Hanze University of Applied Sciences Groningen

Course: Solar Energy — credits: 5

Course code	ZWVH21SLE
Name	Solar Energy
Study year	2022-2023
ECTS credits	5
Language	English
Coordinator	A.A. Bellekom

Modes of delivery	Practical / Training Tutorial
Assessments	Assignment SLE - Other assessment Lab SLE - Other assessment Solar Energy - Written, organised by STAD examinations

Learning outcomes

After the completion of the module the student is able to:

- understand, analyse and optimize the design and operation of solar cells, modules and systems, and to a lesser extent of solar thermal energy systems
- analyse and evaluate the similarities and differences between the various technological approaches towards solar energy conversion
- apply the specific features of solar energy systems for integration in the portfolio of energy technologies
- analyse, synthesize and critically evaluate information and findings in the field of solar energy and present it in a clear, fact-based and convincing way
- perform calculations of solar cell device operation and of power and energy production
- make basic PV system dimensioning calculations and simulations
- measure some of the main performance indicators of solar panels
- communicate plans and results with other members of the group and effectively discuss problems encountered.
- present information and findings in the field of solar energy in a clear, fact-based and convincing way
- describe lessons learned and explain them to professional colleagues with a similar background, but without the specific knowledge of the lessons learned.

Content

In terms of scientific and technical contents this module will treat the following aspects of solar
energy:
The solar resource: properties of sunlight, insolation (amount of sunlight available)
Solar energy conversion technologies compared (electricity, heat, fuels)

Photovoltaic conversion:

- the PV sector in a bird’s eye view: general introduction to history, markets, scenarios, roadmaps, etc.
- basic conversion process and efficiency limitations;
- properties of semiconductors, semiconductor processing and basic semiconductor devices;
- basic solar cell design and operation, including current-voltage characteristics spectral response and quantum efficiency;
- efficiency determining factors, routes to (very) high efficiencies, Standard Test Conditions (STC-) and non-STC (i.e. field) operation;
- photovoltaics in practice: different technologies in lab and production (flat plate and concentrator), various device architectures;
- from cells to modules: module architectures, manufacturing, lifetime & reliability, efficiency definitions, field performance;
- from modules to systems: basic aspects of system design, systems losses and energy production (specific energy yield, performance ration, capacity factor, etc.)
- practical applications: examples of PV systems and their performance;
- economic aspects: system cost (price) components and their evolution, Levelized Cost of Energy(LCoE), grid parity and other indicators;
- environmental aspects: Life Cycle Analyses (LCA), energy pay-back time, materials availability (supply chain), Cradle-to-Cradle and design-for-recycling approaches.

Solar heat:

- general introduction to solar heat
- basic aspects and formulas of heat
- basic aspects of solar radiation
- short introduction to heating systems
- overview of solar thermal collectors
- overview of heat storage types
- short introduction to solar cooling
-

-short introduction to solar thermal electric power systems

Included in programme(s)

European Master in Renewable Energy

School(s)

Institute of Engineering