MASTER IN RENEWABLE ENERGY

Main Language of Instruction:
French ☑ English ○ Arabic ○

Campus Where the Program Is Offered: CST

OBJECTIVES

The Master in Renewable Energy aims to train researchers and engineers in energy efficiency and renewable energy. The program aims to train specialists and experts who can design and implement high-efficiency energy systems powered by renewable sources. Graduates will be prepared to lead innovative projects in this field, whether in academic research or within cutting-edge technology centers and industrial sectors at local and regional levels. Additionally, the program supports students interested in pursuing PhD studies in renewable energy. Through this program, students will gain a comprehensive understanding of global energy challenges, the depletion of fossil fuels, climate change, and pollution, as well as the diverse forms of renewable energy and their practical applications.

PROGRAM LEARNING OUTCOMES (COMPETENCIES)

Graduates will be able to:

- Apply engineering design methods to produce solutions that meet specified needs, while considering public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
- Communicate effectively with diverse audiences.
- Recognize ethical and professional responsibilities in engineering situations and make informed judgments that consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
- Function effectively on a team, providing leadership, creating a collaborative and inclusive environment, setting goals, planning tasks, and achieving objectives.
- Develop and conduct appropriate experiments, analyze and interpret data, and use engineering judgment to draw conclusions.
- Acquire and apply new knowledge as needed, using appropriate learning strategies.
- Conduct independent and collaborative research that addresses contemporary challenges and opportunities.
- Apply research findings to improve practices, processes, and products within their professional environment.

ADMISSION REQUIREMENTS

Candidates are selected based on the review of their application file:

- Admission to the third semester of the Master's program (M3) is available for candidates holding an engineering degree in Electrical, Mechanical, Civil, Chemical, or Petrochemical Engineering.

COURSES/CREDITS GRANTED BY EQUIVALENCE

The content of the MR1 and MR2 semesters (which accounts for 60 Credits) includes prerequisite courses for MR3, which are equivalent to a bachelor degree in Electrical, Mechanical, Civil, Chemical, and Petrochemical Engineering.

PROGRAM REQUIREMENTS

The Master's program comprises 120 credits, spread over 4 semesters: MR1, MR2 (as prerequisites corresponding to the 5th year of engineering), MR3, and MR4, with 30 credits each.
This program provides instruction for the MR3 and MR4 semesters, including:

- Theoretical and practical courses.
- A research internship at an accredited center, culminating in the writing of a thesis.

Required Courses (54 Cr.)
Energy Efficiency (3 Cr.). Wind Energy (3 Cr.). Hydropower (3 Cr.). Solar Energy (4 Cr.). Biomass Energy (3 Cr.). Energy Storage (3 Cr.). Renewable Energy Project Evaluation (3 Cr.). Renewable Energy Seminars (2 Cr.). Research Internship with Thesis (30 Cr.).

Institution's Elective Courses (6 Cr.)
Two courses to choose from the following list:
Distributed Generation Systems (3 Cr.). Advanced Power Electronics (3 Cr.). Thermal and Thermodynamic Conversion Systems (3 Cr.). Modeling and Optimization of Thermal Systems (3 Cr.). Low-Energy Green Buildings (3 Cr.). Smart Electrical Grids (3 Cr.). Recyclable Materials in Construction (3 Cr.).

SUGGESTED STUDY PLAN

Semester 1

Code	Course Name	Credits
MRER00M3	Energy Efficiency	3
MRER01M3	Wind Energy	3
MRER02M3	Hydropower	3
MRER03M3	Solar Energy	4
MRER04M3	Biomass Energy	3
MRER05M3	Energy Storage	3
MRER06M3	Renewable Energy Project Evaluation	3
MRER07M3	Renewable Energy Seminars	2
	Institution's Elective Courses	6
	Total	**30**

Semester 2

Code	Course Name	Credits
MRER00M4	Research Internship with Thesis	30
	Total	**30**

COURSE DESCRIPTION

MRER09M3 Advanced Power Electronics 3 Cr.

Topics covered include: Multi-level converters with clamping diodes and floating capacitors. Matrix structures. Non-polluting converters. Direct current transportation. Active and hybrid filtering. Modeling and control.

MRER04M3 Biomass Energy 3 Cr.

Topics covered include: Basic concepts of bioenergy. Types of biomass. Urban solid waste. Residual biomass dry and wet. Direct incineration. Photo-bioreactors. Biochemistry and biomass transformation. Methanization. Biofuels.

MRER08M3 Distributed Generation Systems 3 Cr.

Topics covered include: Analysis and management of electrical networks. Energy generation in isolated systems. Distributed energy generation. Smart electrical grids. Modelling and optimization techniques.

MRER00M3 Energy Efficiency 3 Cr.

Topics covered include: Global energy context. Reserve status. Links with the environment. Legal aspects, protocols, and global agreements. Consumption sectors. Passive energy-saving measures. Efficient equipment. Efficient conversion means. User behavior.

MRER05M3 Energy Storage 3 Cr.

Topics covered include: Electrical, mechanical, or thermal conversion. Electrical generators. Static conversion of electrical energy. Storage systems: batteries, accumulators, supercapacitors, modelling and control, numerical simulations.

MRER02M3 Hydropower 3 Cr.

Topics covered include: Hydraulic mechanics. Hydraulic turbines. Hydroelectric power plants. Dams and pipelines. Rainfall variability.

MRER12M3 Low-Energy Green Buildings 3 Cr.

Topics covered include: Initiatives in eco-friendly building design. Environmental impact of construction materials. Environmental impact of construction, demolition, and renovation. CO_2 emissions assessment. Integration of sustainable and passive principles in building architectural design. Solar geometry. Climate/regional limitations. Natural lighting. Passive design. Natural ventilation and infiltration. Insulation. Energy storage materials. Bioclimatic concept. Case studies.

MRER11M3 Modelling and Optimization of Thermal Systems 3 Cr.

Topics covered include: Renewable energy thermal systems. Phenomenological laws and conservation principles. General modelling approach. Modelling of thermal phenomena. Spatial discretization methods. Temporal resolution methods. Dynamic simulation. Inverse methods. Optimization methods.

MRER16M3 Recyclable Materials in Construction 3 Cr.

The construction industry is a significant waste-producing industry and, as a result of its inherent size, may have many opportunities for on-site recycling, without transportation costs, providing good environmental solutions for waste management. This course covers fundamental individual construction materials as well as the process of transforming by-products and waste into new construction materials.

MRER06M3 Renewable Energy Project Evaluation 3 Cr.

Topics covered include: Cost analysis, feasibility, reliability, and maintainability of an energy generation system. Environmental impacts. Life cycle analysis.

MRER07M3 Renewable Energy Seminars 2 Cr.

This course involves a series of lectures on subjects and themes related to renewable energies: fuel cells (fuel cell electrochemistry, types and technologies, hydrogen production and storage, transportation, commercialization and applications, hybrid vehicles), geothermal (thermodynamics and fluid dynamics, geothermal fluids, geological exploration techniques, geophysical and geochemical, geothermal power plants), tides and waves, etc.

MRER00M4 Research Thesis 30 Cr.

This course serves as an initiation into research techniques. It is the synthesis of six months of research work in a research centre or laboratory.

MRER14M3 Smart Electrical Grids 3 Cr.

Topics covered include: The ecosystem of smart electrical grids. Production of conventional and renewable energies. Quality and efficiency of electricity transmission. Protection, automation, and control of electrical grids. Management and global control of energy systems. Distributed electricity storage. Active building management. Consumer management in the residential sector. Integration of electric vehicles. Standardization, regulatory modification, and incentives for the development of smart electrical grids.

MRER03M3 Solar Energy 4 Cr.

Topics covered include: Solar radiation. Resource assessment. Calculation of solar contributions. Distribution in a receiving system. Capture systems. Thermal systems and applications. Photovoltaic systems and applications. Hybrid systems.

MRER10M3 Thermal and Thermodynamic Conversion Systems 3 Cr.

Topics covered include: Exergy concept. Exergy analysis. Engine cycles. Cogeneration. Receiver cycles. Heat pumps. Fluid networks. Heat exchangers. Pinch method. Applications to renewable energies.

MRER01M3 Wind Energy 3 Cr.

Topics covered include: Aerodynamics of wind turbines. Wind turbine design. Electromechanical conversion systems. Wind turbine control. Resource assessment. Feasibility, application areas.