

Module Handbook (<https://modhb.uni-kl.de/>)

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Course MAT-81-13-K-7

Nonlinear Partial Differential 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)	9.0 CP		
4	V	Lecture		56 h	124 h
2	U	Exercise class (in small groups)		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.
Level	[7] Master (Advanced)
Language	[EN] English
Lecturers	Surulescu, Christina, Prof. Dr. (PROF DEPT: MAT) (/staff/37/) + further Lecturers of the department Mathematics
Area of study	[MAT-TEMA] Industrial Mathematics
Lifecycle-State	[NORM] Active

Contents

- Fundamentals: Weak convergence and compactness,
- Elliptic Partial Differential Equations: weak solution theory (Lax-Milgram Theorem, Fredholm alternative), regularity (in the interior, to the edge), eigenvalue problems, maximum principles,
- Evolution equations: Duality theory, weak convergence in Hilbert spaces, Gelfand triple,
- Spaces of time-dependent functions, parabolic equations (weak formulation, existence and uniqueness, regularity, maximum principles), hyperbolic partial differential equations,
- Calculus of variations,

- Theory of monotone operators and fixed point theorems,
- Approximations: iterations, space discretisation (Galerkin), time discretisation (Rothe), regularisations.

Literature

- R.A. Adams: Sobolev Spaces,
- H. Brezis: Functional Analysis, Sobolev Spaces and Partial Differential Equations,
- L.C. Evans: Partial Differential Equations,
- G.M. Lieberman: Second Order Parabolic Partial Differential Equations,
- M. Ruzicka: Nichtlineare Funktionalanalysis,
- R. Showalter: Monotone operators in Banach space and nonlinear partial differential equations,
- E. Zeidler: Nonlinear Functional Analysis and its Applications II/B: Nonlinear Mono-tone Operators.

Materials

Further literature will be announced in the lecture.

Registration

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

Requirements for attendance (informal)

Modules:

- [MAT-10-1-M-2] Fundamentals of Mathematics (M, 28.0 LP) (/mhb/modules/MAT-10-1-M-2/)
- [MAT-70-11-M-4] Functional Analysis (M, 9.0 LP) (/mhb/modules/MAT-70-11-M-4/)
- [MAT-80-11A-M-4] Numerics of ODE (M, 4.5 LP) (/mhb/modules/MAT-80-11A-M-4/)

Courses

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

Requirements for attendance (formal)

None

References to Course [MAT-81-13-K-7]

Module	Name	Context
[MAT-81-13-M-7 (/mhb/modules/MAT-81-13-M-7/)]	Nonlinear Partial Differential Equations	P: Obligatory 4V+2U, 9.0 LP