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

Module – No.		852		Mandatory module
Module name		**Photovoltaic Systems**		
Module coordinator		Lukas Gerstenberg, M. Eng.		
Title		Photovoltaic Systems		
Title of examination		Photovoltaic Systems		
Semester		1		
Course type	Language	Lecture		English
SWS/ ECTS/ Workload		4 V	5	150
Requirements for attendance		Successfully completed technical study course (e.g. Bachelor of Engineering)		

1. Content and objectives

Content:

The students should achieve consolidated knowledge about installation, dimensioning and application of photovoltaic systems. In addition, the students get a profound introduction to the physics of solar cells.

1. Introduction

History of photovoltaics - current trends and actors

2. Basics

Introduction to semiconductor theory - generation and recombination processes - the solar cell as a p-n junction - modelling a real solar cell - thermodynamics of solar energy conversion

3. Technology

Production process for silicon solar cells - production process for thin-film solar cells – measuring in photovoltaics

4. System technology

From the single solar cell to a solar generator – control of solar generators - operation of grid-connected photovoltaic systems - operation of off-grid photovoltaic systems

5. System design

Irradiation analysis - shading effects - mounting and interconnection - converters – grid connection – energy yield forecast - operation and maintenance of photovoltaic systems - economics

Learning goals:

After successfully completing the module, the students have a deeper knowledge about solar cells as a semiconductor. They confidently deal with cell and module characteristics and use them, for example, to understand phenomena in interconnecting single modules to generators. Furthermore, the students are able to plan a photovoltaic system using standard design software and estimate the energy yield.

2. Method(s) of instruction

The course takes the form of a lecture with integrated exercises and with the active involvement of the students. Exercises and case studies on the central topics of the lecture are presented, discussed and solved together. In addition, one practical laboratory experiment will be carried out in small groups of three students. Each group works out a report for the experiment. The report is graded zero to five points.

3. Requirements for attendance

No course specific requirements

Literature:

[1] Merten: Photovoltaics: Fundamentals, Technology and Practice. John Wiley & Sons Inc, 2018. (introducing)

[2] Deutsche Gesellschaft für Sonnenenergie (DGS): Planning and Installing Photovoltaic Systems. A Guide for In stallers, Architects and Engineers, 3rd Edition. (introducing)

[3] Wesselak/Voswinckel: Photovoltaik, Springer 2016 (introducing – only in german)

[4] Luque/Hegedus: Handbook of Photovoltaic Science and Engineering, Wiley, Chichester, 2011 (deepening)

[5] Würfel: Physics of Solar Cells, Wiley, Chichester, 2009 (deepening)

4. Usability of this module

The module is offered as mandatory module in the master study course „Renewable Energy Systems“ (M.Eng.)

5. Requirements for assessment

Assessment is performed as written examination, duration 90 min. The prerequisite for the award of credit points is successful participation in the practical laboratory experiment (preliminary examination) with a grading of one to five points for the report and successful passing of the examination. The examination takes place during the examination period on the basis of the entire scope of material.
6. ECTS credits
5 ECTS credits
7. Frequency of offer
The module is lectured in the spring semester
8. Work load
The workload for this module is 150 h; this corresponds to 5 ECTS credits. This workload results from the attendance of lectures with active participation of the students (45 h) as well as the preparation and follow-up of the two laboratory experiments (15 h). Within the framework of self-study, the material covered in the lecture is to be reworked and discrete computer exercises should be carried out (about 75 hours). The preparation and execution of the examination is about 30 hours.
9. Duration of module
The module is lectured in one semester