

## Master study course Renewable Energy Systems (M. Eng.)

<b>Module – No.</b>		<b>871</b>	<b>Mandatory module</b>	
<b>Module name</b>		<b>Basics in Thermal Engineering</b>		
Module coordinator		Prof. Dr.-Ing. Thomas Schabbach		
Title		Basics in Thermal Engineering		
Title of examination		Basics in Thermal Engineering		
Semester		Qualification		
Course type	Language	Lectures / Tutorial / Laboratory	English	
SWS/ ECTS/ Workload		2/1/1	5	150
Requirements for attendance		none		

### 1. Content and objectives

#### Content:

1. Introduction to EES Software (non linear equation solver with thermophysical, mechanical, heat transfer functions library)
  - Installation and overview performance of the software
  - Introduction lecture courses
2. Thermodynamics
  - Repetition basics of Thermodynamic and
  - Material properties
  - Cycle processes
3. Heat Transfer
  - Repetition basics of Heat Transfer
  - Thermal networks
  - Heat transfer in components of renewable energy conversion
4. Fluid Dynamics
  - static laws of fluids, aerostatics, Bernoulli, Continuity equation,
  - momentum equation, compressible flows

#### Learning goals:

The students have repeated the principles of Thermodynamics, Heat transfer and Fluid Dynamics and their calculation. Even if these basics were not the content of the teaching for the first bachelor's degree, they have acquired the necessary knowledge in these areas to take more advanced courses in this area of knowledge at master's level in the following semesters.

With the help of the EES software, the students can also solve complex problems concerning heat transport as well as thermodynamic and fluid dynamic processes.

### 2. Method(s) of instruction

The module consists of a lecture with integrated exercises.

### 3. Requirements for attendance

There are no formal requirements for participation. Basics in physics, mathematics and mechanics are recommended. Basic knowledge in thermodynamics, fluid dynamics and heat transfer is useful.

Literature:

- [1] Wesselak, Schabbach; Link; Fischer: Handbuch Regenerative Energietechnik. Springer Vieweg, Berlin (2017) **{e-book}**
- [2] Struchtrup, H.: Thermodynamics and Energy Conversion. Springer Berlin (2014) **{e-book}**
- [3] Nellis; Klein: Heat Transfer. 1st Edition. Cambridge University Press, Cambridge (2008)
- [4] Munson, Bruce R., Fundamentals of Fluid Dynamics, Hoboken, NJ : Wiley, (2010)

<b>4. Usability of this module</b>
Basics in Thermal Engineering is offered as mandatory module in the Master Study Course "Renewable Energy Systems" (M.Eng.).
<b>5. Requirements for assessment</b>
Assessment is performed as written examination (90 minutes). Other permissible forms of examination (online, oral, homework, etc.) are possible if they are announced by the person responsible for the module at the beginning of the semester.
<b>6. ECTS credits</b>
The grade of the module M871 corresponds to the grade of the exam. With the grading, 5 credit points (ECTS) are awarded.
<b>7. Frequency of offer</b>
The module is lectured annually in the winter semester
<b>8. Arbeitsaufwand (work load)</b>
The total workload for this module is 150 hours; this corresponds to 5 ECTS credits. This workload results from the presence at the lectures with an active participation of the students in the (virtual) laboratory (about 45 hours). As part of the self-study, the lecture material should be reworked (about 55 hours). The preparation and execution of the examination is about 50 hours.
<b>9. Duration of module</b>
The module is lectured in one semester.