Course: Solar Energy — credits: 5

Course code	RWVM26SLE
Name	Solar Energy
Study year	2026-2027
ECTS credits	5
Language	English
Coordinator	A.A. Bellekom

Modes of delivery	Education
Assessments	Assignment Solar Thermal - Assignment Lab PV - Assignment Theory PV - Written, organised by STAD examinations

Learning outcomes

Objective of the Module:

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

- Simulate a basic PV system with commercial software and measure PV panel characteristics
- Understand, analyse and optimize the design and operation of solar cells, modules and systems, and of solar thermal energy systems
- Select, analyse, interpret and critically evaluate component specifications in the field of solar energy and present it in a clear, fact-based and convincing way
- Evaluate suitable solar energy technologies for different applications that require heat and electricity

Content

In terms of scientific and technical contents this module will treat the following aspects of solar energy:

1. The solar resource: properties of sunlight, insolation (amount of sunlight available)
2. 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)

Engineering, Life Sciences & ICT

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