Simulation

Module Code	Workload	Credits	Semester	Frequency of Module	Duration
	180 hrs.	6	1	Only winter semester	1 Semester

1	Module Components	Teaching Language	Contact Hours	Self Study	Class Size
	a) Simulation of dynamical systems	a) English	a) 33,75 hrs.	a) 56,25 hrs.	a) 24
	b) Finite Elements Method	b) English	b) 22,5 hrs.	b) 67,5 hrs.	b) 24

2 Learning Outcomes

After attending the module part

Knowledge (1)
... 'Simulation of Dynamical Systems' the students can explain the concept of differential equations and systems of differential equations. They can distinguish between linear and nonlinear systems of differential equations. They can write down and derive the general analytic form of solutions for linear systems of differential equations. They can derive an appropriate system of differential equations for the description of different engineering applications. They are able to determine whether an engineering system is linear or nonlinear, find the equilibrium points of a nonlinear system and carry out linearisation at its equilibrium points. They can classify the equilibrium points with respect to their stability and oscillatory properties. They are able to interpret the results of linearisation for the behavior of the original nonlinear engineering system. They are able to use MATLAB and SIMULINK for the simulation and analysation of small systems.
... 'Finite Element Methods', the student knows the Mathematical fundamentals of Finite Element Analysis: static analysis of frameworks by using Excel

Application (3)
... 'Finite Element Methods', the student can apply modern FEM-system (ANSYS) in structural analysis, static and dynamic problems

Synthesis (5)
... 'Finite Element Methods', the student develop an analysis of different kinds of stress (normal stress, tangential and shear stress, equivalent stress)

Evaluation (6)
... 'Finite Element Methods', the student can describe Nonlinearities: large deformation and stress stiffening and summarize in reports

3 Individual Component Content

a) Knowlegde about simulation process in general including its limitations. Understanding of the concept of a dynamical system and analytical and numerical solutions. Understanding of and ability to apply and evaluate several numerical simulation methods. Ability to work with several simulation tools.

	b) Ability to simulate small dynamical and FEM systems. Ability to create mathematical and idealized mechanical models from real world systems. Ability to analyse and interpret simulation results.
4	**Teaching Methods** a) Lecture / Practical b) Lecture
5	**Prerequisites** Basic knowledge and understanding of linear algebra and analysis Engineering mechanics of Beams
6	**Methods of Assessment** a) Non Graded Assessment 1sbA (Practical Work) (1 LP) b) Non Graded Assessment 1sbA (Practical Work) (1 LP) Modulprüfung Simulation 1K (Written Exam) (4 LP)
7	**Applicability of Module** Smart Systems M.Sc. (SMA)
8	**Person Responsible for Module** Prof. Dr. Ekkehard Batzies (Module Responsible) Prof. Dr. Helmut Debus (Module Responsible)
9	**Reading List (Core Texts and Recommended Texts)** a) J.H. Hubbard, B.H. West: Differential equations: A dynamical systems approach, Part 1 J.H. Hubbard, B.H. West: Differential equations: A dynamical systems approach, Higher-Dimensional Systems Bossel, Hartmut: Modellbildung und Simulation : Konzepte, Verfahren und Modelle zum Verhalten dynamischer Systeme; ein Lehr- und Arbeitsbuch, 2., veränd. Aufl., mit verb. Simulationssoftware, Vieweg 1994 b) Olgierd C. Zienkiewicz et al., The Finite Element Method. Its Basis and Fundamentals, Elsevier Debus, FEM Lecture Notes