Area B – ANALYSIS AND DIFFERENTIAL EQUATIONS

Foundation in Analysis F4B1:

- **Functional Analysis and PDE** (winter term)
- **PDE and Modelling** (not every year)
- **Global Analysis** (winter term)

Lectures of Foundation modules may be taught in German.

Core Lecture Courses (taught in English)**:**

- **V4B1 Nonlinear PDE I** (winter term)
- **V4B2 Nonlinear PDE II** (summer term)
- **V4B3 Advanced Global Analysis I** (winter term)
- **V4B4 Advanced Global Analysis II** (summer term)
- **V4B5 Real and Harmonic Analysis** (not every year)

Advanced Lecture Courses (taught in English)**:**

- **V5B1 Advanced Topics in Analysis and PDE**
- **V5B2 Selected Topics in Analysis and PDE**
- **V5B3 Advanced Topics in PDE and Mathematical Models**
- **V5B4 Selected Topics in PDE and Mathematical Models**
- **V5B5 Advanced Topics in Analysis and Calculus of Variations**
- **V5B6 Selected Topics in Analysis and Calculus of Variations**
- **V5B7 Advanced Topics in Analysis**
- **V5B8 Selected Topics in Analysis**

Typical topics treated in advanced lecture courses include for example:

- Differential inclusions
- Entropy solutions
- Viscosity solutions
- Navier-Stokes equation
- Schrödinger equation, quantum mechanics
- Quasiconformal maps
- Gamma convergence, homogenization
- Global Analysis

Useful supplementary courses from other areas:

- **F4E1/2 Scientific Computing I / II**
- **F4F1 Stochastic Processes**
- **F4D1 Geometry**
- **V4E1 Numerical Algorithms**
- **V4E2 Numerical Simulation**
- **V4F1 Stochastic Analysis**
- **V4F2 Markov Processes**
- **NP420 Theoretische Physik III (Quantenmechanik)** (taught in German)
- **NP520 Theoretische Physik IV (Statistische Physik)** (taught in German)

You will find the list of modules that are actually offered in a given term in the course overview BASIS at https://basis.uni-bonn.de.

Please note that the summer/winter distribution can sometimes differ from the general schedule shown in the example curricula. Therefore please check BASIS first!

Recommended Curricula

- A good background in basic measure theory (Analysis III) is required and not part of our Master studies.
- Background in functional analysis (including Sobolev spaces) and classical theory of PDEs is needed. If lacking, this may be acquired in the module F4B1.
- **Option I** is intended for students who already have the complete background required.
- **Options II and III** are intended for students who do not have good knowledge of functional analysis yet.
- At least one advanced lecture course is offered each winter term. One or more may be additionally offered in some summer terms, but this is not guaranteed.
- A typical curriculum with specialization in Analysis should include 3 or 4 lecture courses in Analysis.

Start in the Winter Term – October:

- **Option I**
    1. Nonlinear PDE I
    2. Nonlinear PDE II or Real and Harmonic Analysis (+ Topics)
    3. Topics
    4. (Topics)
- **Option II**
    1. Functional analysis
    2. Nonlinear PDE II or Real and Harmonic Analysis
    3. Nonlinear PDE I (+ Topics)
    4. (Topics)
- **Option III**
    1. Functional Analysis + Nonlinear PDE I
    2. Nonlinear PDE II or Real and Harmonic Analysis
    3. (Topics)
    4. (Topics)
- **Option IV**
    2. Advanced Global Analysis I
    3. Advanced Global Analysis II
    4. Topics
    5. (Topics)

Area B – ANALYSIS AND DIFFERENTIAL EQUATIONS

Example Curriculum – Major Area B – Start in the Winter Term (October)

	Major (Area B)		Minor (Area F)	Minor (other)	Options
1	Nonlinear PDE I **9 CP**	Graduate Seminar **6 CP**	Markov Processes **9 CP**	e.g. Discrete Mathematics Geometry Scientific Computing **9 CP**	e.g. Practical Teaching Course External Internship Quantum Mechanics Statistical Physics Mathematical Finance **17-24 CP**
2	Nonlinear PDE II **9 CP**	Graduate Seminar **6 CP**	Adv.Top. in Probability Theory **7 CP**		
3	Advanced Topics **7 CP**	Master's Thesis + Master's Thesis Seminar **30 CP + 6 CP**			
4	Selected Topics **5 CP**				

	Major (Area B)		Minor (Area D)	Minor (other)	Options
1	Advanced Global Analysis I **9 CP**	Graduate Seminar **6 CP**	Algebraic Topology I **9 CP**	e.g. Discrete Mathematics Algebra Scientific Computing **9 CP**	e.g. Practical Teaching Course External Internship Quantum Mechanics Statistical Physics Mathematical Finance **17-24 CP**
2	Advanced Global Analysis II **9 CP**	Graduate Seminar **6 CP**	Advanced Topics in Topology **7 CP**		
3	Advanced Topics **7 CP**	Master's Thesis + Master's Thesis Seminar **30 CP + 6 CP**			
4	Selected Topics **5 CP**				

Area B – ANALYSIS AND DIFFERENTIAL EQUATIONS

Start in the Summer Term – April:

- **Option I**
  1. Nonlinear PDEs II or Real and Harmonic Analysis
  2. Nonlinear PDEs I (+ Topics)
  3. Topics
  4. (Topics)
- **Option II**
  1. Introduction to PDE (no credits for the master program!)
  2. Functional Analysis + Nonlinear PDE I
  3. Nonlinear PDE II or Real and Harmonic Analysis (+ Topics)
  5. (Topics)
- **Option III**
  1. PDE and Modeling
  2. Nonlinear PDE I (+ Topics)
  3. Nonlinear PDE II or Real and Harmonic Analysis
  4. (Topics)

Example Curriculum – Major Area B – Start in the Summer Term (April)

<table>
<tr><th></th><th colspan="2">Major
(Area B)</th><th>Minor
(Area F)</th><th>Minor
(Area E)</th><th>Options</th></tr>
<tr><td>1</td><td>Nonlinear PDE II

9 CP</td><td>Graduate Seminar

6 CP</td><td>Stochastic Processes

9 CP</td><td></td><td rowspan="4">e.g.

Practical Teaching Course

External Internship

Quantum Mechanics

Statistical Physics

Mathematical Finance

15-20 CP</td></tr>
<tr><td>2</td><td>Nonlinear PDE I

9 CP</td><td>Graduate Seminar

6 CP</td><td></td><td>Scientific Computing I

9 CP</td></tr>
<tr><td>3</td><td>Selected Topics

5 CP</td><td rowspan="2">Master's Thesis + Master's Thesis Seminar

30 CP + 6 CP</td><td>Stochastic Analysis

9 CP</td><td rowspan="2"></td></tr>
<tr><td>4</td><td>Advanced Topics

7 CP</td><td></td></tr>
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