<table>
<thead>
<tr>
<th><strong>Study course:</strong></th>
<th><strong>Master’s Program Computational Engineering</strong></th>
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<tr>
<td><strong>Module name:</strong></td>
<td><strong>CE-P05: Finite Element Methods in Linear Structural Mechanics</strong></td>
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<td><strong>Abbreviation, if applicable:</strong></td>
<td>FEM-I</td>
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<td><strong>Sub-heading, if applicable:</strong></td>
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<tr>
<td><strong>Module Coordinator:</strong></td>
<td>Prof. Dr. techn. G. Meschke</td>
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| **Classification within the Curriculum:** | Master’s Program Computational Engineering: compulsory course, 1st Semester  
Master’s Program ‘Bauingenieurwesen’: compulsory course, 1st Semester |
| **Courses included in the module, if applicable:** | Finite Element Methods in Linear Structural Mechanics |
| **Semester/term:** | 1st Semester / Winter term |
| **Lecturer(s):** | Prof. Dr. techn. G. Meschke, Assistants |
| **Language:** | English |
| **Requirements:** | Basics in Mathematics, Mechanics and Structural Analysis (Bachelor level) |
| **Teaching format / class hours per week during the semester:** | Lectures: 2h  
Exercises: 2h |
| **Study/exam achievements:** | - Written examination / 180 minutes (85%)  
- Seminar papers (15%) |
<p>| <strong>Workload [h / LP]:</strong> | 180 / 6 |
| Thereof face-to-face teaching [h] | 60 |
| Preparation and post processing (including examination) [h] | 60 |
| Seminar papers [h] | 60 |
| Homework [h] | - |
| <strong>Credit points:</strong> | 6 |</p>
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<th>Learning goals / competences:</th>
<th>The main goal of this course is to qualify students to numerically solve linear engineering problems by providing a sound methodological basis of the finite element method. In addition to numerical analysis of trusses, beams and plates, the spectrum of possible applications includes analyses of transport processes such as heat conduction and pollutant transport. In seminar papers the students shall apply the basics of the Linear Finite Element Methods learnt in the lectures and solve structural-mechanical problems by means of hand calculations. Furthermore the students are required to program and validate problems in structural analysis and transport processes.</th>
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<tr>
<td>Content:</td>
<td>Introduction to the finite element method in the framework of linear elastodynamics. Based upon the weak form of the boundary value problem principles of spatial discretization using the finite element method are explained step by step. First, one-dimensional isoparametric p-truss elements are used to explain the fundamentals of the finite element method. Afterwards the same methodology is used to develop two- (plane stress and plane strain) and three-dimensional isoparametric p-finite elements for linear structural mechanics. In addition to analyses related to structural mechanics, the application of the finite element method to the spatial discretization of problems associated with transport processes within structures (e.g. heat conduction, pollutant transport, moisture transport, coupled problems) is demonstrated. The second part of the lecture is concerned with finite element models for beams and plates. In this context aspects of element locking and possible remedies are discussed. The lectures are supplemented by exercises to promote the understanding of the underlying theory and to demonstrate the application of the finite element method for the solution of selected examples. Furthermore, practical applications of the finite element method are demonstrated by means of a commercial finite element program.</td>
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<td>Forms of media:</td>
<td>Blackboard, transparencies, beamer presentations</td>
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</table>
| Literature: | Manuscript and Lecture Notes  
J. Fish and T. Belytschko, A First Course in Finite Elements, Wiley, 2007  