APPENDIX A to the Addendum for Double Master's Degrees between Chalmers tekniska högskola and Universität Stuttgart

Double Master's Degree Scheme

The attached MACROPLAN depicts the 2-year MSc double degree structure in Sustainable Energy Systems at Chalmers and in Energietechnik (Energy Engineering) at the U Stuttgart. It shows the compulsory and elective courses in each semester as well as the prerequisites for students wishing to spend their 2nd year at the partner institution.

<table>
<thead>
<tr>
<th>Semester 1</th>
<th>Semester 2</th>
<th>Semester 3</th>
<th>Semester 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chalmers students at Chalmers</td>
<td>Stuttgart students in Stuttgart</td>
<td>Chalmers students at Chalmers</td>
<td>Stuttgart students in Stuttgart</td>
</tr>
<tr>
<td><strong>C1: Heat and Power Systems Engineering (7.5 ECTS)</strong></td>
<td><strong>C2 equivalent: Energiewirtschaft und Energieversorgung (6 ECTS)</strong></td>
<td><strong>C4: Heating, Ventilation and Air Conditioning Systems Engineering (7.5 ECTS)</strong></td>
<td><strong>C1 equivalent: Energie- und Umwelttechnik (6 ECTS)</strong></td>
</tr>
<tr>
<td><strong>C2: Sustainable Energy Futures (7 ECTS)</strong></td>
<td><strong>C4 equivalent: Grundlagen der Heiz- und Raumlufttechnik (6 ECTS)</strong></td>
<td><strong>1 to 3 Semi-compulsory:</strong> Design of Industrial Energy Equipment (7.5 ECTS)</td>
<td><strong>Completion of the 30 ECTS credits in semi-compulsory modules from List 4</strong></td>
</tr>
<tr>
<td><strong>C3: Industrial Energy Systems (7.5 ECTS)</strong></td>
<td><strong>2 Semi-compulsory modules (Vertiefungsmodul) from List 3 (each 6 ECTS)</strong></td>
<td><strong>Combustion Engineering (7.5 ECTS)</strong></td>
<td><strong>or (if already completed): Industriepraktikum (12 ECTS)</strong></td>
</tr>
<tr>
<td>1 Semi-compulsory module: Introduction to Power Systems Analysis (7.5 ECTS)</td>
<td>1 Core Module of specialization from List 4 (6 ECTS)</td>
<td><strong>Energy Systems Modelling and Planning (7.5 ECTS)</strong></td>
<td>one area of specialization from List 5 (15/15** ECTS)**</td>
</tr>
<tr>
<td>or 1 Elective module from List 2 (7.5 ECTS)</td>
<td>Elective modules from List 2 (if 2 semi-compulsory have been taken) (7.5 ECTS each)</td>
<td><strong>and</strong> Industrial Placement * (12 ECTS)</td>
<td>and Industrial Placement * (12 ECTS)</td>
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<tr>
<td><strong>Σ ECTS = 30</strong></td>
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</table>

**C1 - C4:** Compulsory courses in Chalmers or equivalent at Stuttgart

\[ *could be completed from July to October **if 15, then + one Module (3 ECTS) from List 5\]

\[ 1 Semi-compulsory modules from List 1 (7.5 ECTS each)\]

\[ 1 Elective from List 2 (6 or 7.5 ECTS)\]

\[ (this Elective should fit together with semi-compulsory modules to an area of specialization; compare Energietechnik Modules in Specialized Areas at US)\]

\[ Master Thesis (30 ECTS)\]

\[ Master Thesis (30 ECTS)\]

\[ 1 Soft Skills, e.g. English language or Communication (3 ECTS)\]

\[ (to be taken to complete 30 ECTS)\]

\[ 24 FEB 2011\]
Pre-requisites:
If the admission conditions for the MSc program “Sustainable Energy Systems” at Chalmers respectively for “Energietechnik” at Universität Stuttgart have been fulfilled the student can be admitted for the Double Master’s program.

Remarks for Chalmers students:
- All Compulsory courses have to be taken at Chalmers.
- At least 15 semi-compulsory credits taken at Chalmers.
- Remaining semi-compulsory credits (up to at least 30 in total) taken at US in form of Pflichtmodule selected from List 4 (or List 3) (Appendix).
- If all 30 semi-compulsory credits have been taken at Chalmers, an area of specialization (Spezialisierungsfach) consisting of 15 - 18 credits must be taken at US (see List 5 in Appendix).
- Industrial placement (12 credits) in Germany organized by US must be carried out if not absolved in Sweden. Guidelines for this work will be developed by US in agreement with Chalmers.
- Study work (12 credits) is included in the compulsory courses (C1, C2 and C3) taken at Chalmers (meaning there is no need to carry out such at US).
- Soft skills (Schlüsselqualifikation):
  - Fachaffin is included in the compulsory courses (C1, C2 and C3) taken at Chalmers (meaning there is no need to carry out such at US).
  - Fachüberbergreifend (3 credits) is taken at US (from List 6, Appendix)
- Master Thesis:
  Carried out at US, supervised by one US Professor with monitoring of one Chalmers Professor (full, associate, assistant, außerplanmäßig (but employed at the University) or Juniorprofessor)

Remarks for US students:
- 4 modules given at US equivalent to Chalmers compulsory modules are to be taken or, as alternative, the compulsory modules at Chalmers.
- 4 Pflichtmodule given at US (List 3) equivalent to Chalmers semi-compulsory modules are to be taken or, as alternative, semi-compulsory modules at Chalmers.
- Industrial practical work is carried out during 2nd semester in Germany organized by US.
- Studienarbeit is included in any of C1, C2, C3 or S4 at Chalmers. Alternatively, it can be carried out during the 2nd semester at US.
- Soft skills (Schlüsselqualifikation) should be taken at Chalmers:
  - “Fachaffin” is included in any of C1, C2, C3 or S4 at Chalmers. Alternatively, can be taken.
  - “Fachüberbergreifend” should be taken as an English language or Communication course at Chalmers.
- Remaining credits to be taken at Chalmers should belong to the same specialized area.
- Master Thesis:
  Carried out at Chalmers Technical University, supervised by one Chalmers Professor with monitoring of one Stuttgart Professor (full, associate, assistant, außerplanmäßig (but employed at the University) or Junior professor)
Annex: Lists of offered modules

List 1: Semi-compulsory Modules in Chalmers given during first semester

- Introduction to Power Systems Analysis
- Sustainable Development
- Environmental Aspects of Transport

List 2: Elective Modules in Chalmers

- Fuel Cells - function and materials
- Nanotechnology for Sustainable Energy
- Introduction to Nuclear Reactors
- Waste management
- Biorefinery
- Gas Turbine Technology
- Compressible flow
- Turbomachinery
- Computational Fluid Dynamics
- Computational Fluid Dynamics for Engineers
- Multiphase Flow
- Advanced Separation Technology
- Environmental Policy Instruments
- Environmental Measurement Techniques
- Environmental Risk Assessment in Engineering
- Life Cycle Assessment
- Technical Change and the Environment
- Building Technology and Building Services Engineering – Design (I and II)
- Sustainable Aspects of Logistics
- Sustainable Power Production and Transportation
- Power Market Management
List 3: Vertiefungsmodul in Universität Stuttgart, 6 ECTS each

- Air Quality Control and Management (Friedrich/Baumbach)
- Berechnung von Wärmeübertragern (Heidemann)
- Brennstoffzellentechnik - Grundlagen, Technik und Systeme (A. Friedrich)
- Einführung in die energetische Nutzung von Biomasse (Schaffknecht)
- Elektrische Energienetze I (Tenbohlen)
- Energie- und Umwelttechnik (Schaffknecht)
- Energiewirtschaft und Energieversorgung (Völl)
- Erneuerbare Energien (Ellert)
- Festigkeitslehre I (Roos)
- Grundlagen der Heiz- und Raumlufttechnik (Schmidt)
- Grundlagen der Thermischen Strömungsmaschinen (Casey)
- Grundlagen der Verbrennung und Umweltauswirkungen der Energiewandlung (Friedrich/Kronenburg)
- Grundlagen der Windenergie (Hofsäss/Capellaro)
- Grundlagen technischer Verbrennungsvorgänge I+II (Kronenberg)
- Hydraulische Strömungsmaschinen in der Wasserkraft (Riedelbauch)
- Kerntechnische Anlagen zur Energieerzeugung (Laurien)
- Leichtbau (Roos)
- Methoden der Werkstoffsimulation (Schmauder)
- Numerische Strömungssimulation (Laurien)
- Photovoltaik I
- Regelung von Kraftwerken und Netzen (Lehner)
- Simulation mit Höchstleistungsrechner (Resch)
- Solarthermie (ITW)
- Fluidmechanik 2 (Riedelbauch)
- Thermal Waste Treatment and Flue Gas Cleaning (Seifert / Baumbach) *)
- Renewable Energy for Rural Areas (Prof. J. Müller, Universität Hohenheim)

List 4: Semi-compulsory courses (Vertiefungsmodul) in Universität Stuttgart, 6 ECTS each

- Air Quality Control and Management
- Thermal Waste Treatment and Flue Gas Cleaning
- Renewable Energy for Rural Areas
- Firing Systems and Flue Gas Cleaning
- Process Engineering
List 5: Areas of Specialization (Spezialisierungsfächer) in Universität Stuttgart

**Combustion and Power Plant Technology**
- Firing Systems and Flue Gas Cleaning (6 ECTS)
- Engine Combustion and Emissions (3 ECTS)
- Power Plants I (3 ECTS)
- Modelling and Simulation of Technical Firing (6 ECTS)
- Thermal Waste Treatment (3 ECTS)

**Renewable Thermal Energy Systems**
- Firing Systems and Flue Gas Cleaning (6 ECTS)
- Renewable Energy for Rural Areas (6 ECTS)
- Thermal Waste Treatment (3 ECTS)

**Energy and Environment**
- Pollutant Formation and Air Quality Control (6 ECTS)
- Measurement of Air Pollutants (6 ECTS)
- Design of Solid Waste Treatment Plants (6 ECTS)
- Chemistry and Biology for Environmental Engineers (6 ECTS)
- Technology Assessment (3 ECTS)

Some modules of List 3, List 4 and List 5 are offered in different combinations. Each module can be chosen only once. In German language more modules and specializations are offered (see List 2 for semi-compulsory modules).

List 6: Soft Skills at Universität Stuttgart, fachaffin, 3 ECTS each

- Project- and Quality Management
- Emissions reduction at selected industrial processes