

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
<b>Hours</b>	<b>4 weekly</b>
Courses	2 weekly
Exercises	1 weekly
TP	1 weekly
<b>Number of positions</b>	

**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**

Thermodynamics and energetics 1  
Heat and mass transfer

**Recommended courses**

Thermodynamics 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