

Modulname Modulname	Advanced Mathematics for Robotics BA MERO	BM9
Modulverantwortlicher/ Modulverantwortliche Module responsibility	Prof. Dr.-Ing. habil. Carsten Behn (Modulverantwortung)	
Qualifikationsziele Qualification goals	With focus on real problems from the engineering world, e.g., from Physics or Mechanics or Robotics, the student shall be acquainted with the description and modeling of mathematical problems of a higher level. They will be able to describe the movement of robots using the matrix-vector representation and to analyze this movement in investigating the arising matrices from an algebraic point of view. Coming from dynamics, they will be able to investigate the dynamical behavior of robotic systems in observing eigenvalues and eigenvectors of the corresponding systems. Moreover, they apply the absorbed knowledge on linear systems to transfer it to the treatment of nonlinear systems (stability analysis using the Theorem of Hartman & Grobman). Finally, some steps towards linear optimization and the treatment of partial differential equations are introduced.	
Modulinhalte Module contents	• Matrix Algebra (Eigenvectors, Eigenvalues, Transformations in Application to Robotic Systems) • Set of linear ODEs: solution and stability (application of eigenvalues and eigenvectors) • Set of nonlinear ODEs: linearization and Theorem of Hartman & Grobman • Introduction to (linear) Optimization • Introduction to partial differential equations The teaching strategy is a mixture of lectures (using slides and the blackboard) and problemsolving tutorials (incorporating computer aided calculations using Matlab and Maple). The format of lectures is conventional, however, the atmosphere is informal, and interaction and discussion is normal. Students are encouraged to ask questions in the lectures. In the tutorials, the students work on problems to practise and apply the methods introduced in the lectures.	
Lehrformen Forms of teaching	Vorlesung oder Übung (4 SWS)	

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Voraussetzungen für die Teilnahme Requirements for participation	The successful completion of the courses „Mathematics for Engineers 1 & 2“ would be beneficial.	
Literatur/multimediale Lehr- und Lernprogramme Further readings/Learning programmes	• Kreyszig: Advanced Engineering Mathematics, Wiley, 9th edition, 2006 • Bird: Higher Engineering Mathematics, Routledge, Taylor & Francis Group, 8th edition, 2017 • Grewal: Higher Engineering Mathematics, Khanna Publisher, 4th edition, 2010 • Fox and Bolton: Mathematics for Engineers and Technologists, Elsevier, 2002 • Batty: Essential Engineering Mathematic, BookBoon, 2011	
Lehrbriefautor Textbook author	keiner	
Verwendbarkeit Usability	Mechatronics & Robotics 210 CP B.Eng.	
Arbeitsaufwand/Gesamtworkload Workload/Total workload	Selbststudium 90 h + Präsenzzeit 60 h = 150 Stunden = 5,0 Credit Punkte independent work 90 h + presence 60 h + preparation 30 h = 150 hours = 5,0 credit points	
ECTS und Gewichtung der Note in der Gesamtnote ECTS and weighting in overall grade	5 5/210	1
Leistungsnachweis Performance record	Oral exam (45 min). Note: In case of a third attempt, the exam can be performed as an oral exam (60 min.) in agreement with the corresponding professor to pass this course.	
Semester Semester	4	
Häufigkeit des Angebots Frequency of the offer	Annually in summer semester	
Dauer Duration	1 Semester	
Art der Lehrveranstaltung Type of course	Elective module 4. Semester: 1 to be chosen WiSe 2026/27	
Besonderes Peculiarity		

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