

Module description: Metrology in Solar Systems			
Module Code	t.BA.EU.PM1.19HS		
ECTS Credits	4		
Language of Instruction/Examination	German		
Organizational Unit	IEFE		
Module Coordinator	Franz Baumgartner		
Legal Framework	The module description is part of the legal basis in addition to the general academic regulations. It is binding. During the first week of the semester a written and communicated supplement can specify the module description in more detail.		
Module Characteristic	Type 4* 4 lab lessons per semester week and half-class		
Module Description	Students learn methods for measuring the electrical performance of photovoltaic cells. Working in a team, students measure the electrical current and voltage of solar cells as an essential part of the lab project. Commercial software is used for data acquisition and analysis.		
Module Content	<ul style="list-style-type: none"> • -Electrical measuring methods: Analyze current with shunt, four-wire measurement technology, bridge connection • - metrological basic concepts (measurand, unit, guarantee deviation, • - working steps when measuring and creating a measurement report, • - Application and analysis of the measurement uncertainty according to GUM with propagation of the uncertainties in multiplication and division • - Program generation for automatic measurement data acquisition with a commercial measurement data acquisition software with analog / digital converter card • - Independent training in commercial metrology software • - Work planning and efficient cooperation in the team • - Presentation of the function and the result of the data acquisition project 		
Prerequisite Knowledge	https://gpmpublic.zhaw.ch/GPMDocProdDPublic/2_Studium/2_02_Grundlagen_Studium/T_C_L_Modulauspraegungen_SM2025.pdf		
Learning Objectives (Competences)	Students...	Competencies	Taxonomies
	They are qualified to calculate the measurement uncertainty according to the current international GUM standard. This also includes the propagation of uncertainties for the electric current in the shunt and the power of the solar cell.	M, F	K3
	A simple automated data acquisition programs can be created, executed and professionally documented according the project work to measure current, voltage and power at a solar cell, at different temperatures.	F, M	K4
	The laboratory work as well as the data acquisition project will be carried out in a team of two	SO	K3
	The students know the elementary electrical measuring methods with a shunt. The target variable is determined from the measurement data and the used resistive sensor characteristics (for example PT1000), also used in a standard bridge circuit.	M	K2, K3

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Performance Assessment	End-of-module exam	Assessment	Length (min.)	Weighting	Form
	other			0	
	Performance assessment during the semester				
	Performance assessment during the semester	Assessment	Length (min.)	Weighting	Form
	report	Grade		20	acc. to module agreement
	report	Grade		20	acc. to module agreement
report	Grade		30	acc. to module agreement	
written + oral	Grade		30	acc. to module agreement	
Classroom Attendance Requirement	None				
Learning material	<ul style="list-style-type: none"> Hoffmann, J. Taschenbuch der Messtechnik. ISBN 3-446-21977-3. 				
Comments	The basics of electrical engineering for the execution of the electrical measurements, as well as the current-voltage characteristic of a solar cell are communicated in the module ELHL1				