

## Module Description

### Material Modelling – Testing and Parameter Identification

Dr.-Ing. Brita Pyttel

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| 1   | <b>Module name</b><br>Material Modelling – Testing and Parameter Identification   |
| 1.1 | <b>Module short name</b><br>MM  |
| 1.2 | <b>Type</b><br>Elective   |
| 1.3 | <b>Course</b><br>Material Modelling (MM.V)<br>Material Modelling (MM.P)   |
| 1.4 | <b>Semester Commitment</b><br>Material Modelling (MM.V): none<br>Material Modelling (MM.P): none  |
| 1.5 | <b>Responsible Person</b><br>Dr.-Ing. Brita Pyttel  |
| 1.6 | <b>Further teachers</b><br>Other from EU+ et al.  |
| 1.7 | <b>Degree Level</b><br>Bachelor, Master, PhD upon request   |
| 1.8 | <b>Language</b><br>English  |
| 2   | <b>Content</b><br>Material Modelling (MM.V): <ul style="list-style-type: none"><li>– Introduction</li><li>– Classification of Materials</li><li>– Classification of Loading</li><li>– Material Properties and Structure of Materials (strength, deformability at static, dynamic and cyclic loading)</li><li>– Experimental Testing of Materials (testing methods, standard and non-standard tests)</li><li>– Base Material Models and Parameters (elasticity, viscoelasticity, elastoplasticity, viscoplasticity)</li><li>– Material Modelling and Parameter Identification (models in FEM, selection, strategies for parameter identification, examples)</li><li>– Application to Different Materials (metals, plastics, wood, plywood, ceramics, glass, concrete and gypsum, fabrics, bones, composites)</li><li>– Summary and Outlook</li></ul> Material Modelling (MM.P): <ul style="list-style-type: none"><li>– Introduction to Python</li><li>– Programming of Material Models in Python, Sensitivity Analysis</li><li>– Static, Cyclic and Dynamic Tests with e.g. Metals, Plastics, Wood, Plywood, Concrete, Fabrics, Ceramics, Composites, Glass</li><li>– Parameter Identification</li><li>– Comparison of Test and Modelling Results</li></ul> |

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| 3  | <p><b>Aim/Basic Learning Outcomes</b></p> <p>Material Modelling (MM.V):</p> <ul style="list-style-type: none"> <li>- Knowledge and understanding of material modelling in computer based product design. Classification of materials for components and their loading.</li> <li>- Knowledge and understanding of the connection between material properties and structure of materials. Evaluation of standard and non-standard tests for determination of material parameters.</li> <li>- Knowledge of different material models, their application to various materials and implementation into Python</li> </ul> <p>Material Modelling (MM.P):</p> <ul style="list-style-type: none"> <li>- Selection and realisation of experimental investigations for different materials with evaluation of their limits</li> <li>- Ability of data engineering with measured test results based on Python with identification of material parameters</li> </ul> |
| 4  | <p><b>Teaching and Learning Methods</b></p> <p>Material Modelling (MM.V): lecture</p> <p>Material Modelling (MM.P): exercise and lab</p>  |
| 5  | <p><b>Work Load and ECTS</b></p> <p>Material Modelling (MM.V) and (MM.P): 5 ECTS, presence study 64 h, self-study 86 h</p>  |
| 6  | <p><b>Examination - Type, Time and Prerequisites</b></p> <p>Online-Test, homework, technical report, presentation according to teacher</p> <p>Announced in the first week of the course</p>   |
| 7  | <p><b>Necessary Prerequisites</b></p> <p>Materials Engineering 1-2, Engineering Mechanic 1-2</p>  |
| 8  | <p><b>Suggested Prerequisites</b></p> <p>none</p>   |
| 9  | <p><b>Duration, Time Structure and Frequency of Offer</b></p> <p>Determination by the Dean's office</p>   |
| 10 | <p><b>Module Applicability</b></p> <p>n/a</p>   |
| 11 | <p><b>Literature</b></p> <ul style="list-style-type: none"> <li>- Lecture notes according to teachers</li> </ul> <p>Further e.g.</p> <ul style="list-style-type: none"> <li>- J. M. Gere, Mechanics of Materials, Thomson Brooks/Scole</li> <li>- J.F. Shackelford, Introduction to Material Science for Engineers, Pearson</li> <li>- J. Lemaitre, J.-L. Chaboche, Mechanics of Solid Materials, Cambridge University Press</li> <li>- J. Ernesti, P. Kaiser, Python 3: The Comprehensive Guide to Hands-On Python Programming, Rheinwerk Computing</li> </ul>   |