

Area C – DISCRETE MATHEMATICS

Foundation in Discrete Mathematics F4C1:

- **Combinatorics, Graphs, Matroids** (Winter term)
- **Linear and Integer Optimization** (Summer term)

Lectures of Foundation modules may be taught in German.

Core Lecture Courses:

- **V4C1 Combinatorial Optimization** (Winter term)
- **V4C2 Approximation Algorithms** (Summer term)
- **V4C3 Chip Design** (Summer term)

Advanced Lecture Courses:

- **V5C1 Advanced Topics in Discrete Mathematics**
- **V5C2 Selected Topics in Discrete Mathematics**

Typical Topics treated in advanced lecture courses include for example:

- **Scheduling** (e.g. single/parallel machine models, open shop, flow shop and job shop models, timetabling, transportation, on-line models)
- **Flows over Time** (e.g. maximum flows over time, time-expanded networks, earliest arrival flows, quickest transshipment, minimum-cost flows over time, load-dependent transit times)
- **Facility Location** (e.g. uncapacitated facility location, primal-dual algorithms, scaling and greedy augmentation, capacitated facility location, universal facility location)
- **Steiner Trees** (e.g. euclidean and rectilinear Steiner tree problems, Steiner trees in graphs, exact Steiner tree algorithms, approximation algorithms and inapproximability results)

Useful supplementary courses from other areas:

- **F4A1 Set Theory**
- **V4A8 Models of Set Theory I**
- **F4E1 Scientific Computing I**
- **V4E1 Numerical Algorithms**
- **F4F1 Stochastic Processes**
- **V4F1 Stochastic Analysis**
- **V4F2 Markov Processes**

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Recommended Curricula

- In all modules in Area C, a basic knowledge of graph theory, graph algorithms, network flows, linear optimization and complexity theory is assumed.
- If you did not take any course on linear programming or graph algorithms during your Bachelor studies, we recommend that you start with one of the Foundation modules “Combinatorics, Graphs, Matroids” or “Linear and Integer Optimization” or both, and take the core modules “Combinatorial Optimization” or “Approximation Algorithms” afterwards (Option I).
- If you have already enough knowledge in Area C you may directly start with one of the core modules “Combinatorial Optimization” or “Approximation Algorithms” (Option II).

Start in October:

- **Option I**
 1. Combinatorics, Graphs, Matroids (F4C1)
 2. Chip Design (V4C3) + Approximation Algorithms (V4C2)
 3. Combinatorial Optimization (V4C1)
 4. Selected Topics in Discrete Mathematics (V5C2)
- **Option II**
 1. Combinatorial Optimization (V4C1)
 2. Chip Design (V4C3) + Approximation Algorithms (V4C2)
 3. Advanced Topics in Discrete Mathematics (V5C1)
 4. Selected Topics in Discrete Mathematics (V5C2)

Start in April:

- **Option I**
 1. Chip Design (V4C3) + Linear and Integer Optimization (F4C1)
 2. Combinatorial Optimization (V4C1)
 3. Approximation Algorithms (V4C2)
 4. Advanced Topics in Discrete Mathematics (V5C1)
- **Option II**
 1. Chip Design (V4C3) + Approximation Algorithms (V4C2)
 2. Combinatorial Optimization (V4C1)
 3. Selected Topics in Discrete Mathematics (V5C2)
 4. Advanced Topics in Discrete Mathematics (V5C1)

Example Curriculum- Major Area C – Start in October

	Major (Area C)			Minor (Area A)	Minor (Area F)
1	Combinatorial Optimization 9 CP			Set Theory 9 CP	Markov Processes 9 CP
2	Chip Design 9 CP	Approximation Algorithms 9 CP		Graduate Seminar on Discrete Optimization 6 CP	Advanced Topics in Mathematical Logic 7 CP
3	Advanced Topics in Discrete Mathematics 7 CP	Graduate Seminar on Chip Design 6 CP	Practical Training Course Algorithms for Chip Design 9 CP	Master Thesis + Master Thesis Seminar 30 CP + 6 CP	
4	Selected Topics in Discrete Optimization 5 CP				

Example Curriculum- Major Area C – Start in April

	Major (Area C)				Minor (Area E)	Minor (Area F)
1	Chip Design 9 CP	Approximation Algorithms 9 CP			Numerical Simulation 9 CP	
2	Combinatorial Optimization 9 CP		Graduate Seminar on Chip Design 6 CP		Advanced Topics in Numerical Methods in Science and Technology 7 CP	Foundations in Stochastic Analysis 9 CP
3	Selected Topics in Discrete Optimization 5 CP	Practical Training Course Combinatorial Algorithms 9 CP	Graduate Seminar on Discrete Optimization 6 CP	Master Thesis + Master Thesis Seminar 30 CP + 6 CP		
4	Advanced Topics in Discrete Mathematics 7 CP					