TECHNISCHE UNIVERSITÄT KAISERSLAUTERN

Module Handbook

TUK MODHB Homepage

Course MAT-80-20-K-4

Dynamical Systems; Differential-Algebraic Equations (4V+2U, 9.0 LP)

Course Type

SWS	Type	Course Form	CP (Effort)	Presence-Time / Self-Study	
-	K	Lecture with exercise classes (V/U)			
4	V	Lecture	6.0 CP	56 h	124 h
2	U	Exercise class (in small groups)	3.0 CP	28 h	62 h
(4V+2U)			9.0 CP	84 h	186 h

Basedata

SWS	4V+2U
CP, Effort	9.0 CP = 270 h
Position of the semester	1 Sem. irreg. SuSe
Level	[4] Bachelor (Specialization)
Language	[EN] English
Lecturers	Damm, Tobias, Prof. Dr. (PROF | DEPT: MAT) Simeon, Bernd, Prof. Dr. (PROF | DEPT: MAT) Surulescu, Christina, Prof. Dr. (PROF | DEPT: MAT) + further Lecturers of the department Mathematics
Area of study	[MAT-TEMA] Industrial Mathematics
Livecycle-State	[NORM] Active

Notice

The course consists of the two parts **[MAT-80-17-K-6]** and **[MAT-81-23-K-4]**.

Possible Study achievement

- Verification of study performance: **proof of successful participation in the exercise classes (ungraded)**
- Details of the examination (type, duration, criteria) will be announced at the beginning of the course.

The certificate for the exercises ("Übungsschein") consists of the two (partial) certificates for the exercises in the courses **[MAT-80-17-K-6]** and **[MAT-81-23-K-4]**.

Contents

Dynamical Systems:

- basics: existence and uniqueness,
- autonomous equations,
- stability theory,
- nonlinear systems, local theory, theorem of Hartman-Grobman, non hyperbolic equilibrium points and Lyapunov theory,
- periodic orbits, Poincaré Bendixon and applications, invariant sets,
- bifurcation theory,
- applications.

Differential-Algebraic Equations:

The theory and numerical analysis of differential-algebraic equations is discussed, in particular:

- application fields (electrical circuits and multibody mechanical systems),
- relation with singularly perturbed problems,
- solution theory and index concepts,
- normal form for linear DAEs,
- numerical aspects

Competencies / intended learning achievements

The students have studied methods for qualitative treatment of dynamic systems and are able to apply them. The focus is on the behavior of solutions of ordinary differential equations under the influence of varying parameters in a system. The techniques taught are very useful for the study of nonlinear partial differential equations and control theory as well as for the study of practical problems that are modeled by using differential equations.

In addition, have studied and understand the basic concepts of the theory and numerical analysis of differential-algebraic equations.

Literature

Dynamical Systems:

- J.K. Hale, H. Kocak: Dynamics and Bifurcations,
- H. Heuser: Gewöhnliche Differentialgleichungen,
- B. Marx, W. Vogt: Dynamische Systeme,
- J.W. Prüss, M. Wilke: Gewöhnliche Differentialgleichungen und dynamische Systeme.
- K. Burg, H. Haf, F. Wille, A. Meister: Höhere Mathematik für Ingenieure. Band III: Gewöhnliche Differentialgleichungen, Distributionen, Integraltransformationen.

Differential-Algebraic Equations:

- P. Kunkel, V. Mehrmann: Differential-Algebraic Equations. Analysis and Numerical Solution,
- B. Simeon: Computational Flexible Multibody Dynamics,
- S. Trenn: Solution concepts for linear DAEs: a survey; in: Surveys in Differential-Algebraic Equations I (Eds. A. Ilchmann, T.

Reis).

Materials

Further literature will be announced in the lecture; Exercise material is provided.

Registration

Registration for the exercise classes via the online administration system URM (https://urm.mathematik.uni-kl.de).

Requirements for attendance (informal)

Modules:

- [MAT-10-1-M-2] Fundamentals of Mathematics (M, 28.0 LP)

Courses

- [MAT-12-25-K-3] Introduction to Ordinary Differential Equations (2V+1U, 4.5 LP)

Requirements for attendance (formal)

None

References to Course [MAT-80-20-K-4]

Course-Pool	Name
[MAT-80-4V-KPOOL-4]	Elective Courses Modelling and Scientific Computing (4V, B.Sc.)
[MAT-80-KPOOL-4]	Specialisation Modelling and Scientific Computing (B.Sc.)