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| Data: | MHP. MA. Nr. 3615 / Examination number: 41913 | Version: 06.06.2018 | Start Year: WiSe 2018 |
| Module Name: | **Micromechanics and Homogenization Principles** | | |
| (English): | | | |
| Responsible: | Kiefer, Björn / Prof. PhD. | | |
| Lecturer(s): | Kiefer, Björn / Prof. PhD.<br>Kozinov, Sergii / Dr.-Ing. | | |
| Institute(s): | Institute of Mechanics and Fluid Dynamics | | |
| Duration: | 1 Semester(s) | | |
| Competencies: | Successful participants of this course are able to apply fundamental concepts of micromechanics to determine effective properties of multiphase elastic solids such as composite materials. They understand the theoretical foundations as well as the advantages and shortcomings of classical micromechanics techniques. The students are also familiar with advanced homogenization principles—both analytical and numerical in nature—that incorporate the influence of micro-defects (inclusions, cavities, cracks) and inelastic behavior. They have further acquired first experience with numerical implementation of these modeling concepts through simple programing examples. | | |
| Contents: | The main ingredients are:<br>• Micromechanics techniques for computing effective elastic properties of composite media<br>• Fundamental Eshelby solutions, inclusions, inhomogeneities<br>• Dilute distribution, Mori-Tanaka, and self-consistent approaches<br>• Energetic bounds on effective properties<br>• General averaging theorems, Hill-Mandel Principle, periodic homogenization, asymptotic expansions<br>• Direct numerical homogenization schemes, including the $FE^2$-method<br>• Numerical examples (programing in Matlab /Mathematica/Python<br>• Strength and failure, localization | | |
| Literature: | • S. Nemat-Nasser and M. Hori, Micromechanics: *Overall Properties of Heterogeneous Materials*, Second Edition, North-Holland Series in Applied Mathematics and Mechanics, 1999<br>• Christensen, *Mechanics of Composite Materials*, Dover Publications, 2005<br>• D. Gross and T. Seelig, *Bruchmechanik — mit einer Einführung in die Mikromechanik*, Springer-Verlag Berlin Heidelberg, 2016 | | |
| Types of Teaching: | S1 (WS): Lectures / Lectures (2 SWS)<br>S1 (WS): Excercises / Exercises (1 SWS) | | |
| Pre-requisites: | **Recommendations:**<br>Continuum Mechanics, 2017-05-18 | | |
| Frequency: | yearly in the winter semester | | |
| Requirements for Credit Points: | For the award of credit points it is necessary to pass the module exam.<br>The module exam contains:<br>MP/KA (KA if 10 students or more) [MP minimum 30 min / KA 120 min] | | |
| Credit Points: | 4 | | |
| Grade: | The Grade is generated from the examination result(s) with the following weights (w):<br>MP/KA [w: 1] | | |
| Workload: | The workload is 120h. It is the result of 45h attendance and 75h self-studies. To help deepen the understanding of the subject matter, (voluntary) homework problems are given out along with the exercise | | |

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