### Numerical Methods and Stochastics

<table>
<thead>
<tr>
<th>Module-No./Abbreviation</th>
<th>Credits</th>
<th>Workload</th>
<th>Term</th>
<th>Frequency</th>
<th>Duration</th>
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<tbody>
<tr>
<td>CE-WP08/NMS</td>
<td>6 CP</td>
<td>180 h</td>
<td>2nd Sem.</td>
<td>Summer term</td>
<td>1 Semester</td>
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<thead>
<tr>
<th>Courses</th>
<th>Contact hours</th>
<th>Self-Study</th>
<th>Group Size:</th>
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<tbody>
<tr>
<td>Numerical Methods and Stochastics</td>
<td>4 SWS (60 h)</td>
<td>120 h</td>
<td>No Restrictions</td>
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**Prerequisites**
Basic knowledge of: partial differential equations, numerical methods and stochastics

**Learning goals / Competences**
Students should become familiar with modern numerical and stochastic methods

- should be able to formulate and analyze data from a probabilistic perspective,
- should understand the theoretical aspects of FEM and FVM methods,
- should be familiar with modern iterative solvers for large systems of linear equations and their necessity for numerical PDE solving,
- should be familiar with standard methods for solving optimization problems.

**Content**

**Numerical Methods:**
- Boundary value problems for ordinary differential equations (shooting, difference and finite element methods)
- Finite element methods (brief retrospection as a basis for further material)
- Efficient solvers (preconditioned conjugate gradient and multigrid algorithms)
- Finite volume methods (systems in divergence form, discretization, relation to finite element methods)
- Nonlinear optimization (gradient-type methods, derivative-free methods, simulated annealing)

**Stochastics:**
- Fundamental concepts of probability and statistics, such as random variables, univariate distributions & densities, descriptive statistics, parameter estimation, & law of large no
- Regression, such as univariate and multivariate linear regression, least-squares estimation, data transformations, qualitative predictors, and regularization
- Exploratory data analysis, such as qq-plots and summary statistics

**Teaching Methods / Language**
Lectures (3h / week), Exercises (1h / week) / English

**Mode of assessment**
Written examination (180 min, 100%)

**Requirement for the award of credit points**
Passed final module examination

**Module applicability**
MSc. Computational Engineering, MSc. Bauingenieurwesen

**Weight of the mark for the final score**
6 %

**Module coordinator and lecturer(s)**
Prof. Dr. M. Weimar, Prof. Dr. J. Lederer, Assistants

**Further information**