MSc/PhD. Environmental Engineering and Management

MSC: One-year thought and One-year Research

PhD: One year though course and Two years of Research

PROGRAMME QUALIFICATION PROFILE

PhD. Environmental Engineering and Management		
TYPE OF DEGREE / LENGTH		MSc/Two academic years Doctor of Philosophy / 4 Academic Years
TOTAL CREDIT		≥52
INSTITUTION		University of Energy and Natural Resources, Department of Civil and Environmental Engineering
ACCREDITATION AGENCIES		National Accreditation Board & National Council for Tertiary Education (Tertiary Education Council)
QUALIFICATION(S)		Master's Degree (Civil/Environmental/Geological/Chemical/ Agric/ Mechanical/Materials/Sanitary Engineering, Chemical /Biological /Biochemical and Environmental Sciences, Water Supply and Sanitation, Natural Resources Management (Minimum of Second Class lower, working experience is an added advantage)
A	**PURPOSE**	
	The environmental engineering and management graduate degree programme has been designed for students wishing to enhance their career prospects in environmental engineering and management. The programme aims to provide advanced training for both engineers and scientists concerned with protecting the environment and human health through the provision of services such as water supply, sanitation, wastewater treatment and municipal solid waste and hazardous waste management, resource recovery from waste materials, etc.	
B	**CHARACTERISTICS**	
1	**DISCIPLINE(S)/SUBJECT AREA(S)**	The students under the programme take all the environmental related courses. Students are allowed to choose options in the second semester of the first year.
2	**GENERAL/SPECIALIST**	Specialist training – Environmental Engineering and Management
3	**ORIENTATION**	Applied

4	**DISTINCTIVE FEATURES**	• One of the practical aspects of the programme is the industrial attachment. Students are assigned to collaborating institutions on industrial attachment for practical training. The faculty go round the institutions of attachment and assess students' performance and progress. Students come back to campus to make a final presentation of their experiences on attachment and present written reports for assessment. Vacation based internships are also encouraged in the program. • Students also have the option of taking courses from other departments that are peculiar to their project or of interest to the students. • Guest lecturers from industry.
C	**EMPLOYABILITY & FURTHER EDUCATION**	
1	**EMPLOYABILITY**	Graduates can work in a range of companies in design, supervision and management of environmental related projects including environmental systems. They can also work in academic and research institutions. Graduates from the programme can be employed in: • NGOs working in the environmental sector • Donor and multinational agencies (GIZ, AfDB, World Bank, UN, etc.) • Ministry of Land and Natural Resources • Ministry of Sanitation and Water Resources • Metropolitan, Municipal and District Assemblies • Sector Agencies (Environmental Protection Agency, CWSA, GWCL) • Ministry of Environment, Science and Technology • Teaching and Research institutions • Mining companies • Consultancy firms • Waste management companies • Gas and oil companies • Self-employment
2	**FURTHER STUDIES**	Graduates can proceed to study post doctorate programme or research studies
D	**EDUCATION STYLE**	

1	**LEARNING & TEACHING APPROACHES**	Lectures (online/classroom based), hands-on practical demonstrations, hands-on practical training (lab & field, industrial attachment), group project, seminars, graduate thesis, case studies, discussions and brainstorming sessions. Problem-based learning approach will be applied wherever relevant in the delivery of the courses.
2	**ASSESSMENT METHODS**	Presentations, written & oral exams, practical exams, quizzes, term papers, assignments (individual and group work), review of published papers and seminars.
E	**PROGRAMME COMPETENCIES**	
1	**INSTITUTIONAL COMPETENCIES (GENERIC)** These are university-wide competencies **At the end of this programme, graduate should be able to:** • **Complex problem solving:** apply experimental design, conduct data analysis, and perform modelling. • **Effective leadership and management**: take up leadership positions and manage them effectively. • **Innovation and Entrepreneurship:** demonstrate a creative and innovative mind-set and apply innovative and entrepreneurial skills to provide needed services in their communities. • **Good attitude and excellent ethics**: apply good moral principles to their field of profession. develop the ability to examine sets of obligations in their profession to society, to their clients, and to the profession. Work with different people from diverse backgrounds and with various skills. • **Good communication skills**: communicate effectively with different audiences and changing the style as appropriate. These skills are seen through an effective PowerPoint presentation, creating an effective 'pitch' and writing a business proposal, thesis writing, technical reports, and scientific papers, actively participating in group discussions, writing a resume and networking among stakeholders. • **Lab & Field safety skills:** conduct independent field or lab work with adequate safety measures in place. • **Research ability:** conduct scientific research in understanding and appreciation of the philosophical bases, methodologies, and characteristics of scholarship and creative work, publish.	
2	**PROGRAMME LEARNING OUTCOMES**	
	The learning outcomes of the programme are categorized into three broad areas: knowledge, skill, and competence **Knowledge: At the end of this programme, graduates should be able to: -** • Gain advanced knowledge of the principles of environmental engineering underpinning sustainable development. • Understand and appreciate current issues and debates in the field of environmental engineering and management.	

	• Understand and appreciate the philosophical bases, methodologies, and characteristics of scholarship, research and creative work in the environmental engineering and management field. **Skills: At the end of this programme, graduates should be able to:-** • Demonstrate mastery of theoretical knowledge and to reflect critically on theory and professional practise in environmental engineering and management • Investigate, analyse, evaluate and synthesize complex information, problems, concepts and theories and to apply established theories to different bodies of knowledge or practise in the environmental engineering and management. • Build capacity for critical, conceptual and reflective thinking, creativity and originality • Exhibit Intellectual openness and curiosity • Exhibit Intellectual Integrity, Respect for truth and for the ethics of research and scholarly activity • Make appropriate use of advanced information and communication technologies • Communicate effectively with range of audiences • Apply innovative and entrepreneurial skills to identify and recognise business opportunities in the environmental field • Work in a team of people with diverse educational and cultural backgrounds. **Competencies: At the end of this programme, graduate should be able to:-** • Identify, analyse, formulate and solve problems in a location in collaboration with local community and stakeholders. • Design and deliver environmental solutions/interventions in a safe, reliable way taking into consideration relevant sustainable development goals (e.g. SDG 6, 7, 11, 13, 17. Agenda 2063, Aspiration No. 1). • Develop environmentally efficient strategies in the design and management of environmental systems. • Conduct environmental and social impact and health-risk assessment of infrastructure and projects. • Formulate research problem, plan and execute the research and communicate the findings to targeted audience. • Execute duties in an ethical and professional way, examine obligations to society. • Develop their own learning through lifelong learning approaches including the use of e-learning tools.

1. **Components of the programme:**

(a) Core course (s);

Year One Semester One	
EEMA 701	Environmental Chemistry
EEMA 703	Environmental Microbiology
EEMA 707	Air Pollution Control
EEMA 705	Climate Change Management
EEMA 709	Solid and Hazardous Waste Engineering and Management
EEMA 711	Water and Wastewater Treatment
EEMA 713	Remote Sensing and GIS
Year One Semester Two	

EEMA 702	Environmental Engineering Master plan
EEMA 704	Statistics & Research Methods
EEMA 706	Environmental and Social Impact Assessment and Safeguards
EEMA 708	Environmental Health & Safety and Risk Assessment
EEMA 710	Environmental Law, Policy and Governance
EEMA 712	Project Management, Entrepreneurship and Ethics
EEMA 714	Water Resources Engineering and Management

(b) Elective course (s);

Year One Semester One	
EEMA 721	Modelling of Water Systems
EEMA 723	Design of Water and Wastewater Conveyance Systems
EEMA 725	Climate Change Modelling
EEMA 727	Data Science and Artificial Intelligence
Year One Semester Two	
EEMA 722	Water, Food, Energy Nexus
EEMA 724	Sustainability and Life Cycle Assessment
EEMA 726	Advanced Processes for Recycling and Reuse of Resources
EEMA 728	Management of Oil, Gas and Mining Waste

(c) Mandatory course(s)

Year One Semester One	
Course Code	**Course Title**
EEMA 701	Environmental Chemistry
EEMA 703	Microbiology for Engineers
EEMA 707	Air Pollution
EEMA 705	Climate Change Management
EEMA 709	Solid and Hazardous Waste Engineering and Management
EEMA 711	Water and Wastewater Treatment
EEMA 713	Remote Sensing and GIS
Electives (One option)	Modelling of Water Systems
	Design of Water and Wastewater Conveyance Systems
	Climate Change Modelling
	Data Science and Artificial Intelligence

Year One Semester Two	
Course Code	**Course Title**
EEMA 702	Environmental Engineering Master plan
EEMA 704	Statistics & Research Methods
EEMA 706	Environmental and Social Impact Assessment and Safeguards
EEMA 708	Environmental Health and Safety
EEMA 710	Environmental Law, Policy and Governance
EEMA 712	Project Management, Entrepreneurship and Ethics
EEMA 714	Water Resources Engineering and Management
Electives	
Electives (One option)	Water Food Energy Nexus
	Sustainability and Life Cycle Assessment
	Advanced Processes for Recycling and Reuse of Resources
	Management of Oil, Gas and Mining Waste

(d) Research component;

YEAR TWO	
EEMA 700	Thesis

Year One Semester Two	
EEMA 720	Environmental Engineering Seminar
EEMA 730	Industrial Attachment

(e) Structure of the programme (Semester-by-semester schedule/structure of course, showing the credit value of each course).

YEAR ONE

Year One Semester One				
Course Code	**Course Title**	**Theory**	**Practical**	**Credits**
EEMA 701	Environmental Chemistry	2	1	2
EEMA 703	Microbiology for Engineers	2	1	2
EEMA 707	Air Pollution	2	1	2
EEMA 705	Climate Change Management	2	1	2
EEMA 709	Solid and Hazardous Waste Engineering and Management	2	2	3
EEMA 711	Water and Wastewater Treatment	2	2	3
EEMA 713	Remote Sensing and GIS	1	2	2
Electives				
One option	Modelling of Water Systems	1	2	2
	Design of Water and Wastewater Conveyance Systems	1	2	2
	Climate Change Modelling	1	2	2
	Data Science and Artificial Intelligence	1	2	2
Total Credit for Semester				**18**

Year One Semester Two				
Course Code	**Course Title**	**Theory**	**Practical**	**Credits**
EEMA 702	Environmental Engineering Master plan	0	4	2
EEMA 704	Statistics & Research Methods	2	1	2
EEMA 706	Environmental and Social Impact Assessment and Safeguards	2	1	2
EEMA 708	Environmental Health and Safety	2	1	2
EEMA 710	Environmental Law, Policy and Governance	2	0	2
EEMA 712	Project Management, Entrepreneurship and Ethics	2	1	2
EEMA 714	Water Resources Engineering and Management	2	1	2
Electives				
One Option	Water Food Energy Nexus	2	1	2
	Sustainability and Life Cycle Assessment	2	1	2
	Advanced Processes for Recycling and Reuse of Resources	2	1	2
	Management of Oil, Gas and Mining Waste	2	1	2

Total Credit for Semester		**18**
Cumulative Credits		**36**

Year Two				
Course Code	**Course Title**	**Theory**	**Practical**	**Credits**
	Thesis	0	24	12
Total Credit				**12**
Cumulative Credits				**48**

2. **Course Description**

YEAR ONE (Semester One)

EEMA 701**: Environmental Chemistry**

Objective

To equip students with advance knowledge of chemical processes and environmental toxicology to enable student perform qualitative and quantitative environmental risk assessment.

EEMA 703: Environmental Microbiology

Objective

To introduce students to basic concepts of microbiology and to employ these techniques in waste treatment systems.

EEMA 707: Air Pollution Control

Objective

The objective of this course is to deliver knowledge about the atmospheric environment, ambient air pollution, and pollution control.

EEMA 705: Climate Change Management

Objective

The key objective of the training is to introduce the current issues of climate change, a global phenomenon influencing greatly a wide range of international and national economic and political decisions and enhancing a number of mitigation and adaptation initiatives. The participants are exposed to the scientific, economic, policy and social impacts and approaches to climate change, climate science, energy policy, greenhouse accounting and clean technologies in order to ensure a first-hand experience of the execution, monitoring and evaluation process of successful projects and the latest trends in climate changes

management, underlining the fact that climate change does not only have an environmental-climatic dimension but also a regulatory-market economy dimension.

EEMA 709: Solid and Hazardous Waste Engineering and Management

Objective

This course is designed to provide students with the necessary advanced knowledge and skills pertaining to the engineering technologies for the management of solid and hazardous waste.

EEMA 711**: Water and Wastewater Treatment**

Objective

To enable students to understand the processes and technologies for water and wastewater treatment including conventional and advanced wastewater treatment and the sizing of various treatment units. The course also tends to create awareness of the importance of effective wastewater treatment for river pollution control.

EEMA 713**: Remote Sensing and GIS**

Objective

- Students will be able to apply the principles and concepts of geographic information systems (GIS) and remote sensing for environmental management.
- Students would also learn the advances in Artificial intelligence and its integration with GIS and RS for automation of environmental systems

EEMA 721**: Modelling of Water Systems**

Objective

To help students acquire skills and to solve water related problems using models such as WEAP, SWAT and MODFLOW.

EEMA 723**: Design of Water and Wastewater Conveyance Systems**

Objective

Identification and evaluation of design solutions for providing a community with adequate water supply, collecting and disposing of stormwater and sewage, and managing excess stormwater flow.

EEMA 725: Climate Change modelling (3 credits)

Objective

Climate models are fundamental tools for learning about our planet, assisting scientists and governments in assessing current and future risks and vulnerabilities. The reality of today's climate modelling landscape, with ever more complex numerical models, running on the world's largest super computers, requires a high degree of competence and efficiency, which must be instilled in scientists at the early stages of their careers.

EEMA 727**: Data Science and Artificial Intelligence**

Objective

With the increased availability of data from varied sources there has been increasing attention paid to the various data driven disciplines such as analytics and machine learning. In this course we intend to introduce some of the basic concepts of machine learning from a mathematically well motivated perspective. We will cover the different learning paradigms and some of the more popular algorithms and architectures used in each of these paradigms.

YEAR ONE (Semester Two)

EEMA 702**: Environmental Engineering Master Plan**

O b j e c t i v e s

This Master plan-integrated project has been designed to emphasize and give opportunity to;

- Problem solving and thought-provoking analysis which establishes confidence, advancing to problems of industrial character and complexity.
- In the end, delivering innovations in environmental engineering with technically sound pre-design and a preliminary business plan

EEMA 704: Statistics & Research Methods

Objective

To enable students to collect survey data and design experiments with constraints on block and treatment sizes. To enhance capacity of students to handle large-multivariable data sets arising from sampling and experimentation studies using appropriate statistical software.

EEMA 706: Environmental and Social Impact Assessment and Safeguards

Objectives

The course aims to introduce the concepts, procedures and methodology of Environmental Impact Assessment (EIA), to develop a critical awareness of factors which affect the use of EIA as part of project management, and to expose the students to the need for environmental impact

assessments and how to prepare the various documents required by regulators. The specific objectives are below:

- To provide a basic understanding of the EIA process as it is used for research, planning, project or program evaluation, monitoring, and regulatory enforcement.
- To introduce students to the legal, economic, social, administrative and technical process of preparing and/or evaluating environmental impact documents.
- To relate the uses of scientific research to practical situations in project planning and decision making.
- To provide experience and training in environmental planning and related professions.

EEMA 708: Environmental Health and Safety

Objective

To develop knowledge and skills necessary in remedying occupational safety and health hazards within the working environment.

EEMA 708: Risk Assessment

Risk Assessment is a transdisciplinary, multifaceted approach to solving public and environmental health science problems because it combines the key principles of exposure sciences (through assessment of exposure), toxicology (through hazard identification), and modeling (through dose-response assessment) to characterize risks from biological, chemical, or physical agents and public health situations. Risk management includes delineating options, making decisions, and taking actions to address the risks identified. Making decisions in the face of significant uncertainty is a key challenge to which risk assessment and risk management approaches can be applied. Risk communication identifies approaches to exchange information about risks to stakeholder groups.

Objectives

The course objectives include:

- Identifying hazards and understanding the methodologies and types of data generated by public health studies (epidemiology, toxicology, etc)
- Define risk assessment, describe the what, why and how of risk assessment, i.e., describing and differentiating the public health risks, benefits and costs of a particular action or chemical and thereby developing a framework for decision-making in environmental health and safety.
- Characterizing the public health risks of a specific hazard by accounting for variables, differing sensitivities and uncertainties of analysis.
- Identifying factors that contribute to the diversity of the response of human populations to environmental toxicants.
- Define risk management and identify means to control risk including intervention as well as use of legislative and regulatory guidelines.
- Effectively communicate environmental and public health risks and prevention strategies to potentially affected communities

EEMA 710: Environmental Law, Policy and Governance

Objective

This course is developed to provide first-hand principles on governance (political context on how environment is controlled, manipulated, regulated and contested by a range of actors and institutions) while zooming in on the wide-ranging theories and approaches that underpin policy and practice. It will also enable students to apply their understanding of environmental problems and assess potential solutions through the application of law, policy, and management

EEMA 712: Project Management, Entrepreneurship and Ethics

Objective

To help students acquire skills and knowledge in Project Management and Entrepreneurship. To inculcate professional ethical principles and practices into the students.

EEMA 714: Water Resources Engineering and Management

Objective

To train students to understand integrated water resources management to apply the knowledge gained in the design of wastewater transmission systems and sustainable management of water resource systems.

EEMA 720: Water Food Energy Nexus

Objective

In light of emerging global challenges such as climate change, increasing urbanization, population growth and advancing degradation of ecosystems, a collaborative and sensitive approach such as the Nexus is essential to meet increasing water, energy and food security demands in the long-term.
The Nexus approach challenges existing structures, policies and procedures at global, regional and national levels and hence, needs to overcome various barriers such as sectoral governance frameworks and arrangements, power imbalances, or conflicting perceptions, interests and practices.

EEMA 724: Sustainability and Life Cycle Assessment

Objective

To enable students to assess the environmental performance of various products and systems.

Learning outcome

- The course provides the student with knowledge about:

- Develop knowledge about Life Cycle Assessment (LCA), a framework for evaluation of the environmental footprint of various systems and technologies.
- Apply Life Cycle Assessment on products and on various technologies and systems.
- Perform robust assessments of the environmental characteristics of systems.
- Perform a moderately complex LCA under supervision.

EEMA 726: Advanced Processes for Recycling and Reuse of Resources

Objective
The course will equip students with the knowledge and skills to reuse/recycle resources.

Content

Thermo-chemical processes: combustion, pyrolysis, gasification, liquefaction. Physical processes: drying and densification. Biochemical processes: digestion, fermentation, methane capture from landfill. Mechanical-biological processes: composting and anaerobic digestion. Regrinding, glycolysis, energy recovery. Recycling methods applications in batteries, cell phones, TVs, computers and other electronics, cars construction materials (recycling paint, wood recycling), fabric materials, glass, metals, paper, plastic, water (recycling grey water)

EEMA 728: Management of Oil, Gas and Mining Waste

Objective

This course is designed to enable students to employ the appropriate methodologies and technologies to solve pollution problems regarding mining, oil and gas industries.

YEAR TWO (SEMESTERS ONE AND TWO)

EEMA 700: Project Work/Research Project

Objective
This course is the project component of the research method and proposal writing. The course will equip students with skills to apply cumulative knowledge gained to solve environmental problems in relation to the design and or analysis of systems in the field of sustainable environment management.