Programme and Course Description

Renewable Energy Systems – Master RES

Faculty of Mechanical Engineering

As per: Sommersemester 2019

This program and course description becomes effective on 15.03.2019. It supplements the program and examination regulations and secures the offerings in courses. Additionally, it contains detailed information about courses, contents, assessments and examinations.
1. Structure of the RES-Program:

The master program Renewable Energy Systems (RES) aims at providing graduates with the skills required to successfully plan, develop and control energy systems. Graduates will expand their expertise in renewable energy technologies, whereby here the focus is not on one single technology but on the interrelation between technologies and the structure of the demand side. Graduates will be perfectly prepared to take on leading positions in the energy sector. The regular study time is 3 semesters, whereby the first two semesters are filled with courses and the third semesters is reserved for the master thesis.

Three out of four energy system modules will be offered every year, where students will be confronted with the practical task to design energy systems in a project-oriented approach. Students are supported by a team of specialists, who will teach them the relevant aspects of components. Students compare, select and determine components according to the defined requirements of the systems, to learn which constraints and requirements are important for planning, financing and operating energy systems. The idea of these energy system courses is, that emphasis is neither put on a technology nor on a method, but on the integral approach of fulfilling the energy demand with the best renewable supply in the most economic and efficient way. Energy System Courses contain lectures about certain technologies and project work on examplatory systems. But there is, depending on the individual knowledge of the students, also the necessity to enrich the knowledge with individual preparation in the library.

2. Learning Results of the RES-Program:

The master program aims for the dissemination of engineering knowledge and interdisciplinary abilities from the areas of business and technics. Based on scientific methods and knowledge graduates will be prepared for leadership and expert tasks in international companies and organisations. Besides methods and knowledge the program aims for the development of the social competence. It also encourages independent research with a focus on applied science. It aims for

- Integrated approach to the design of an energy system
- Deep Knowledge of renewable technologies
- Application of knowledge on practical example systems
- Ability to complex engineering on the basis of different methods
- Ability to apply scientific methods and carry out research projects
- Ability to start a PhD-program
- Ability to work in an international team
Description of Modules Pflicht Module **Master-RES VL SS 2019**
(Start erstmal ab WS 2017/18)

<table>
<thead>
<tr>
<th>SPO Nr.</th>
<th>Pflichtmodule Master Renewable Energy Systems</th>
<th>Vorlesung SS 19</th>
<th>Vorlesung WS19/20</th>
<th>ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introductory Laboratory Course</td>
<td>4 SWS</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>System Analysis an Control</td>
<td>4 SWS</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Energy Policies and Economies</td>
<td>4 SWS</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Numerical Methods and Comp. Simulation</td>
<td>4 SWS</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Core Electives (1)</td>
<td>16 SWS</td>
<td>8 SWS</td>
<td>30</td>
</tr>
<tr>
<td>6</td>
<td>Individual Elective (1)</td>
<td>4 SWS</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Scientific Research Seminar</td>
<td>2.5 SWS</td>
<td>5</td>
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</tr>
<tr>
<td>8</td>
<td>Master Thesis</td>
<td></td>
<td>30</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Summe</strong></td>
<td><strong>46.5 SWS</strong></td>
<td><strong>90 ECTS</strong></td>
<td></td>
</tr>
</tbody>
</table>

1 Individual Electives select only 1 with 4 SWS. Bei den LN kann es sich um eine: schriftl. Prüfung, mündl. Prüfung, Studienarbeit, Seminararbeit oder Projektarbeit handeln.
2 Core Electives select 3 with 8 SWS.

**Nr. 5. Core Electives Master RES, Vorlesungen SS 2019**

<table>
<thead>
<tr>
<th>SPO Nr. 5</th>
<th>Core Electives (2)</th>
<th>VL Angebot für Master Renewable Energy Systems</th>
<th>VL nur SS 19</th>
<th>VL nur WS 19/20</th>
<th>ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1</td>
<td>Building Energy System (kein VL-Angebot im WS 2019/20)</td>
<td>8 SWS</td>
<td>10</td>
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<td></td>
</tr>
<tr>
<td>5.2</td>
<td>Industrial Energy System</td>
<td>8 SWS</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.3</td>
<td>Off-Grid Energy System</td>
<td>8 SWS</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.4</td>
<td>Urban Area Energy System</td>
<td>8 SWS</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Summe</strong></td>
<td><strong>24 SWS</strong></td>
<td><strong>30 ECTS</strong></td>
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<td></td>
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</table>

1 Individual Electives select 1 with 4 SWS. Bei den LN kann es sich um eine: schriftl. Prüfung, mündl. Prüfung, Studienarbeit, Seminararbeit oder Projektarbeit handeln.
2 Core Electives select 3 with 8 SWS.

**Nr. 6 Individual Elective Master Renewable Energy Systems, M_RES VL SS 2019**

<table>
<thead>
<tr>
<th>SPO Nr. 6</th>
<th>Individual Elective (1)</th>
<th>Vorlesungs-Angebot</th>
<th>ECTS</th>
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<tbody>
<tr>
<td>5.1</td>
<td>Fahrzeugsicherheit</td>
<td>d 4 SWS</td>
<td>5</td>
</tr>
<tr>
<td>5.2</td>
<td>Software Engineering</td>
<td>d 4 SWS</td>
<td>5</td>
</tr>
<tr>
<td>5.3</td>
<td>Korrosion- und Oberflächentechnik</td>
<td>d 4 SWS</td>
<td>5</td>
</tr>
<tr>
<td>5.4</td>
<td>Engineering Processes in Automotive Industry</td>
<td>e 4 SWS</td>
<td>5</td>
</tr>
<tr>
<td>5.5</td>
<td>Personnel Management and Leadership</td>
<td>e 4 SWS</td>
<td>5</td>
</tr>
</tbody>
</table>

1 Individual Electives select 1 with 4 SWS. Bei den LN kann es sich um eine: schriftl. Prüfung, mündl. Prüfung, Studienarbeit, Seminararbeit oder Projektarbeit handeln.
3 Voraussichtliches Angebot im Folgesemester. Änderungen vorbehalten.
Description of Modules

**Energy Policies and Economies**

<table>
<thead>
<tr>
<th>Module abbreviation:</th>
<th>EnPolEc_M-RES</th>
<th>Reg.no.: According to SPO from WS 2017/18</th>
<th>3</th>
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<tbody>
<tr>
<td>Curriculum:</td>
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<td>Programmes Module type Semester</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Renewable Energy Systems – Master</td>
<td>2</td>
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<td>Language of instruction:</td>
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<td>English</td>
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<tr>
<td>Credit points / SWS:</td>
<td>5 ECTS / 4 SWS</td>
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<td></td>
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<tr>
<td>Workload:</td>
<td></td>
<td>Contact hours: 45 h Self-study: 80 h Exam preparation time 0 h Total: 125 h</td>
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</tr>
<tr>
<td>Subjects of the module:</td>
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<td>Energy Policies and Economies (EnPolEc_M-RES)</td>
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<tr>
<td>Lecture types:</td>
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<td>EnPolEc_M-RES:</td>
<td></td>
</tr>
<tr>
<td>Prerequisites according examination regulation:</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Recommended prerequisites:</td>
<td>none</td>
<td></td>
<td></td>
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<tr>
<td>Objectives:</td>
<td></td>
<td>The students</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>understand climate protection policies worldwide and their relation to energy issues</td>
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<tr>
<td></td>
<td></td>
<td>are able to critically reflect on and discuss issues of climate change and energy</td>
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<tr>
<td></td>
<td></td>
<td>understand different shaping of energy legislation in selected countries</td>
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<tr>
<td></td>
<td></td>
<td>are able to critically reflect on and discuss issues of energy legislation</td>
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<tr>
<td></td>
<td></td>
<td>understand renewable energies as an economic factor</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>understand the energy economy in selected countries</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>are able to critically reflect on and discuss issues of the energy economy</td>
<td></td>
</tr>
<tr>
<td>Content:</td>
<td></td>
<td>Energy and climate change</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Climate protection policies worldwide, in Germany and other selected countries</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Energy legislation in Germany and other selected countries</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>• Renewable energies as economic factor</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Energy economy / industry in Germany and other selected countries</td>
<td></td>
</tr>
<tr>
<td>Examinations:</td>
<td></td>
<td>Gemäß der Anlage zur SPO M.RES: Seminararbeit mit Kolloquium:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>schriftliche Ausarbeitung 8-15 Seiten;</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Präsentation 15-20 Folien</td>
<td></td>
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</table>
### Numerical Methods and Computation Simulation

<table>
<thead>
<tr>
<th>Module abbreviation:</th>
<th>NumMetCS_M-RES</th>
<th>Reg.no.:</th>
<th>According to SPO from WS 2017/18</th>
<th>4</th>
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</thead>
<tbody>
<tr>
<td>Curriculum:</td>
<td></td>
<td>Programme: Renewable Energy Systems – Master</td>
<td>Module type: Compulsory Subject</td>
<td>Semester: 2</td>
</tr>
</tbody>
</table>

| Language of instruction: | English |
| Credit points / SWS:     | 5 ECTS / 4 SWS |

| Workload:               | Contact hours: 47 h | Self study: 48 h | Exam preparation time: 30 h | Total: 125 h |

| Subjects of the module: | Numerical Methods and Computation Simulation (NumMetCS_M-RES) |
| Lecture types:          | NumMetCS_M-RES: SU/Ü - lecture with integrated exercises |

**Prerequisites according examination regulation:**

- None

**Recommended prerequisites:**


**Objectives:**

- The students can estimate the error of a numerical approximation of derivatives and use a suitable order of approximation for the given application,
- understand the influence of the round-off error and conditioning on the numerical solution of linear algebraic equations and can assess which direct or iterative methods are suitable for the given purpose,
- recognize the above methods in the finite difference discretization of the heat equation, can explain consistency, stability and convergence, are able to evaluate the merits of the explicit and implicit approaches,
- are familiar with simple implementations of the discussed numerical methods in some widely used computer algebra system (e.g. MATLAB) or programming language
- are familiar with the mathematical background of the Finite-Volume method
- are able to apply different computational methods like Computational Fluid Dynamics and 1D simulation of thermal and hydraulic processes to problems in renewable energy systems
- are able to evaluate and discuss simulation results with respect to theory and experiments

**Content:**

- Numerical approximation of derivatives,
- Numerical solution of large systems of linear algebraic equations, round-off error,
- Numerical solution of the linear heat equation
- Introduction into numerical flow simulation theory (computational fluid dynamics, CFD)
- Finite-volume method and its mathematical background
- Application to 3D fluid simulation with commercial software

**Examinations:**

- schrP90 - written exam, 90 minutes

- Theory of computational simulation of thermal and hydraulic processes
- Thermal and hydraulic simulation in building services engineering
- Computational simulation of thermodynamic processes
- Application to practical problems (computer lab)
### 1.1 Core Electives Master RES SS 2019

**Industrial Energy System**

<table>
<thead>
<tr>
<th>Module abbreviation:</th>
<th>IndustEnerSys_M-RES</th>
<th>Reg.no.: According to SPO from WS 2017/18</th>
<th>5.2</th>
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<tbody>
<tr>
<td>Curriculum:</td>
<td>Programme:</td>
<td>Module type: General Elective Subject</td>
<td>2</td>
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</table>

<table>
<thead>
<tr>
<th>Language of instruction:</th>
<th>English</th>
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</thead>
<tbody>
<tr>
<td>Credit points / SWS:</td>
<td>10 ECTS / 8 SWS</td>
</tr>
<tr>
<td>Workload:</td>
<td>Contact hours: 93 h</td>
</tr>
<tr>
<td></td>
<td>Self-study: 157 h</td>
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<tr>
<td></td>
<td>Exam preparation time: 0 h</td>
</tr>
<tr>
<td></td>
<td>Total: 250 h</td>
</tr>
</tbody>
</table>

**Subjects of the module:** Industrial Energy System (IndustEnerSys_M-RES)

**Lecture types:** IndustEnerSys_M-RES:

**Prerequisites according examination regulation:**

None

**Recommended prerequisites:**

None

**Objectives:**

The students have an overview of the most important consumers of electricity, heat and gas in a typical industrial operation can establish and evaluate the different energy consumptions and efficiency improvement strategies in an industrial operation.

are familiar with the biogas process, the construction of biogas plants, the most important components and process parameters and can dimension a biogas plant.

are familiar with the most important procedural basics and concepts of the combustion of solid biomass and the corresponding plant technology for heat and power generation and can design a corresponding power plant.

know the most important procedural basics and concepts of the thermal gasification of solid biomass and the corresponding plant technology for heat and power generation.

are able to project the energy supply of an industrial company with the acquired knowledge.

**Content:**

- Energy efficiency
- Rating of energy systems
- Example project: meat processing
  - Definition of boundaries
  - Applied thermodynamics for energy efficiency
  - Presentation and Reporting
- Cross cutting technologies
  - Drives and pumps
Mechanical power
Lighting
Thermal Energy
Renewable Electricity Integration
Bio energy
Biogas
Anaerobic fermentation
Construction of biogas plants
operating parameters and environmental conditions
substrates and manure
process and plant engineering
process variants
biogas production and storage
Solid biomass
basics of combustion
special features and design of the furnace
combustion concepts
cyclic processes
plants for electricity and heat generation and their components
basics and concepts of gasification
Project
Building an energy-efficient and environmentally friendly energy supply for an industrial company

Examinations:
Gemäß der Anlage zur SPO M_RES: Seminararbeit mit Kolloquium:
schriftliche Ausarbeitung 8-15 Seiten;
Präsentation 15-20 Folien

Off-Grid Energy System

Module abbreviation: Off-GridEnSy_M-RES
Reg.no.: According to SPO from WS 2017/18
5.3

Curriculum: Programme Module type Semester
Renewable Energy Systems – Master General Elective Subject 2

Language of instruction: English
Credit points / SWS: 10 ECTS / 8 SWS

Workload:
Contact hours:
Self-study:
Exam preparation time:
Total:
93 h
157 h
0 h
250 h

Subjects of the module:
Off-Grid Energy System (Off-GridEnSy_M-RES)

Lecture types:
Off-GridEnSy_M-RES:

Prerequisites according examination regulation:
None

Recommended prerequisites:
Mathematics: bachelor level calculus (functions of one and more variables, derivatives, integrals, sequences, series, ordinary differential equations, Laplace transformation), Control techniques. Electric Engineering, System Analysis and Control

Objectives:
The students:
Can model an offgrid electrical system Know the main components in an Offgrid System : Generators, Loads, safety devices...
Know the principles of the grid frequency control
Know the principles of the grid voltage control
Are able to determine the stability of an off grid system
Know how to do a power flow analysis
Can take the decision of the needed requirements (Hardware an control) to design an offgrid system
Can write the project specification for the given system

Content:
Voltage Control
Frequency Control
Generators (Synchronous, Asynchronous)
Converters description
Load flow calculation
Load behavior
Energy Storage
Energy conversion and transport
Wind Power description

Examinations:
Gemäß der Anlage zur SPO M_RES: Seminararbeit mit Kolloquium:
schriftliche Ausarbeitung 8-15 Seiten;
Präsentation 15-20 Folien

1.2 Individual Elective Master RES SS 2019
### Personnel Management and Leadership

<table>
<thead>
<tr>
<th>Module abbreviation:</th>
<th>WMod_PersLead_Master</th>
<th>Reg.no.:</th>
<th>6</th>
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</thead>
</table>

**Curriculum:**

<table>
<thead>
<tr>
<th>Programme</th>
<th>Module type</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Master</td>
<td>General Elective</td>
<td>1</td>
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</table>

**Language of instruction:** English

**Credit points / SWS:** 5 ECTS / 4 SWS

**Workload:**

<table>
<thead>
<tr>
<th>Contact hours:</th>
<th>Self-study:</th>
<th>Exam preparation time</th>
<th>Total:</th>
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<tbody>
<tr>
<td>47 h</td>
<td>78 h</td>
<td>0 h</td>
<td>125 h</td>
</tr>
</tbody>
</table>

**Subjects of the module:** Personnel Management and Leadership (WMod_PersLead)

**Lecture types:**

WMod_PersLead

**Prerequisites according examination regulation:**

None

**Recommended prerequisites:**

None

**Objectives:**

- The students analyze different management models and instruments of successful personnel management in the digital age. They critically discuss current questions of managing interdisciplinary and intercultural teams.

**Content:**

- Seminar topics differ from semester to semester, e.g.
  - Comparison of traditional and modern management approaches
  - Requirements for project managers in the digital age
  - Successful management of change processes
  - Dimensions, challenges and methods of planning human resources
  - Process and instruments of recruiting
  - Solving problems and conflicts in teams

**Examinations:**

LN - seminar paper/presentation
paper (8-10 pages) and oral presentation and discussion (30 min)

### Engineering Processes in Automotive Industry

<table>
<thead>
<tr>
<th>Module abbreviation:</th>
<th>WModul-EngineeProcAuto_M-APE</th>
<th>Reg.no.:</th>
<th>6</th>
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</table>

**Curriculum:**

<table>
<thead>
<tr>
<th>Programme</th>
<th>Module type</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Master APE</td>
<td>General Elective</td>
<td>2</td>
</tr>
</tbody>
</table>

**Language of instruction:** English

**Credit points / SWS:** 5 ECTS / 4 SWS

**Workload:**

- Contact hours: 47 h
- Self-study: 48 h
- Exam preparation time: 30 h
- Total: 125 h

**Subjects of the module:** (WModul-EngineeProcAuto_M-APE)

**Lecture types:**

WModul-EngineeProcAuto_M-APE

**Prerequisites according examination regulation:**

None

**Recommended prerequisites:**

None

**Objectives:**

- Get to know the strongly networked and parallel processes in the product development of automobiles ("product process" and "product development process")
- Can recognise, assess and include in their work interactions between production and product in particular.
- Know the significance and working methods of Simultaneous Engineering (SE) including the involvement of suppliers in product design and product and process quality to meet the requirements of production.
- Can handle tools of project and process management (e.g. master product processes with structured levels of action in terms of decisions and themes, milestone definitions and synchronisation, levels of product maturity, ENPV, 3Ps „Production Preparation Process“, etc.) and know the working methods and processes, for example, for networking, decision-making, escalation, theme contributions etc. in large automotive and supplier companies.
- Know the significance of prototype, pilot production and release processes, their tools (e.g. Meisterbock processes, audit scores, process capability evidence, VFF, PVS, etc.) as well as their involvement in the product and engineering process
- Know about the significance of Lean Development

**Content:**

- Product development and quality management (during the product development process) in the automotive industry
- Project and process management in the product development process
- Prototype, pilot production and release processes
- Lean Development, generic principles and application
Examinations:
LN - written exam, 90 minutes

Master: Korrosion- und Oberflächentechnik

Module abbreviation: WMod_KorOT_M-WT
Reg.no: 6
According to SPO from SS 2017

Curriculum: Programme Module type Semester
Master WT Allgemeines Wahlpflichtfach 1

Language of instruction: Deutsch
Credit points / SWS: 5 ECTS / 4 SWS

Workload:
Contact hours: 47 h
Self-study: 48 h
Exam preparation time: 30 h
Total: 125 h

Subjects of the module: Korrosion- und Oberflächentechnik (WMod_KorOT_M-WT)

Lecture types:
WMod_KorOT_M-WT: SU/Ü/PR - Seminaristischer Unterricht/Übung/Praktikum

Prerequisites according examination regulation:
Keine

Recommended prerequisites:
Keine

Objectives:
Die Studierenden kennen den Mechanismus der Korrosion einschließlich seiner relevanten thermodynamischen und kinetischen Einflussfaktoren, können verschiedene Korrosionsformen erkennen und den jeweiligen Korrosionsursachen zuordnen.

Die Studierenden kennen die wichtigsten Korrosionsprüfungen einschließlich elektrochemischer Methoden und können ihre Ergebnisse sinnvoll interpretieren.


Die Studierenden sind informiert über die verbreitetsten Möglichkeiten, wenig korrosionsbeständige Werkstoffe mit Hilfe von Beschichtungen und Überzügen zu schützen. Sie kennen die einschlägigen Methoden und Prozesse und sind in der Lage zu entscheiden, welches Verfahren zu einem gegebenen Bauteil und den dort herrschenden Anforderungen passt.


Content:
- Theoretische Grundlagen, Methoden der Elektrochemie, Korrosionsprüfung
- Mechanische Einflüsse auf das Korrosionsgeschehen
- Korrosionsbeständige Werkstoffe mit ihren Möglichkeiten, Grenzen und ihrem Sonderkorrosionsformen
- Korrosionsschutz durch Beschichtungen, Vorbehandeln und Vorbereiten, Beschichtungsprozesse, Beschichtungsstoffe
- Korrosionsschutz durch Überzüge, Verfahren und Materialien
- Grundbegriffe des konstruktiven Korrosionsschutzes
- Fügetechnik und Korrosion
### Master Software Engineering

**Module abbreviation:** WMod_SWEng_M-WI  
**Reg.no:** 6  
**Accordig to SPO from SS 2017**

<table>
<thead>
<tr>
<th>Curriculum:</th>
<th>Programme</th>
<th>Module type</th>
<th>Semester</th>
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</thead>
<tbody>
<tr>
<td>Master Wi</td>
<td>Allgemeines Wahlpflichtfach</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

**Language of instruction:** Deutsch  
**Credit points / SWS:** 5 ECTS / 4 SWS  
**Workload:**  
- Contact hours: 47 h  
- Self-study: 48 h  
- Exam preparation time: 30 h  
- Total: 125 h

**Subjects of the module:** Software Engineering (WMod_SWEng_M-WI)

**Lecture types:**  
WMod_SWEng_M-WI: SU/Ü/PR - Seminaristischer Unterricht/Übung/Praktikum

**Prerequisites according examination regulation:**  
Keine

**Recommended prerequisites:**  
Keine

**Objectives:**  
- Verständnis der Grundlagen des Softwareengineering  
- Verständnis und sicherer Umgang mit grundlegenden Begriffen der Softwareentwicklung  
- Verständnis der Unterschiede zur klassischen Produktentwicklung  
- Kenntnisse der grundlegenden Prinzipien der Softwareentwicklung  
- Erlangung von Sicherheit im Umgang mit verschiedenen Entwicklungsumgebungen (IDE) und Methoden  
- Programmentwicklung in einer höheren Programmersprache  
- Sinnvoller Einsatz von Sprachkonstrukten dieser Programmiersprache  
- Grundlegende Konzepte des objektorientierten Entwurfs  
- Praktische Erfahrung bei der Erstellung von Programmen bzw. Softwareanwendungen

**Content:**  
- Grundlagen des Software Engineering:  
- Fähigkeiten zum Arbeiten mit Computern (Grundlagen)  
- Kenntnisse der grundlegenden Prinzipien der Softwareentwicklung (Grundlagen)  
- Erlangung von Sicherheit im Umgang mit verschiedenen Softwareentwicklungsumgebungen (IDE), sichere und zielführende Anwendung  
- Sicherer Umgang mit Softwaremodellen und Modellierungstools  
- Entwurf von Algorithmen (Methodik und Anwendung)  
- Erfassen von Benutzungsanforderungen  
- Validierung anhand von Benutzungsanforderungen

**Examinations:**  
Gemäß der Anlage zur SPO: SA - Studienarbeit mit Präsentation:  
- schriftliche Ausarbeitung 8-15 Seiten,  
- Präsentation (15-20 Folien)
# Fahrzeugsicherheit

<table>
<thead>
<tr>
<th>Module abbreviation:</th>
<th>WModul-FzgSich_M-RES</th>
<th>Reg.no.: 6</th>
<th>According to SPO from WS 2017/18</th>
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## Curriculum:

<table>
<thead>
<tr>
<th>Programme</th>
<th>Module type</th>
<th>Semester</th>
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<tbody>
<tr>
<td>Renewable Energy Systems – Master</td>
<td>Allgemeines Wahlpflichtfach</td>
<td>2</td>
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## Language of instruction:
Deutsch

## Credit points / SWS:
5 ECTS / 4 SWS

## Workload:

- Contact hours: 47 h
- Self study: 48 h
- Exam preparation time: 30 h
- Total: 125 h

## Subjects of the module:
Fahrzeugsicherheit (WModul-FzgSich_M-RES)

## Lecture types:
WModul-FzgSich_M-RES: unbestimmt

## Prerequisites according examination regulation:
Keine

## Recommended prerequisites:
Keine

## Objectives:
Die Studierenden
- kennen die Bereiche Unfallvermeidung und Unfallfolgenmilderung (aktive und passive Sicherheit)
- verstehen die Ursachen von Unfällen und können Risiken bewerten
- kennen die Einwirkungen auf Fahrzeuge bei Unfällen
- verstehen die Vorschriften aus Gesetzen und Verbraucherschutz
- kennen Schutzmaßnahmen für Insassen, äußere Verkehrsteilnehmer und zur Verbesserung der Kompatibilität
- verstehen die Grundlagen der Biomechanik
- kennen Versuchs- und Berechnungsmethoden

## Content:
- Einführung in die Fahrzeugsicherheit / Unfallstatistik
- Unfallforschung und -analyse
- Risikobewertung
- Mechanische Grundlagen bei Unfällen
- Gesetzegebung und Verbraucherschutz in der Fahrzeugsicherheit
- Testverfahren in der passiven Sicherheit
- Insassenschutz
- Kompatibilität und äußere Verkehrsteilnehmer
- Biomechanik
- Konstruktive Ausführung von Sicherheitssystemen
- Versuchsdurchführung, Berechnungsmethoden und Bewertungsverfahren
### Scientific Research Seminar

<table>
<thead>
<tr>
<th>Module abbreviation:</th>
<th>SciResSem_M-RES</th>
<th>Reg.no.:</th>
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**Curriculum:**

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<tr>
<th>Programme</th>
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<th>Semester</th>
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<tbody>
<tr>
<td>Renewable Energy Systems – Master</td>
<td>Compulsory Subject</td>
<td>2</td>
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</table>

**Responsible for module:** Schrag, Tobias

**Lecturers:**
SciResSem_M-RES: Bayer, Peter; Bschorer, Sabine; Navarro Gevers, Daniel; Schrag, Tobias; Zörner, Wilfried

**Language of instruction:** English

**Credit points / SWS:** 5 ECTS / 2.5 SWS

**Workload:**
- Contact hours: 5 h
- Self-study: 110 h
- Exam preparation time: 10 h
- Total: 125 h

**Subjects of the module:** Scientific Research Seminar (SciResSem_M-RES)

**Lecture types:**
SciResSem_M-RES: Pj – project

**Prerequisites according examination regulation:**

**Recommended prerequisites:**

**Objectives:**

Processing of a semester-accompanying scientific question differ from semester to semester. Several topics are offered, from which one can be selected. The task is a scientific question and is handled by the student on his own responsibility. At the end of the semester, the results are summarized in the form of a report and a presentation. Some tasks are suitable for groups some only for individuals. The report and the presentation must be an individual.

**Content:**

Processing of a semester-accompanying scientific question differ from semester to semester. Several topics are offered, from which one can be selected. The task is a scientific question and is handled by the student on his own responsibility. At the end of the semester, the results are summarized in the form of a report (approx. 10-15 pages) and a presentation (approx. 15-30 minutes).

**Examinations:**

Gemäß der Anlage zur SPO M_RES: Seminararbeit mit Kolloquium:
- schriftliche Ausarbeitung 8-15 Seiten;
- Präsentation 15-20 Folien

### Master’s thesis (Masterarbeit)

<table>
<thead>
<tr>
<th>Module abbreviation:</th>
<th>SciResSem_M-RES</th>
<th>Reg.no.:</th>
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**Curriculum:**

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<th>Programme</th>
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<tbody>
<tr>
<td>Renewable Energy Systems – Master</td>
<td>Compulsory Subject</td>
<td>3</td>
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**Responsible for module:** Prof. Dr. Schrag

**Lecturers:** Different lectures with courses in the Master’s program

**Language of instruction:** English

**Credit points / SWS:** 30 ECTS / 4 SWS

**Workload:**
- Lecture time (Discussions and seminars): 30 h
- Self-study: 870 h
- Exam preparation time: 0 h
- Total: 900 h

**Subjects of the module:**

**Lecture types:**

**Prerequisites according examination regulation:**

**Recommended prerequisites:**

**Objectives:**

Acquisition and proof of the ability to work independently on complex problems from the field of Automotive Production Engineering to a high academic level using the expert knowledge gained as well as academic methods and knowledge within a specified period of time. The Master’s students are furthermore able to classify results in a professional and interdisciplinary context and present them in the form of an academic piece of work.

**Content:**

- Analysis of the problem and definition of the theme
- Literature/patent research
- Formulation of the approach/methods
- Determination of a solution/approach
- Planning and development of the solution, analysis of results
- Classification of references to professional sources and other non-subject related references
- Use of academic work methods and methodology, i.e. proceeding systematically, analytically and using correct methodology, forming arguments logically and concisely, as well working in a targeted manner and time critically and presenting results in a formally correct manner

**Examinations:**

MA = Written piece of work and participation in Master’s seminar

<table>
<thead>
<tr>
<th>Sprachkurs</th>
<th>Angebotsform</th>
<th>Sprache</th>
<th>SWS</th>
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<td>APE German A2 intensive</td>
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<tr>
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