pre367 - Solar High Temperature

**Module label**  
Solar High Temperature

**Module code**  
pre367

**Credit points**  
12.0 KP

**Workload**  
360 h

**Used in course of study**  
- Master's Programme European Master in Renewable Energy (EUREC) > Mastermodule

**Contact person**  

**Entry requirements**  

**Skills to be acquired in this module**

- At the end of the module the student will
  - understand the principles of operation, design and methods of production of concentrated solar plants and the principles of thermochemistry and process engineering to produce either gaseous or liquid fuels using concentrated solar energy and resource of C, H, O elements.
  - be aware of the potentialities of concentrated solar resource for energy vectors production (mechanical, electricity, fuels)
  - will understand the different solar concentrating systems: linear concentration, point concentration, high concentration systems
  - understand the thermodynamics of chemical reactions that lead to fuels production from solar heat.
  - be familiar with the utilisation of different numeric tools for CSP design, performance evaluation and techno-economic viability
  - have a critical understanding of the physical principles relating to the operation and design of concentrating systems, solar receivers and concentrated solar plants.
  - be able to compare the design and operation of concentrating systems, solar receivers and concentrated solar plants.
  - have a critical understanding on the influence of the design and performance of concentrating systems on solar receivers.
  - have a critical understanding of the thermodynamic limitation of solar fuels production
  - have a critical understanding of the complete system efficiency on the basis of sub-systems efficiency limitation.
  - be able to compare and evaluate different chemical pathways with respect to solar energy stored in the chemicals and to CO2 mitigation impact.
  - have a critical understanding of the principles of solar thermochemical reactor design and modelling.
  - be able to compare and evaluate various solar thermochemical and thermodynamic processes.

**Module contents**

1. Solar concentrating systems and receiver
   - The solar resource for concentrating systems
   - Introduction to concentration optics
   - Linear concentration: trough and linear Fresnel
   - Point concentration: Dish and Tower (Central receiver systems)
   - High concentration systems: solar furnace and compound parabolic concentrator (CPC)
   - Selective surfaces for solar receiver
   - Solar receivers (absorbers) for linear concentrators

2. Solar concentrating systems and receiver
   - Introduction to Concentrating Solar Power (CSP): various options, plants in operation, industry
   - Tools for CSP design and performance evaluation
   - Techno-economics of CSP
   - Case study: Parabolic trough plant
   - Case study: Central receiver plant
   - Case study: Dish-engine plant
   - Cogeneration systems: electricity and heat, electricity and water

3. Solar fuels
   - Thermodynamics of chemical reactions
   - Chemical pathways to hydrogen, methanol and hydrocarbons from water, carbon dioxide and carbonaceous materials
   - Energy and exergy balances
   - Energy and material balances when using natural gas, coal and biomass as Carbon resource
   - Principle of Redox reaction to split H2O and CO2
   - Various options for redox reactions
   - Material and separation issues of the various options
   - Thermodynamics and kinetics of the various redox reactions
   - Principles of solar reactors
   - Material issues in solar reactors
   - Concentrating systems for high temperature solar thermochemistry
   - Efficiency of a solar thermochemical process
   - Case study as a function of the reaction temperature
   - Lab-scale and pilot scale development, state of the art
   - Solar thermo-chemistry for industry

**Reader's advisory**

Journal of Solar Energy Engineering
Proceedings of SolarPACES

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<td>Written reports: during the semester / February to May</td>
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<td>Written report (33%): project report, 30 pages</td>
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Course type
Seminar

SWS

Frequency
0 h

Workload attendance
0 h