

## Module Handbook

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# Course INF-56-53-K-5

Complexity Theory (4V+2U, 8.0 LP)

## Course Type

SWS	Type	Course Form	CP (Effort)	Presence-Time / Self-Study
-	K	Lecture with exercise classes (V/U)	8.0 CP	156 h
4	V	Lecture		56 h
2	U	Exercise class (in small groups)		28 h
<b>(4V+2U)</b>			<b>8.0 CP</b>	<b>84 h 156 h</b>

## Basedata

SWS	4V+2U
CP, Effort	8.0 CP = 240 h
Position of the semester	1 Sem. in WiSe
Level	[5] Master (Entry Level)
Language	[EN] English
Lecturers	Majumdar, Rupak, Prof. Dr. (PROF   DEPT: INF)
Area of study	[INF-ALG] Algorithmics and Deduction
Lifecycle-State	[NORM] Active

## 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.

## Contents

- Time Complexity
  - P, NP, NP-completeness.
- Space Complexity
  - Savitch's theorem, games.
  - NL, Immerman and Szlepcseny's theorem.
- Diagonalization
  - Hierarchy theorems
  - Ladner's theorem.
- Parameterized Complexity
  - Graphs of bounded tree width.
  - Courcelle's theorem.
  - Hardness theory.
- Polynomial Hierarchy
  - Definition and complete problems.
  - Alternation.
  - Collapse
- Circuits
  - P/poly.
  - Karp and Lipton's theorem.
  - Lower bounds.
  - NC and parallel computing.
- Randomness
  - BPP.
  - Adleman's theorem.
  - Sipser and Gac's theorem.
- Countin
  - P.
  - Approximate counting.
  - Toda's theorem.
- Communication Complexity
  - Fooling sets.
- Logic in Complexity Theory
  - Alternative definitions of complexity classes.
  - Theories.

## Literature

- Downey, Rodney G., and Michael R. Fellows. Fundamentals of parameterized complexity. Vol. 4. London: Springer, 2013.
- Hopcroft, John E., Jeffrey D. Ullman, and Rajeev Motwani. Einführung in die Automatentheorie, formale Sprachen und Komplexitätstheorie. Vol. 2. Deutschland, München: Pearson Studium, 2002.
- Papadimitriou, Christos H. Computational complexity. John Wiley and Sons Ltd., 2003.
- Reischuk, Karl Rüdiger. Einführung in die Komplexitätstheorie. BG Teubner, 1990.
- Sipser, Michael. Introduction to the Theory of Computation. Vol. 2. Boston: Thomson Course Technology, 2006.

Further literature will be announced in the lecture.

## Requirements for attendance (informal)

None

## Requirements for attendance (formal)

**References to Course [INF-56-53-K-5]**

<b>Module</b>	<b>Name</b>	<b>Context</b>	
[INF-56-53-M-5]	Complexity Theory	P: Obligatory	4V+2U, 8.0 LP

<b>Course-Pool</b>	<b>Name</b>
[INF-Alg_V-KPOOL-6]	Lectures of the teaching area Algorithmics and Deduction