

# Renewable Energy Systems

<b>Number of module: 7</b>	<b>Module: Solar Energy – PV (Photovoltaics)</b>
<b>Coordinator of module</b>	<b>Prof. Dr. T. Kampschulte</b>
<b>Lecturer</b>	<b>Prof. Dr. T. Kampschulte</b>
<b>Period</b>	1 <sup>th</sup> and 2 <sup>nd</sup> semester
<b>Credits</b>	5
<b>Workload</b>	On campus program: 64 h, self study: 86 h.
<b>Status</b>	optional
<b>Prerequisites</b>	physics, electrical engineering
<b>Max. number of participants</b>	25
<b>Language</b>	English
<p><b>Skills to be acquired / Learning objectives</b></p> <p><b>Subject based and methodical skills</b>  The students are able to ...</p> <ul style="list-style-type: none"> <li>• develop advanced knowledge about photovoltaic (PV) systems</li> <li>• analyze locations according to the suitability for PV systems and to calculate the yield</li> <li>• decide about appropriate components and to plan a PV-system with regard to technical, economical and environmental aspects.</li> <li>• work in planning office for PV projects, in the field of monitoring, service and maintenance of PV systems or within environmental authorities</li> <li>• discuss energy resource issues and the impact of solar energy projects.</li> <li>• discuss global and German energy use and its effect on the environment.</li> <li>• introduce solar energy as alternatives to fossil-based energy conversion.</li> <li>• understand the industrial aspects of the photovoltaic sector</li> </ul> <p><b>Personal and social skills</b>  The students are able to ...</p> <ul style="list-style-type: none"> <li>• translate energy need of consumers to requirements of an energy systems</li> <li>• elaborate a planning strategy for renewable / solar energy systems</li> <li>• discuss / defend technical concepts they elaborated</li> <li>• present results of a planning process/technical concepts</li> <li>• anticipate the practical constrains of a solar energy project</li> <li>• formulate, evaluate and select from alternative technologies and location to meet legal requirements and financial interests.</li> <li>• make a critical appraisal between the technological efficacy and commercial feasibility</li> </ul>	
<p><b>Contents</b></p> <ul style="list-style-type: none"> <li>• Introduction: <ul style="list-style-type: none"> <li>○ status quo of PV-technology and -market, scope of application of PV-systems, overview of system design, solar irradiation</li> </ul> </li> <li>• Characteristics of PV system devices <ul style="list-style-type: none"> <li>○ PV-panel, inverter, charge controller, battery, monitoring systems, mounting systems, market overview, recent innovations</li> </ul> </li> <li>• Grid connected systems <ul style="list-style-type: none"> <li>○ electrical system design, simulation, performance ratio, yield optimization, grid connection</li> </ul> </li> <li>• Off grid and hybrid systems</li> </ul>	

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<ul style="list-style-type: none"> <li>○ load analysis, electrical system design, simulation, operation strategies, embedding of wind generators, small hydro power systems, diesel back up</li> <li>• Mounting and mechanical design             <ul style="list-style-type: none"> <li>○ roof mounting on top and integrated, façade systems, tracking systems, static aspects</li> </ul> </li> <li>• Requirements of grid authorities, environmental aspects and subsidies</li> <li>• Installation and operation             <ul style="list-style-type: none"> <li>○ steps from planning to construction, monitoring and service</li> </ul> </li> </ul>	
<b>Related courses</b> <b>Photovoltaic (PV) – System Engineering</b>	
<b>Teaching skills</b>	Power point presentations, students team work, arithmetic problems and exercises
<b>exam</b>	Project work, essays, presentations, tests; examination of case study results
<b>Literature / Teaching aids</b>	<ul style="list-style-type: none"> <li>• lecture notes</li> <li>• V. Quaschnig: Understanding renewable energy systems, Earthscan, London 2007</li> <li>• DGS Leitfaden: Planning and Installing Photovoltaic Systems, Earthscan, London 2009</li> <li>• T. Markwart (Ed.): Solar Electricity, Wiley, Chichester 2001</li> <li>• I. Freris, D. Infield: Renewable Energy in Power Systems, Wiley, Chichester 2008</li> </ul>