MSc/Ph.D. Sustainable Energy Engineering and Management (SEEM)

Programme Qualification Profile

Ph.D. Sustainable Energy Engineering and Management	
TYPE OF DEGREE / LENGTH	MSc/Two Academic Years Ph.D. / Three Academic Years
TOTAL CREDIT	≥72 hours
INSTITUTION	University of Energy and Natural Resources, Department of Energy and Petroleum Engineering
ACCREDITATION AGENCIES	National Accreditation Board
ENTRY QUALIFICATION(S)	Second degree in a relevant field
A	**AIM**

	The programme aims to produce graduates with advanced knowledge and skills in energy engineering and management; this will be by providing high-level teaching and research, in an interdisciplinary approach, to deliver a set of skills and competencies in sustainable energy systems.	
B	**CHARACTERISTICS**	
1	DISCIPLINE(S)/SUBJECT AREA(S)	The students go through all the courses together; thus, the students under the programme take all the energy-related courses. Students are given the chance to choose a course of their choice in their second year.
2	GENERAL/SPECIALIST	Specialist training - Renewable Energy Engineering
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.
C	**EMPLOYABILITY & FURTHER EDUCATION**	
1	**EMPLOYABILITY**	Students can work in a range of companies in designing, installing, and operating renewable energy generating systems such as wind, solar, biomass, or hydro systems. They could also work on designing and assisting in constructing energy-efficient buildings. They can also work in academic and research institutions. Graduates from the programme can be employed as: • Renewable Energy Engineer • Renewable Energy Systems Designer • Renewable Energy Resource Analyst • Energy Efficiency and Management Consultant.
2	**FURTHER STUDIES**	Ph.D. in areas like Renewable Energy, Sustainable Energy Management, Energy Systems Engineering, and any other related engineering or management programme
D	**EDUCATION STYLE**	

1	**LEARNING & TEACHING APPROACHES**	Lectures, hands-on practical demonstrations, hands-on practical training (lab & field, industrial attachment), group project, final year thesis, case studies, discussions, and brainstorming sessions. A problem-based learning approach will be applied wherever relevant to the delivery
2	**ASSESSMENT METHODS**	Presentations, written & oral exams (mid-semester and final), practical exams, quizzes, assignments (individual and group work), seminars, and journals/notebooks.
E	**PROGRAMME COMPETENCIES**	
1	**INSTITUTIONAL COMPETENCIES (GENERIC)** The generic competencies to be acquired include: • Creativity • Innovation • Entrepreneurship • Leadership • Sustainability	
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, the graduate should be able to:** • Describe the different energy resources and explain their respective advantages and disadvantages including environmental impacts (e.g. climate change), health issues, usage, safety, and energy security, and their share in the energy mix at the local, national and global levels. • Discuss the concept of energy efficiency and sufficiency and how socio-technical strategies and policies affect them. • Describe how policies can influence the development of energy supply and demand. • Explain the processes and institutional arrangements in the energy sector and describe the structure of the energy market. **Skills: At the end of this programme, the graduate should be able to:** • Analyse, compare, and communicate different energy-efficient technology options for use by stakeholders in the energy sector. • Conduct computational modelling and energy simulation. • Cooperate and collaborate with others to transfer and adapt energy technologies to different contexts and to share energy best practices. • Apply innovative and entrepreneurial skills to identify and recognise business opportunities for new products, processes, and systems.	

	• Examine and make appropriate use of advanced information and communication technologies in their professional activities. • Work in a team of people with diverse educational and cultural backgrounds. **Competencies: At the end of this programme, the graduate should be able to:** • Identify, analyse, formulate, and solve problems in a location in collaboration with the local community and stakeholders. • Design and deliver energy solutions in a safe, reliable way taking into consideration relevant sustainable development goals (e.g. SDG 7, 13, etc.). • Develop energy-efficient strategies in the design and construction of buildings in collaboration with building professionals. • Evaluate different business models in the energy sector and select suitable ones for a given socio-economic context. • Conduct, socio-economic, techno-economic, and environmental studies of energy systems. • Formulate the research problem, plan and execute the research and communicate the findings to the targeted audience. • Execute their duties ethically and professionally, examine their obligations to society. • Develop their learning through lifelong learning approaches using e-learning tools.

1. Components of the Programme

Students are required to complete all core courses plus one elective course every semester.

	Course Description	
1	Sustainable Energy Resources and Technologies	
2	Energy Efficiency and Management	
3	Optimization Methods for Engineers	
4	Energy Operations and Supply Chain Management	
5	Energy and Environmental Sustainability	
6	Energy Policy, Economics & Markets	
8	Statistics & Research Methods	
9	Energy Systems - Analysis, Design and Optimization	
10	Entrepreneurship, Project Management and Ethics	
11	Master Plan-Integrated Project	
12	Field Practicum	Non-scoring
13	Ph.D. Sustainable Energy Engineering and Management Project (Dissertation)	
14	Ph.D. Energy Seminar	Non-scoring

15	Renewable Energy	Elective
16	Modelling and Analysis of Sustainable Energy Systems	Elective
17	Waste to Energy	Elective
18	Power Grid Analysis	Elective
19	Computational Fluid dynamics (CFD)	Elective
20	Application of GIS and Remote Sensing in Energy Systems	Elective
21	Life Cycle assessment	Elective
22	Energy Innovation & Entrepreneurship	Elective
23	Energy Storage and Conversion Systems	Elective

Aside from the core courses, the Sustainable Energy Engineering and Management programme also has a substantial research component. In the second year, each student is required to choose a research topic for an investigation into a specific Energy engineering related issue and submits a proposal in the first semester for consideration by the faculty. After the proposal is accepted, the student will research under the supervision of at least one Lecturer. Students are also required to undergo a mandatory industrial attachment training of at least four (4) weeks in a related organisation for hands-on training.

Course-by-Course Structure of the MSc Sustainable Energy Engineering and Management

Year One (Semester One)

	Code	**Course Description**	**T**	**P**	**C**
1	SEEM 751	Sustainable Energy Resources and Technologies	2	2	3
2	SEEM 753	Optimization Methods for Engineers	2	2	3
3	SEEM 755	Energy Efficiency and Management	2	2	3
4	SEEM 757	Energy Operations and Supply Chain Management	2	2	3
5	SEEM 759	Energy and Environmental Sustainability	2	2	3
6	SEEM 761	Energy Policy, Economics & Markets	2	2	3
		Total Semester Credit	**12**	**6**	**18**

Year One (Semester Two)

	Code	**Course Description**	**T**	**P**	**C**
7	SEEM 752	Statistics & Research Methods	2	2	3
8	SEEM 754	Energy Systems - Analysis, Design and Optimization	2	2	3
9	SEEM 756	Entrepreneurship, Project Management and Ethics	2	2	3
10	SEEM 758	Master Plan-Integrated Project	2	2	3
		Elective Courses*			
11	SEEM 1*		2	2	3

12	SEEM 2*		2	2	3
		Total Semester Credit	**8**	**4**	**18**

***Elective Courses:**

	Code	**Course Description**	**T**	**P**	**C**
1	SEEM 762	Renewable Energy	3	0	3
2	SEEM 764	Modelling and Analysis of Sustainable Energy Systems	3	2	3
3	SEEM 766	Waste to Energy	3	0	3
4	SEEM 768	Power Grid Analysis	3	2	3
5	SEEM 778	Computational Fluid dynamics (CFD)	3	2	3
6	SEEM 782	Application of GIS and Remote Sensing in Energy Systems (to be added to elective)	2	2	3
7	SEEM 772	Life Cycle Assessment	3	0	3
8	SEEM 774	Energy Innovation & Entrepreneurship	3	2	3
9	SEEM 776	Energy Storage and Conversion Systems	3	0	3

Year Two (Semesters 1 &2)

	Code	**Course Description**	**T**	**P**	**C**
1	SEEM 771	Field Practicum	0	0	0
2	SEEM 800	Ph.D. Sustainable Energy Engineering and Management Project (Dissertation)	0	48	24
3	SEEM 850	Ph.D. Seminar	0	0	0
			0	**48**	**24**

Year Three (Semesters 1 & 2)

	Code	**Course Description**	**T**	**P**	**C**
1	SEEM 800	Ph.D. Energy Management Project (Dissertation)	0	24	12
2	SEEM 750	Energy Seminar	0	0	0
			0	**12**	**12**
		Total Credits for Ph.D.			**72**

2. Course Objectives

Year One (Semester One)

SEEM 751: Sustainable Energy Resources and Technologies (3 Credits)

Objective

As the energy systems nationally and globally are becoming increasingly sustainable. The main objective of this course is to give students an overview of the past and current energy resources usage and their limitations. The course with introducing students to sustainable energy resources and technologies for their conversion to final energy.

SEEM 753: Optimization Methods for Engineers (3 credits)

Objective

The course aims at providing the students with the hard skills and competencies in system optimization. Beyond the traditional techniques, meta-heuristics will be addressed and the very recent problems in energy-big data analysis will also be addressed.

SEEM 755: Energy Efficiency and Management (3 Credits)

Objective

The broad aims of this unit are to:

- Explore what is meant by Energy Management in a range of contexts
- Explore some of the tools and techniques involved in Energy Management Programmes
- Apply tailored policies to subtly delimit energy efficiency market barriers.

SEEM 757: Energy Operations and Supply Chain Management (3 Credits)

Objective

The course introduces the student to core concepts and applications in Supply Chains and Operations Management. The practical nature of this course will ensure that the students can apply recent trends in Supply Chain Management to Energy Infrastructures such as Hydrothermal power stations, off-shore wind farms, crude oil supply management, demand-side energy management, and quality management using Six Sigma Methodology. The course is in six sections: Concepts in Supply Chain Operations Management, Applied Supply Chain, Procurements, Engineering Economics, and Mathematical Modelling of Complex Supply Chain processes in Energy Infrastructure.

SEEM 759: Energy and Environmental Sustainability (3 Credits)

Objective

To equip students with the knowledge, skills, and set of competencies in sustainable energy development and its impact on the environment, to address the dual challenge of satisfying growing energy demand while reducing environmental impacts.

SEEM 761: Advanced Energy Policy, Economics and Markets (3 Credits)

Objective

The broad aims of this unit are to:

- Introduce students to basics in microeconomic theory
- Provide students with an understanding of the basic concepts in policy analysis, and in particular to enable a student to assess the factors relevant to the policy decision processes, as well as equipping the student with the ability to identify appropriate and inappropriate policies.
- Make students aware of the role of a range of institutions in the policy process.
- Identify the range of policy objectives and to demonstrate the necessity for the appropriate choice of policy instrument to match the policy objective in a way that achieves the policy objective and does not have unintended consequences.

Year One (Semester Two)

SEEM 752: Statistics & Research Methods (3 Credits)

Objective

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

SEEM 754: Energy Systems - Analysis, Design and Optimization (3 Credits)

Objective

The course aims at presenting and applying techniques for energy system design and process optimization.

Learning Outcomes

At the end of this course students should be able to:

- Model, design and optimize energy system processes.
- Evaluate the effectiveness of energy systems.
- Create alternative designs of energy systems that can optimally achieve the desired functionality for given objectives.

SEEM 756: Entrepreneurship, Project Management and Ethics (3 Credits)

Objective

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

SEEM 758: Master Plan - Integrated Project (3 Credits)

Objective

To equip students with the knowledge, skills, and set of competencies in master-planning of an integrated project which leads to successful project completion, through innovations in sustainable energy or an energy service with a technically sound masterplan.

SEEM 762: Renewable Energy (3 credits)

Objective

To equip students with the knowledge, skills, and set of competencies to enable them to identify renewable energy resources availability, its utilization and decide on a viable or suitable technology option(s) by carrying out a techno-economic assessment.

SEEM 764: Modelling and Analysis of Sustainable Energy Systems (3 credits)

Objective

This course aims to provide students with the requisite knowledge, skills, and competencies in energy performance modelling and simulation techniques for assessing sustainable energy

systems. This is intended to assist students to perform integrated studies on the energy sector. This course will utilize tools such as Microsoft Excel, HOMER, LEAP, SAM, RETScreen, TRNSYS, and other modelling software packages as may be required to simulate mathematical models.

SEEM 766: Waste to Energy (3 Credits)

Objective

The course is aimed at delivering information about modern technologies and environmental restrictions on recovering energy from waste.

SEEM 768: Power Grid Analysis (3 Credits)

Objective

This course aims at providing students with exhaustive knowledge, skills, and competency in modelling and analysis of electrical power network systems. The course provides the foundational blocks of the smart grid with an emphasis on practical applications of power system networks and renewable energy integration as this is crucial for the stable and safe operation of the modern utility grid.

SEEM 778: Computational Fluid Dynamics (3 Credits)

Objective

To introduce students to Computational Fluid Dynamics (CFD) techniques and tools for modelling, simulating, and analyzing practical energy engineering problems especially renewable energy, with hands-on practical sessions using CFD software packages.

SEEM 782: Application of GIS and Remote Sensing in Energy Systems (3 Credits)

Objective

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

SEEM 772: Life Cycle Assessment (3 Credits)

Objective

To equip students with the knowledge, skills, and set of competencies in life cycle assessment of energy products, systems, and services, which allows for consistent comparisons of alternate system designs for their environmental performance.

SEEM 774: Energy Innovation & Entrepreneurship (3 Credits)

Objective

The course covers everything from the recent advances in energy generation, transmission and storage, to taking these new ideas and starting and managing a successful business, and finally ends with managing enterprise innovations. The course is in four sections: Recent Energy Advances, Entrepreneurship, Advanced Entrepreneurship, Innovations Management. Students go through the process of forming and starting a mock business entity, prepare a business and financial plans, and present the business for investments.

SEEM 776: Energy Storage and Conversion Systems (3 credits)

Objective

The main objective of this course is to introduce students to the operation of, and the criteria used in the design of the principal small to medium scale energy supply systems currently in use. The course also introduces students to the different ways in which energy can be stored, and how quickly it can be delivered on-demand to consumers.

Year Two (Semesters One & Two)

SEEM 771: Field Practicum

Objective

SEEM 800: Ph.D. Sustainable Energy Engineering and Management Project (Dissertation) - (24 Credits)

Objectives

This course is the project component of the programme for MSc. students. The project will equip students with skills to apply cumulative knowledge gained to solve energy problems to the design and or analysis of systems in the field of sustainable energy management, culminating in a Ph.D. thesis.

SEEM 850: Ph.D. Energy Seminar

Objective

This course is designed to allow Ph.D. students to share presentations relating to their project, critique the work, and give them input to their thesis.

Year Three (Semesters One & Two)

SEEM 800: Ph.D. Energy Management Project (12 Credits)

Objectives

This course is the project component of the programme for Ph.D. students. The project will equip students with skills to apply cumulative knowledge gained to solve energy problems to the design and or analysis of systems in the field of sustainable energy management, culminating in a Ph.D. thesis.

SEEM 810: Ph.D. Seminar

Objective

This course is designed to allow Ph.D. students to share presentations relating to their project, critique the work, and give them input to their thesis.

Mode of Delivery

Seminars, oral presentations, and poster presentations.