## Computational Plasticity

<table>
<thead>
<tr>
<th>Module-No./Abbreviation</th>
<th>Credits</th>
<th>Workload</th>
<th>Term</th>
<th>Frequency</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE-WP12/CoPla</td>
<td>6 CP</td>
<td>180 h</td>
<td>2nd Sem.</td>
<td>Summer term</td>
<td>1 Semester</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Courses</th>
<th>Contact hours</th>
<th>Self-Study</th>
<th>Group Size:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computational Plasticity</td>
<td>4 SWS (60 h)</td>
<td>120 h</td>
<td>No Restrictions</td>
</tr>
</tbody>
</table>

### Prerequisites
- 

### Learning goals / Competences

After successfully completing the module, the students

- remember the definitions of the classifications of mechanical behavior and to which materials the different types of behavior can be associated,
- understand the phenomenology and mechanisms of elastic and plastic behavior of crystalline materials,
- know the different types of plasticity models in solid mechanics,
- understand the basic concepts and the mathematical formulation of continuum plasticity and crystal plasticity,
- understand the basic concepts of the numerical implementation of plasticity models,
- can assess which method is most suited to solve a given mechanical problem,
- are able to implement and apply a numerical scheme for the solution of elasto-plastic problems within the finite element method,
- have basic knowledge about the use of homogenization methods to describe plasticity in polycrystals.

### Content

- Basics of continuum mechanics and FEM
- Phenomenology and atomistic origin of elastic and plastic deformation
- Concepts of continuum plasticity (yield criterion, flow rule, isotropic and kinematic hardening)
- Rate dependent and rate-independent formulations of continuum plasticity
- Numerical solution schemes for elasto-plasticity (operator split, return mapping, consistent tangent modulus)
- Computational aspects of small and large strain formulations
- Concepts of crystal plasticity (dislocation slip, flow rule, hardening models, consistent tangent modulus)
- Plasticity of polycrystals (Sachs, Taylor and self-consistent model)
- Numerical solution schemes of the crystal plasticity method
- Structure, implementation and application of an Abaqus UMAT

### Teaching methods

Lecture (2h / week), Exercises (2h / week) / Homework (60h) / English

### Mode of assessment

Written examination (120 min, 100 %) / Bonus points for homework

### Requirement for the award of credit points

Passed homework and passed final module examination

### Module applicability

MSc. Computational Engineering, MSc. Maschinenbau, MSc. Materials Science and Simulation
<table>
<thead>
<tr>
<th>Weight of the mark for the final score</th>
<th>6 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module coordinator and lecturer(s)</td>
<td>Prof. Dr. rer. nat. A. Hartmaier, Assistants</td>
</tr>
<tr>
<td>Further information</td>
<td></td>
</tr>
</tbody>
</table>