

## Environmental and Recycling Technology (M. Eng.), 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
  - 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. Fundamentals of Combustion
  - Thermodynamics of combustion
  - Chemical kinetics on combustion
  - Fundamentals of complete and incomplete combustion
5. CFD Simulation und Laboratory Work
  - Applications in heat transfer with CFD
  - Test rig planning, Sensor types, Setup, Data acquisition
  - Test rig data evaluation (MATLAB / Octave)

#### Learning goals:

The students have repeated the principles of Thermodynamics, Heat transfer, Combustion processes and their calculation and CFD simulation. They have the required knowledge in these fields to follow advanced courses at master level. With the help of the EES software, the students can also solve complex problems concerning heat transport and thermodynamic cycle processes.

They are able to work in the lab and are capable of reliably determining the most important measurement parameters (temperature, volume flow, pressure etc.). Even large amounts of measurement data can be safely processed using engineering software (MATLAB, Octave).

### 2. Method(s) of instruction

The module consists of a lecture with integrated exercises and an active involvement of the students in the laboratory.

### 3. Requirements for attendance

There are no formal requirements for participation. Basics in physics, mathematics and mechanics are recommended. Basic knowledge in thermodynamics, heat transfer and renewable energies 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] Glassman, I.: Combustion, 4th edition, Academic press, Burlington (2008)
- [5] Ferziger, Joel H.; Perić, Milovan: Computational Methods for Fluid Dynamics. Fourth edition. Springer, Cham (2020)

#### **4. Usability of this module**

Basics in Thermal Engineering is offered as mandatory module in the Master's Programmes "Renewable Energy Systems" (M. Eng.) and "Environmental Recycling Technology" (M. Eng.).

#### **5. Requirements for assessment**

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.

#### **6. ECTS credits**

The grade of the module M871 corresponds to the grade of the exam. With the grading, 5 credit points (ECTS) are awarded.

#### **7. Frequency of offer**

The module is lectured annually in the winter semester

#### **8. Arbeitsaufwand (work load)**

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.

#### **9. Duration of module**

The module is lectured in one semester.