervisor selects an aligned research topic. Students must complete their research within four semesters.

More information here: <http://ar.ensh.dz/>