Course Unit	Solar Energy Technologies			Field of study	Energy		
Bachelor in	Renewable Energy Engineering			School	School of Technology and Management		
Academic Year	2023/2024	Year of study	3	Level	1-3	ECTS credits	6.0
Type	Semestral	Semester	1	Code	9910-743-3104-00-23		

Workload (hours)	162	Contact hours	T	TP	PL	TC	S	E	OT	O
			30	-	30	-	-	-	-	-

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): João da Rocha e Silva, Orlando Manuel de Castro Ferreira Soares, Leandro Almeida Vasconcelos, Luis Miguel Silva Correia

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:
1. Describe the different types of photovoltaic systems and the operation of their technological components – photovoltaic modules, sun trackers, inverters, charge regulators and batteries.
2. Understand the main control techniques (algorithms) of sun trackers and power converters with maximum power point tracking.
3. Understand the basis of the control techniques (algorithms) of grid-tied inverters and the requirements to be considered.
4. Select different technologies and constituent components of a solar thermal system based on their features and functions.
5. Calculate and design a solar thermal system to particular purposes: hot water, swimming pools, central heating.
6. Know how to act upon architecture projects to enhance the building energy efficiency.

Prerequisites

Before the course unit the learner is expected to be able to:
1. Understand the basis of the electric circuits and power converters.
2. Undersand the different forms of energy and their physical models.

Course contents

Heliotech concepts. Photovoltaic energy: Types and technological components: photovoltaic cells, modules and strings; sun trackers; inverters, charge regulators and batteries. Design. Technical requirements to be considered and control basis of: sun trackers, power converters with maximum power point tracking, grid-tied and stand-alone inverters. Solar Thermal: Types of collectors, tanks, heat exchangers and other components. Methods of sizing. Circuit analysis. Legislation.

Course contents (extended version)

1. The different ways of using solar energy.
2. Photovoltaic energy:
   - Types of photovoltaic systems.
   - Technology of photovoltaic energy: photovoltaic modules and cells.
   - Sun trackers. Technical requirements to be considered and control basis.
   - Power converters with maximum power point tracking.
   - Technical requirements to be considered and control basis grid-tied and stand-alone inverters.
   - Batteries and Charge regulators.
   - Design of autonomous photovoltaic systems and grid connected.
3. Solar thermal energy:
   - General concepts energy: sources, forms, conversion and energy conservation. Power & performance.
   - National energy outlook and legislation. Solar thermal applications.
   - Solar collectors: principles of operation, types of panels and their applications.
   - Balance of energy. Energetic study of the collector. Losses and optical performance.
   - Distribution and connection of the collectors. Hydraulic balance. Heat transfer fluid.
   - Flow. Sizing Pressure loss. Accumulators. Exchangers. Other elements.
   - Solar thermal software. Circuit analysis. Installation and maintenance.

Recommended reading

1. Photovoltaics for Professionals: Solar Electric Systems Marketing, Design and Installation, Falk Antony, Christian Dürschner, Karl-Heinz Remmers, Earthscan Publications Ltd. , June 2007;
2. Power Electronics. Converters, Applications and Design, N. Mohan, T. Undeland, W. Robbins, 3rd Edition, John Wiley and Sons, 2003;
3. Grid Converters for Photovoltaic and Wind Power Systems, Remus Teodorescu, Marco Liserre, Pedro Rodriguez, and Frede Blaabjerg, John Wiley & Sons Inc, February, 2009.
4. Thermal Analysis and Design of Passive Solar Buildings, Athienitis, A. K. , Santamouris, M. , Earthscan Publications Ltd, 2002
5. Solar Technologies for Buildings, U. Eicker, Wiley, ISBN 047148637X, 2003.

Teaching and learning methods

Teaching Methods: lectures, problem-solving sessions and laboratory teaching with supervised simulation and experimental work. Learning Methods: notes from lectures; individual study and with other students to carry out works and solve problems; work in the laboratory.

Assessment methods

1. Alternative 1 - (Regular, Student Worker) (Final, Supplementary, Special)
   - Laboratory Work - 50%
   - Final Written Exam - 50% (Minimum required values of 7 (on a scale of 20 values) for approval to the unit.)
2. Alternative 2 - (Regular, Student Worker) (Special)
   - Final Written Exam - 100% (Theoretical-practical exam.)

Language of instruction

Portuguese

Electronic validation

João da Rocha e Silva, Orlando Manuel de Castro Ferreira Soares	José Luís Sousa de Magalhaes Lima	João Eduardo Pinto Castro Ribeiro	Ana Maria Alves Queiroz da Silva	José Carlos Rufino Amaro
07-10-2023	09-10-2023	10-10-2023	14-10-2023	31-10-2023