Courses in English
Course Description

Department	07 Computer Science and Mathematics
Course title	**Uncertainty Quantification - Fundamentals**
Hours per week (SWS)	4
Number of ECTS credits	5
Course objective	The students are able to - deal with terms of Uncertainty Quantification (UQ), - to select methods in a target-oriented manner and to apply them to solve various problems with uncertainties, - to combine theoretical and application-oriented aspects, - to reflect and discuss different views, - demonstrate their acquired skills by working independently on real-life examples. Students practice and improve their social and communication skills - by discussing their own points of view, - group work.
Prerequisites	Mathematical Competencies: Students know the main contents of the following mathematical courses and will be able to apply the methods learned in them: - Calculus - Linear algebra - Differential calculus and differential equations - Probability and statistics - Numerics of ODEs (a numerics class could be taken in parallel) Digital Competencies: Students have programming skills - preferably in Python.
Recommended reading	General: - R. Smith, Uncertainty Quantification: Theory, Implementation, and Applications, 2014 - T. Sullivan, Introduction to Uncertainty Quantification, 2015 - J. Tinsley Oden, Foundations of Predictive Computational Science, 2017 Specialized: - J. Liu, Monte Carlo Strategies in Scientifc Computing, 2008 - A. Saltelli et al., Global Sensitivity Analysis: The Primer, 2008
Teaching methods	- Blackboard, slides, or beamer - Virtual lectures e.g. via BigBlueButton - Computer, programming language Python - Jupyter notebooks, development environments like PyCharm or Visual Studio Code - Version control systems like Git or SVN - Moodle
Assessment methods	Assignments
Language of instruction	English
Name of lecturer	Dr. Mario Teixeira Parente
Email	mario.parente@gmx.de
Link	
Course content	Students will learn and practice using the following concepts and methods: - Types and sources of uncertainties or indeterminacies. - Motivation for investigating them with concrete model examples - Sampling strategies (e.g. Monte Carlo methods or Latin Hypercube Sampling) - Sensitivity analysis techniques (e.g. Sobol indices, partial rank correlation coefficients) - Forward UQ (e.g., propagation of uncertainties using surrogate models) Students test the methods on independently implemented models from different application areas such as - biology, mechanics, or epidemiology.

Remarks