ME-468

Solar energy conversion

Haussener Sophia

Cursus	Sem.	Type
Energy Science and Technology	MA1, MA3	Opt.
Mechanical engineering minor	H	Opt.
Mechanical engineering	MA1, MA3	Opt.

Language of teaching	English
Credits	4
Session	Winter
Semester	Fall
Exam	Written
Workload	120h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Exercises	1 weekly
Practical work	1 weekly
Number of positions	

Summary

The course will provide fundamentals and technological details of solar energy conversion devices and systems, including 1) solar fuels by photoelectrochemistry, photocatalysis, and solar thermochemistry, 2) solar electricity by PV and concentrated solar power, and 3) solar heat by solar collectors.

Content

The **generalities and fundamentals** cover: Solar energy characteristics, (concentrator) optics, radiation and electromagnetic wave propagation, multi-mode heat transfer, semiconductor physics, electrochemistry, thermochemistry, fluid flow and species transport.
Fundamentals, devices and technology for **solar fuels** (Photocatalytic, photoelectrochemical, and solar thermochemical approaches), **solar electricity** (PV and concentrated solar power), and **solar heat** (low-temperature solar collectors and high-temperature solar receiver, thermal energy storage).
Computational examples with 3 computational projects: Monte Carlo techniques, finite differences for semiconductor physics and electrochemistry
Experimental techniques with 5 laboratory projects: Equilibrium potentials, electrochemical techniques (CV, LSV), PV and electrolyzer characterization

Keywords

Solar energy, electrochemistry, solar fuels, hydrogen, thermal storage, multi-physics modeling

Learning Prerequisites

Required courses

Thermodyanmics and energetics 1
Heat and mass transfer

Recommended courses

Thermodyanmics and energetics 2
Advanced heat transfer
Nano-scale heat transfer

Learning Outcomes

By the end of the course, the student must be able to:

- Implement solar energy conversion problems using computational methods

- Compute solar energy conversion devices
- Advise on solar energy conversion approaches and technologies
- Characterize solar energy conversion devices
- Carry out experiments on solar devices
- Design codes for solar energy conversion problems

Transversal skills

- Access and evaluate appropriate sources of information.
- Continue to work through difficulties or initial failure to find optimal solutions.
- Use a work methodology appropriate to the task.

Teaching methods

ex cathedra and exercises, computational project, laboratory project, group project

Assessment methods

Group project during semester, (computational and lab) exercises during semester, written exam

Resources

Moodle Link

- https://go.epfl.ch/ME-468