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

<table>
<thead>
<tr>
<th>Module – No.</th>
<th>854</th>
<th>Mandatory module</th>
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<tbody>
<tr>
<td>Module name</td>
<td>Bioenergy Systems I - Solid Biomass</td>
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<tr>
<td>Module coordinator</td>
<td>Prof. Dr.-Ing. Joachim Fischer</td>
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<tr>
<td>Title</td>
<td>Bioenergy Systems I - Solid Biomass</td>
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<tr>
<td>Title of examination</td>
<td>Bioenergy Systems I - Solid Biomass</td>
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<tr>
<td>Semester</td>
<td>1</td>
<td></td>
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<tr>
<td>Course type</td>
<td>Lecture with excursion</td>
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<tr>
<td>Language</td>
<td>English</td>
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<tr>
<td>SWS/ ECTS/ Workload</td>
<td>4 V</td>
<td>5</td>
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<tr>
<td>Requirements for attendance</td>
<td>Successfully completed technical study course (e.g. Bachelor of Engineering)</td>
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1. Content and objectives

Objective
The objective of this course is to understand state-of-the-art technologies for thermal biomass conversion. Based on the properties of different biofuels and the fundamentals of thermal conversion processes the course covers conversion processes as combustion, gasification, torrefaction and pyrolysis. Furthermore, emissions from thermal biomass conversion are addressed; methods for their reduction are explained. Additionally, economical aspects of solid biofuel systems are covered.

Module content:
- Biomass for thermal processes: origins and properties
- Fundamentals of thermal biomass conversion processes
- Combustion of biomass: technologies
- Gaseous and particulate emissions: formation processes and abatement technologies
- Power generation from solid biomass, technologies and plant layout
- Synthesis gas production: Biomass gasification
- Mastering the tar problem in biomass synthesis gas
- Pyrolysis and torrefaction: additional pathways for solid biomass conversion
- Hydrothermal conversion processes
- Economical aspects of thermal bioenergy conversion processes

On-line Lecture notes and training material will be available.

Recommended Literature:
John Love (Editor): Biofuels and Bioenergy, Wiley Blackwell 2017

Learning goals:
Students acquire competent knowledge in modern technologies of thermal biomass conversion. In addition to fundamental knowledge of the physical and chemical properties, students are familiar with the formation of gaseous emissions and particulate matter and their abatement. Students are enabled to recognize and evaluate the application and limitations of solid biomass technologies compared to conventional technologies and to draw appropriate conclusions considering technical and economic aspects.

2. Method(s) of instruction
Lecture in combination with an excursion to a biomass- CHP - plant

3. Requirements for attendance
No course specific requirements

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

5. Requirements for assessment
- Participation in the integrated excursion is mandatory
- Assessment is performed either as written examination (90 minutes) or oral examination
- Students need to pass the module examination, which encompasses all contents of the lecture.

6. ECTS credits
- 5 ECTS credits

7. **Frequency of offer**
- Annually in the spring semester.

8. **Work load**
150 h of total work load, therefrom
- 80 h of presence at lectures
- 40 h of self-study
- 30 h preparation for examination

9. **Duration of module**
1 semester