

Mathematical Methods

1	Module Number 13570	Study Program ASM	Semester 1	Offered in XWS ☐ SS	Duration 1 Semester	Module Type compulsory	Workload (h) 240	ECTS Points 8
2	Courses		Teaching and Learning Forms		Contact Time		Self-Study Time	Language
					(SWS)	(h)	(h)	English
	a) Numerical Analysis		Lecture		3	45	120	
	b) Numerical Differential Equations		Lecture		2	30		
	c) Statistics and Kalman Filter		Lecture		3	45		
3	Learning Outcomes and Competences Once the module has been successfully completed, the students can... Knowledge and Understanding ... explain the basic ideas of numerical analysis and understand the relation to the applications ... understand the algorithms and their constraints ... understand the limitations of the algorithms Use, Application and Generation of Knowledge <i>Use and Transfer</i> ... apply the algorithms in MATLAB. ... analyze the solutions concerning plausibility. ... recognize and classify connections. ... analyze technical problems and derive or develop solutions. ... familiarize themselves with new ideas and topics based on their basic knowledge. <i>Scientific Innovation</i> ... use methods and tools to gain new insights in the field of numerical analysis. ... create new models. ... optimize systems. ... independently develop approaches for new concepts and assess their suitability. ... develop concepts for the optimization of technical applications. Communication and Cooperation ... interpret the results of numerical analysis and draw admissible conclusions. ... use the learned knowledge, skills and competences to evaluate the field and interpret them according to other aspects. ... communicate and cooperate within the group in order to find adequate solutions for the task at hand. Scientific Self-Conception/ Professionalism ... justify the solution theoretically and methodically.							

4	Contents Lecture a) • Linear systems • Regression • Numerical differentiation and integration • Nonlinear equations and nonlinear systems Lecture b) • Ordinary differential equations (Runge-Kutta methods, stability and stiffness, shooting methods, applications) • Partial differential equations (finite difference methods, finite element methods, applications) Lecture c) • Descriptive and inferential statistics • Probability theory • Kalman filter Programming in MATLAB as part of the lecture.
5	Participation Requirements compulsory: - recommended: Good knowledge of further mathematics
6	Examination Forms and Prerequisites for Awarding ECTS Points Written Examination 120 min
7	Further Use of Module Applying mathematical methods in other lectures and major fields of automotive engineering
8	Module Manager and Full-Time Lecturer Prof. Dr. rer. nat. J. Gaukel, Prof. Dr. rer. nat. M. Stämpfle, Prof. Dr. rer. nat. G. Schaaf
9	Literature • Gander W., Gander M.J., Kwok, F., Scientific Computing • Stanoyevitch, Introduction to Numerical Ordinary and Partial Differential Equations Using MATLAB, Wiley • Marchthaler, Dingler: Kalman-Filter: Einführung in die Zustandsschätzung und ihre Anwendung für eingebettete Systeme • Chui, Chen: Kalman Filtering, Springer
10	Last Updated 06.12.2023