Module MAT-81-20-M-7

PDE based Multiscale Problems and Numerical Approaches for their Solution (M, 4.5 LP)

Module Identification

Module Number	Module Name	CP (Effort)
MAT-81-20-M-7	*PDE based Multiscale Problems and Numerical Approaches for their Solution*	4.5 CP (135 h)

Basedata

CP, Effort	4.5 CP = 135 h
Position of the semester	1 Sem. irreg.
Level	[7] Master (Advanced)
Language	[EN] English
Module Manager	Klar, Axel, Prof. Dr. (PROF | DEPT: MAT) (/staff/18/)
Lecturers	Klar, Axel, Prof. Dr. (PROF | DEPT: MAT) (/staff/18/) Pinnau, René, Prof. Dr. (PROF | DEPT: MAT) (/staff/27/) + further Lecturers of the department Mathematics
Area of study	[MAT-TEMA] Industrial Mathematics
Reference course of study	[MAT-88.105-SG] M.Sc. Mathematics (/mhb/FB-MAT/cos-538/)
Livecycle-State	[NORM] Active

Courses

Type/SWS	Course Number	Choice in Module-Part	SL	PL	CP	Sem.
2V	**MAT-81-20-K-7** (/mhb/courses/MAT-81-20-K-7/)	P	-	PL1	4.5	irreg.

- About **[MAT-81-20-K-7]**: Title: "PDE based Multiscale Problems and Numerical Approaches for their Solution"; Presence-Time: 28 h; Self-Study: 107 h

Examination achievement PL1

- Form of examination: **oral examination (20-30 Min.)**
- Examination Frequency: irregular (by arrangement)
- Examination number: 86362 ("PDE based Multiscale Problems and Numerical Approaches for their Solution")

Evaluation of grades

The grade of the module examination is also the module grade.

Contents

From [MAT-81-20-K-7] PDE based Multiscale Problems and Numerical Approaches for their Solution (/mhb/courses/MAT-81-20-K-7/)**:**

Introduction to PDE based multiscale problems and to approaches for their treatment. Special attention will be given to the following topics:

- homogenisation of elliptic equations with oscillating coefficients,
- classification of multiscale problems,
- advanced numerical algorithms for PDEs and systems of PDEs with oscillating coefficients (including multiscale finite element method, multiscale finite volume method, heterogeneous multiscale method, subgrid approach),
- numerical approaches for stochastic elliptic PDE.

Competencies / intended learning achievements

Upon successful completion of this module, the students master the theory and numerical methods for the analysis and solution of multiscale problems based on partial differential equations.They are able to name the essential propositions of the lecture as well as to classify and to explain the connections.

With the help of concrete examples, the students have developed a skilled, precise and independent handling of the terms, propositions and methods taught in the lectures. They understand the proofs presented in the lecture and are able to reproduce and explain them. In particular, they can outline the conditions and assumptions that are necessary for the validity of the statements.

Literature

From [MAT-81-20-K-7] PDE based Multiscale Problems and Numerical Approaches for their Solution (/mhb/courses/MAT-81-20-K-7/)**:**

The literature will be announced in the lecture.

Requirements for attendance (informal)

Knowledge from the module **[MAT-81-11-M-7]** (/mhb/modules/MAT-81-11-M-7/) is useful, but not necessarily required.

Modules:

- [MAT-10-1-M-2] Fundamentals of Mathematics (M, 28.0 LP) (/mhb/modules/MAT-10-1-M-2/)
- [MAT-80-11A-M-4] Numerics of ODE (M, 4.5 LP) (/mhb/modules/MAT-80-11A-M-4/)
- [MAT-80-11B-M-4] Introduction to PDE (M, 4.5 LP) (/mhb/modules/MAT-80-11B-M-4/)

Requirements for attendance (formal)

None

References to Module / Module Number [MAT-81-20-M-7]

Module-Pool	Name
[MAT-81-MPOOL-7 (/mhb/modulepools/MAT-81-MPOOL-7/)]	Specialisation Partial Differential Equations (M.Sc.)
[MAT-8x-MPOOL-7 (/mhb/modulepools/MAT-8x-MPOOL-7/)]	Specialisation Modelling and Scientific Computing (M.Sc.)
[MAT-AM-MPOOL-7 (/mhb/modulepools/MAT-AM-MPOOL-7/)]	Applied Mathematics (Advanced Modules M.Sc.)