

Course Unit	Renewable Energies	Field of study	Thermodynamics and Thermal Processes
Master in	Mechanical Engineering	School	School of Technology and Management
Academic Year	2023/2024	Year of study	1
Type	Semestral	Semester	1
Workload (hours)	162	Contact hours	T - , TP 60 , PL - , TC - , S - , E - , OT - , O -
Level	2-1	ECTS credits	6.0
Code	5071-793-1101-00-23		

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s)

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:

1. Understand the physical principles and estimate the renewable resource;
2. Assess and identify the maturity and suitability of the renewable technology for the intended service;
3. Parameterize energy services in their various dimensions: economic, environmental, societal and strategic;
4. Distinguish between renewable energy technology and energy efficiency systems;
5. Communicate, in writing and orally, the critical issues of renewable systems, their strengths, characteristics and limitations.

Prerequisites

Before the course unit the learner is expected to be able to:

1. Notions of classical thermodynamics.
2. Analyse linear circuits in both direct and alternate current.
3. Notions of classical mechanics.

Course contents

Energy, definition and concepts; Technology and technological maturity; The energy service: heat, work and electricity; Energy markets and electricity sector; The renewable resource: what is estimated and how it is estimated; The energy/environment dilemma and sustainable development; Renewable technologies: hydro, wind, solar photovoltaic, solar thermal, biomass, geothermal, urban solid waste, waves and tides. Fundamentals, sizing and applications.

Course contents (extended version)

1. Energy, definition and concepts:
 - Technology;
 - Technological maturity.
2. The energy service:
 - Heat;
 - Work;
 - Electricity.
3. Energy markets and electricity sector.
4. Basic concepts of finance:
 - Framework;
 - Concepts related to investment projects.
5. The renewable resource:
 - What is estimated?
 - How is it estimated?
6. Energy and the Environment:
 - Sustainable development and pollution;
 - Parameterization.
7. Hydropower:
 - Types of technology;
 - Sizing;
 - Production calculation.
8. Wind energy:
 - Types of technology;
 - Sizing;
 - Production calculation.
9. Biomass:
 - Types of technology;
 - Sizing;
 - Production calculation.
10. Solar Thermal Energy:
 - Types of technology;
 - Sizing;
 - Production calculation.
11. Solar Thermal Energy:
 - Types of technology;
 - Sizing;
 - Production calculation.
12. Other renewable technologies:
 - Geothermal;
 - Tidal;
 - Waves;
 - Urban waste.

Recommended reading

1. Renewable Energy: Physics, Engineering, Environmental Impacts, Economics and Planning Book, Fifth Edition, Bent Sørensen, Academic Press, 2017 - ISBN 978-0-12-804567-1
2. Renewable Energy – Power for a Sustainable Future, Boyle, G. , Oxford University Press, 2012
3. Uma introdução às energias renováveis, Rui Castro, IST Press, 2012
4. Energy and Civilization: A History, Vaclav Smil, The MIT Press, 2017
5. Energias renováveis, Eduardo Oliveira Fernandes, Atelier Nunes e Pã, 2009

Teaching and learning methods

Lectures of explanation of concepts and methodologies for the understanding the course contents. Practices: lectures will rely on Project Based Learning methodology with a common project for different groups in the class. Each group will make regular presentations to the classroom.

Assessment methods

- Evaluation method: - (Regular, Student Worker) (Final, Supplementary, Special)
- Case Studies - 80% (Development of group work on a specific renewable energy technology.)
- Practical Work - 20% (Individual assignments over the classroom material.)

Language of instruction

Portuguese, with additional English support for foreign students.

Electronic validation

Luis Manuel Frolen Ribeiro	João Eduardo Pinto Castro Ribeiro	Paulo Alexandre Gonçalves Piloto	José Carlos Rufino Amaro
12-10-2023	12-10-2023	12-10-2023	20-10-2023