Name of module:	**Mathematical Methods in Engineering**
Keywords:	Numerical Analysis, Numerical Differential Equations
Modulenumber:	**ASM 101**
Target group(s):	1. Semester ASM
ECTS-Credits:	7
Language of instruction:	english
Module owner:	Prof. Dr. Alexander Hornberg

Extent of work (hours)

Workload	Contact hours	Self study	Exam preparation
210	105	75	30

Prerequisites:	• Analysis • Linear algebra • Ordinary differential equations • Partial differential equations
Total target:	• Ability to understand and use numerical methods of analysis, linear algebra, and differential equations • Ability to apply numerical methods in the engineering context • Ability to interpret results from numerical calculation • Ability to visualize numerical results
Module content:	• Linear systems • Matrix eigenvalue problems • Linear least square problems • Nonlinear systems • Nonlinear Least square problems • Ordinary differential equations Euler's method Runge-Kutta methods Multistep methods Stability and stiffness • Partial differential equations Finite difference methods Finite element methods

Reference material:	• R L Burden, J.D. Faires, Numerical Analysis, Brooks/Cole • G Allaire, S M Kaber, Numerical Linear Algebra, Springer • A Quateroni, R Sacco, F Saleri, Numerical Mathematics, Springer • A Stanoyevitch, Introduction to Numerical Ordinary and Partial Differential Equations Using MATLAB, Wiley • E Hairer, S P Norsett, G Wanner, Solving Ordinary Differential Equations I, II, Springer • G D Smith: Numerical Solution of Partial Differential Equations: Finite Difference Methods, Oxford University Press • K H Huebner, D L Dewhirst, D E Smith, T G Byrom, The Finite Element Method for Engineers, Wiley
Offered:	Winter term only

Submodules and assessment

Title of submodule	**Numerical Analysis**
Type of instruction / form of learning:	Lecture
ECTS-Credits:	4
Hours per week:	4
Aims, learning outcomes:	• Ability to understand and use linear systems solver. • Ability to understand and use matrix eigenvalue problem solver • Ability to understand and use least square problem solver • Ability to understand and use nonlinear systems solver • Ability to understand and use nonlinear least square problems solver • Ability to implement, solve, and visualize numerical solutions with MATLAB
Type of assessment:	final written examination part I: 60 min

Title of submodule	**Numerical Differential Equations**
Type of instruction / form of learning:	Lecture
ECTS-Credits:	3
Hours per week:	3
Aims, learning outcomes:	• Ability to apply one-step methods and multistep methods to initial value problems • Ability to distinguish between elliptic, parabolic, and hyperbolic partial differential equations • Ability to use finite difference methods • Ability to use simple finite element approaches • Ability to discuss differences between different numerical methods • Ability to implement, solve, and visualize numerical solutions with MATLAB
Type of assessment:	final written examination part II: 60 min