



## General Description of the Department

The Computer Science/Mathematics Department 07 offers programs of study in two different areas:

- Computer Science (Bachelor and Master)
- Information Systems and Management (Bachelor and Master, in cooperation with the Business Administration Department 10)

This brochure only describes the Computer Science Bachelor program of study. There are separate brochures for the Master Degree Program, and for the programs of study in Information Systems and Management.

The following 13 laboratories with about 100 workstations are available to students:

- Laboratory for Chip Cards,
- Laboratory for Computer Anatomy,
- Laboratory for Computer Graphics and Image Processing,
- Laboratory for Autonomous Systems,
- Laboratory for Microcomputers,
- Laboratory for Computer Vision and Pattern Recognition,
- Laboratory for Computer Integrated Manufacturing,
- Laboratory for Computer Organisation,
- Laboratory for Software Development,
- Laboratory for Java,
- Laboratory for Knowledge-Based Systems, and
- Laboratory for e-Commerce.
- Laboratory for Database Systems and Information Management,

In addition, two theme-based laboratories do not have their own facilities and hardware but rather share space in the laboratories listed above:

## Qualification achieved

### Bachelor program of Study

Within 7 semesters, students of the newly designed Bachelor program can achieve the

**Academic degree:** Bachelor of Science (B.Sc.)

The Bachelor degree program was **accredited** by the ASIIN.

Concurrently to the Bachelor program of study, students may enrol in the supplemental program „Privacy and Data Protection“. Successful graduates of this supplemental program will receive a state-approved university certificate.

## Admission requirements

The general requirements for admission to a University of Applied Sciences (Fachhochschule) apply. This means that generally a high school degree or a degree from a polytechnic college is a prerequisite.

In addition, applicants must take an aptitude test whose components may change over time. You may obtain details on the current process from the departmental webpage ([www.cs.fhm.edu](http://www.cs.fhm.edu)).

## Recommendations for exchange students

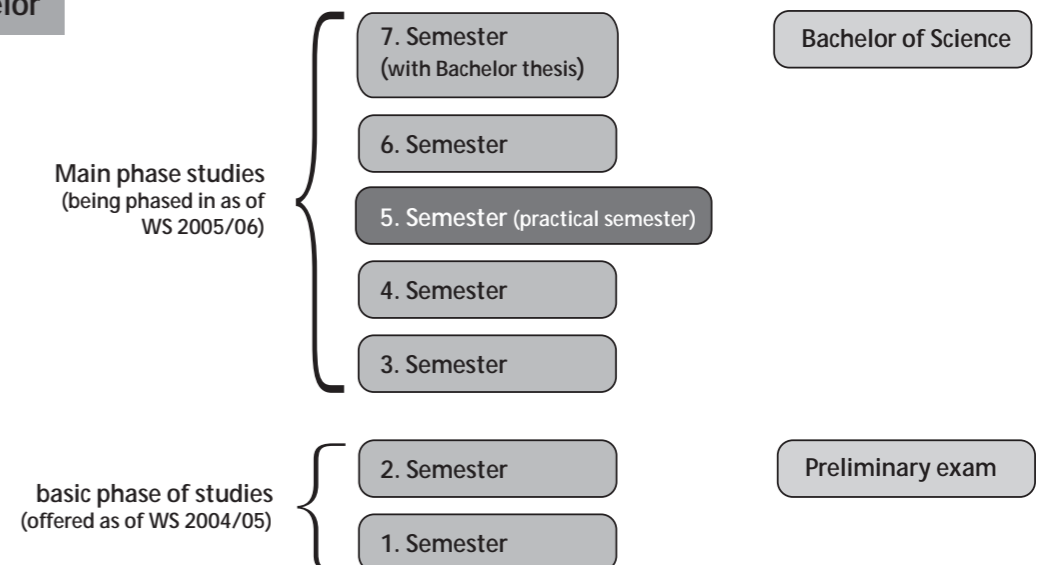
The study period at the Munich University of Applied Sciences (MUAS) can be one or more semesters in length. All courses in the Bachelor degree program are one semester in length and conclude with an examination at the end of the semester. Note, however, that not all courses are offered in every semester. Some courses will only be offered in summer semester, others only in winter semester. In each semester, only a choice of the electives will be offered.

Exchange students are free to make a course selection that most complements the course requirements of their home university. When making their choice, it is irrelevant whether the chosen courses are required courses, or electives, or whether the courses are from different programs of study or take place in different semesters of study. It is, however, the student's own responsibility to make sure that there are no scheduling conflicts in the student's weekly lecture schedule. Such conflicts can generally be avoided by choosing courses that all take place in the same semester of study.

Each semester, a small number of the courses will be offered in English language. However, in order to allow for a useful and flexible selection of courses, it is strongly recommended that exchange students be able to attend courses in German language.

## Diagram

### Computer Science Bachelor



## Course overview

### Examination regulations and grading procedures

In most courses, students will have to pass a written exam at the end of the semester. Others require students to also hand in practicum assignments or research project reports, or to give presentations. Most of these assignments receive a grade. Some are marked on a „pass“ or „fail“ basis.

1.0 is the highest grade and 5.0 the lowest; a grade of 4.0 means you have just passed the exam.

1,0 or 1,3	means: very good
1.7 or 2.0 or 2.3	means: good
2.7 or 3.0 or 3.3	means: satisfactory
3.7 or 4.0	means: adequate
5,0	means: insufficient (failed)

Students may repeat any failed exam once. A limited number of exams may be repeated twice upon applying to do so.

You will find the binding rules for exams in the current course calendar (Studienplan) as well as in the conditions of study and exam ordinance (Studien- und Prüfungsordnung).

### International Student Advisor

Name: Prof. Dr. Christian Vogt  
Responsible for all of the department's partner universities.

### Description of the individual courses in each semester

#### Abbreviations

GSCE = General Studies Compulsory Elective  
DCE = Departmental Compulsory Elective  
H/W = Hours per Week

### Computer Science Bachelor

#### Computer Science - Bachelor

This Bachelor degree program can only be started in the winter semester. First semester courses are only offered in the winter, and second semester courses are only offered in the summer. Courses in the third and higher semesters will be offered in every semester.

1 Semester				
Course no	Title	Type	H/W	Credits
IF-I-B01	Analysis	Mandatory	4	5
IF-I-B02	Linear Algebra	Mandatory	4	5
IF-I-B05	IT-Systems I	Mandatory	4	5
IF-I-B07	Software Development I	Mandatory	6	8
IF-I-B10	Technical Computer Science I	Mandatory	4	5
IF-I-B11	General Studies Course	Mandatory		2

2 Semester				
Course no	Title	Type	H/W	Credits
IF-I-B03	Discrete Mathematics	Mandatory	4	5
IF-I-B04	Applied Mathematics	Mandatory	4	5
IF-I-B06	IT Systems II	Mandatory	4	5
IF-I-B08	Software Development II	Mandatory	6	8
IF-I-B09	Theoretical Computer Science I	Mandatory	4	5
IF-I-B11	General Studies Course	GSCE		2

3 Semester				
Course no	Title	Type	H/W	Credits
IF-I-B12	Software Engineering I	Mandatory	4	5
IF-I-B14	Computer Networks I	Mandatory	4	5
IF-I-B15	Database Systems I	Mandatory	4	5
IF-I-B16	Algorithms and Data Structures I	Mandatory	4	5
IF-I-B21	Computer Architecture	Mandatory	4	5
IF-I-B24	Integral Transformations	Mandatory	4	5

4 Semester				
Course no	Title	Type	H/W	Credits
IF-I-B13	Operating Systems I	Mandatory	4	5
IF-I-B17	Data Security and Privacy I	Mandatory	4	5
IF-I-B18	Software Architecture	Mandatory	4	5
IF-I-B25	Management of IT Projects	Mandatory	4	5
IF-I-B23	Probability Theory and Statistics	Mandatory	4	5
	Departmental Compulsory Elective	DCE	4	5

5 Semester				
Course no	Title	Type	H/W	Credits
IF-I-B39	Practical Study Semester	Mandatory*		25
IF-I-B40	Course Accompanying the Practical Study Semester	Mandatory*	4	5

\* The practical semester may be waived if the job experience can be demonstrated. Applications to do so must be made at the beginning of the program.

6 Semester				
Course no	Title	Type	H/W	Credits
IF-I-B20	Distributed Software Systems	Mandatory	4	5
IF-I-B22	Computer Graphics and Image Processing	Mandatory	4	5
	DCE from the Compulsory Mathematics Electives Group (1)	DCE	4	5
	DCE from the Compulsory Immersion Courses Electives Group (2)	DCE	4	5
	DCE from the Compulsory Immersion Courses Electives Group (2)	DCE	4	5
IF-I-B37	Departmental Compulsory Elective	DCE	4	5

7 Semester				
Course no	Title	Type	H/W	Credits
IF-I-B19	Compiler	mandatory	4	5
	DCE from the Compulsory Immersion Courses Electives Group (2)	DCE	4	5
	Departmental Compulsory Elective	DCE	4	5
IF-I-B38	Bachelor's Thesis	Mandatory		15

(1) Courses in the Mathematics electives group (*)				
Course no	Title	Type	H/W	Credits
IF-I-B26	Numerical Analysis	DCE	4	5
IF-I-B27	Operations Research	DCE	4	5
IF-I-B28	Differential Calculus in $R^n$ and Differential Equations	DCE	4	5

(2) Courses in the Immersion Courses electives group (*)				
Course no	Title	Type	H/W	Credits
IF-I-B29	Theoretical Computer Science II	DCE	4	5
IF-I-B30	Technical Computer Science II	DCE	4	5
IF-I-B31	Software Engineering II	DCE	4	5
IF-I-B32	Operating Systems II	DCE	4	5
IF-I-B33	Computer Networks II	DCE	4	5
IF-I-B34	Database Systems II	DCE	4	5
IF-I-B35	Algorithms and Data Structures II	DCE	4	5
IF-I-B36	Data Security and Privacy II	DCE	4	5

\* Each semester, only a selection of the courses will be offered.

#### „Privacy and Data Protection“ Supplemental Program

Students who have successfully completed the preliminary exam may enrol in the „Privacy and Data Protection“ supplemental program. The program includes the following courses. Some of the courses also are compulsory courses in the Bachelor program of study.

„Privacy and Data Protection“ Supplemental Program			
Course no	Title	H/W	Bemerkungen
IF-Z-BD01	Privacy and Data Protection*	4	Contained in IF-I-B17 and IF-I-B36
IF-Z-BD02	IT Security*	4	Contained in IF-I-B17 and IF-I-B36
IF-Z-BD03	Business Law	4	
IF-Z-BD04	Practical Studies in Privacy and Data Protection	2	
IF-Z-BD05	Current Issues in Data Protection	2	

\* The two courses IF-Z-BD01 and IF-Z-BD02 together are equivalent to the two courses IF-I-B17 and IF-I-B36.

# Course Description

## 1. Analysis (Calculus)

Course: IF-I-BO1

4 H/W

1. Semester

5 ECTS-Credits

### Objectives

Course description: The basic terminology of analytic conclusions, particularly series, sequences, continuity and differentiability and the integrability of functions are introduced. The most important elemental classes of functions, namely polynomials, rational functions, trigonometric functions, exponential functions, hyperbolic functions and their inverse functions, will be discussed in order to become familiar with calculus techniques. Students will practice solving integration problems by using primitive functions. Through the use of Taylor series, students will see that power series coupled with differential calculus are suitable for solving elementary approximation problems. Furthermore, examples will illustrate that differential and integral calculus form the theoretical basis required to explain the physical and electro-engineering basics of computer science.

Prerequisites	none
Course objective	Introduction to and practice of the most important methods and techniques of differential and integral calculus.
Recommended literature	E.g. Stewart, „Calculus“
Method of instruction	Seminars
Examination	written exam
Language of instruction	german
Name of lecturer	Eich-Soellner, Plöchinger, Recknagel

## 2. Linear Algebra

Course: IF-I-BO2

4 H/W

1. Semester

5 ECTS-Credits

### Objectives

The standard topics of linear algebra (linear transformations, linear systems of equations, scalar products, determinants, eigenvalues) will be discussed. Due to the limited number of instruction hours, these topics are presented in a simplified format.

Prerequisites	none
Course objective	Students should know the most important terminology and findings of linear algebra.
Method of instruction	Seminars
Examination	written exam
Language of instruction	german
Name of lecturer	Hörwick

## 3. Discrete Mathematics

Course: IF-I-BO3

4 H/W

2. Semester

5 ECTS-Credits

### Objectives

Numbers theory: induction, largest common factors, prime numbers, Chinese remainder theory.

Graph theory: graphs, trees, search and sort algorithms.

Combinatorics: combinatorial calculation of probabilities.

Prerequisites	none
Course objective	Students are introduced to numbers theory, graph theory and combinatorics
Method of instruction	Seminars
Examination	written exam
Language of instruction	german
Name of lecturer	Hörwick, Recknagel

## 4. Applied Mathematics

Course: IF-I-BO4

4 H/W

2. Semester

5 ECTS-Credits

### Objectives

The course has two goals: Solving a problem of medium difficulty with mathematical modelling and using computer science tools will be demonstrated. The mathematical model precedes its own implementation or the application of mathematics software. The economic gains of applying mathematical methodology will be shown. Students will learn how to work in teams and make presentations. Examples:

- treatment of themes from OR, optimisation, graph theory and similar problems and implementation of solutions by the students.
- treatment of mathematical themes taking computer algebra systems into account.

Prerequisites	Analysis, Linear Algebra modules
Course objective	An understanding of computer algebra systems, development of mathematical models and their implementation, working in teams.
Recommended literature	E.g. Stephen Wolfram „Mathematica-Handbook“
Method of instruction	presentation and seminar work
Examination	written exam
Language of instruction	german
Name of lecturer	Eich-Soellner, Gruber

## 5. IT-Systems I

Course: IF-I-BO5

4 H/W

1. Semester

5 ECTS-Credits

### Objectives

Lectures will cover the common characteristics of modern IT systems:

- Information representation and coding
- Principles of the classic John von Neumann computer
- Control
- Principles of machine-level programming
- Basic data structures

Machine-level programming will be practiced during the practicum with the simulated MMIX model computer of Donald E Knuth.

Prerequisites	none
Course objective	The composition and functioning of an IT system from the register level to the operating system will be explained. Students will become familiar with the interface between hardware and software.
Recommended literature	Anlauff, Böttcher, Ruckert: „Das MMIX-Buch“, Springer 2002
Method of instruction	presentation and seminar work
Examination	written exam
Language of instruction	german
Name of lecturer	Anlauff, Böttcher, Ruckert



## 6. IT-Systems II

### Objectives

Machine-level programming:

- Structure of programmes and data
- Interface to the operating system

Course: IF-I-B06

4 H/W

2. Semester

5 ECTS-Credits

Handling modern operating systems:

- Introduction to Linux
- Practical exercises with Linux

Prerequisites	IF-I-B06: IT Systems I
Course objective	Building on IT Systems I, complex processes at the machine level will be discussed. IT Systems II covers operating systems basics and provides an overview of the essential characteristics. In the practicum, students will learn how to use modern operating systems.
Recommended literature	Anlauff, Böttcher, Ruckert: „Das MMIX-Buch“, Springer 2002
Method of instruction	seminars and a practicum
Examination	written exam
Language of instruction	german or english
Name of lecturer	Anlauff, Böttcher, Ruckert

## 7. Software Development I

### Objectives

Basic concepts of procedural and object-oriented programming based on current and generally available programming languages. The most important topics covered are algorithms, data encapsulation, and inheritance.

Course: IF-I-B07

6 H/W

1. Semester

8 ECTS-Credits

Prerequisites	none
Course objective	The ability to develop systematic and efficient software for solving simple problems.
Recommended literature	R. Schiedermeier: Programmieren mit Java, Pearson Studium 2005
Method of instruction	seminars with practical exercises
Examination	written exam
Language of instruction	german or english
Name of lecturer	Böttcher, Köhler, Möncke, Pleier, Schiedermeier

## 8. Software Development II

### Objectives

On the one hand, this course teaches advanced programming concepts, e.g. recursion, evaluating the complexity of algorithms and concurrency. On the other hand, practical aspects will be addressed such as input and output, network programming, the definition and use of data structure containers, use of class libraries, tests and dealing with errors.

Course: IF-I-B08

6 H/W

2. Semester

8 ECTS-Credits

Prerequisites	none
Course objective	Coming up with solutions to problems of medium difficulty through use of the appropriate programming methods and libraries.
Recommended literature	R. Schiedermeier: Programmieren mit Java, Pearson Studium 2005
Method of instruction	seminars with practical exercises
Examination	oral exam
Language of instruction	german or english
Name of lecturer	Böttcher, Köhler, Möncke, Pleier, Schiedermeier

## 9. Theoretical Computer Science I

### Objectives

This course introduces the methods and findings of significant areas in theoretical computer science which are applied to many other areas in computer science. This includes:

- Automata theory
- Formal languages
- Complexity and computability theory

Course: IF-I-B09

4 H/W

2. Semester

5 ECTS-Credits

Prerequisites	none
Course objective	Knowledge of important theories and methods of theoretical computer science which are applied in many areas of computer science.
Recommended literature	Uwe Schöning: Theoretische Informatik kurzgefaßt. Spektrum Akademischer Verlag. J. Hopcroft, R. Motwani, J. Ullman: Introduction to Automata Theory, Languages, and Computation. Addison-Wesley.
Method of instruction	seminars
Examination	written exam
Language of instruction	german or english
Name of lecturer	Motsch, Nischwitz, Vogt

## 10. Technical Science I

### Objectives

This course discusses techniques derived from the most important logic families. Students are introduced to Boolean algebra, the technical assembly of digital elementary logic gates and the principles of impulse and digital technology. Building on that, methods for the design and analysis of simple digital components are explained. This allows students to be able to design the basic elements of logical, arithmetic or storage entities in computer systems and understand how they work.

Course: IF-I-B10

4 H/W

1. Semester

5 ECTS-Credits

Prerequisites	none
Course objective	An understanding of the assembly of digital elements and the design and behaviour of combinatorial and sequential circuits.
Recommended literature	Tietze, Schenk: Halbleiterbauelemente Springer Ernst: Grundlagen und Konzepte der Informatik
Method of instruction	seminars with theoretical and practical exercises
Examination	written exam
Language of instruction	german
Name of lecturer	Marke, Motsch, Nischwitz, Vogt

## 11. General Studies Courses

Course: IF-I-B11

4 H/W

1 and 2 Semester

4 ECTS-Credits

### Objectives

- The compulsory electives from the General Studies department may be freely selected from the department's course catalogue.
- The total number of ECTS credits must conform to the number of ECTS credits stated in the lecture schedule.

Prerequisites	none
Course objective	The acquisition of character-building general knowledge.
Method of instruction	seminars
Examination	determined by the General Studies department
Language of instruction	german or english

## 12. Software Engineering I

Course: IF-I-B12

4 H/W

3. Semester

5 ECTS-Credits

### Objectives

Objectives of software engineering

- Classic models of the software life cycle, "agile" approaches
- Notion of model and method
- Object-oriented analysis and design
- Functional, static and dynamic views
- Classes and associations in particular inheritance, subtyping, subclassing and generalisation
- Unified Modelling Language
- Selected design patterns
- Interdisciplinary topics: Quality control, configuration management, documentation

Prerequisites	Software Development I and II
Course objective	Coming up with solutions to problems of medium difficulty through use of the appropriate programming methods and libraries.
Recommended literature	Balzert, Helmut; Lehrbuch der Software-Technik Bd 1: Software-Entwicklung, Spektrum, Akademischer Verlag, Heidelberg, 2001; Lehrbuch der Software-Technik Bd 2: Software-Management, Software-Qualitätssicherung, Unternehmensmodellierung, Spektrum, Akademischer Verlag, Heidelberg, 1998 Balzert, Heide, Lehrbuch der Objektmodellierung: Software-Management, Software-Qualitätssicherung, Unternehmensmodellierung, Spektrum-Elsevier, München, 2005 Booch, Object-oriented Design with Applications, Benjamin/Cummings, 1994 Brügge/Dutoit: Objektorientierte Softwaretechnik, Pearson-Prentice Hall, 2004 Gamma et.al., Design Patterns, Elements of Reusable Object-Oriented Software, Addison-Wesley, 1997 Fowler, Scott, UML distilled, Addison-Wesley, 2004 Oesterreich; Objektorientierte Softwareentwicklung, Oldenburg, 2005 Rumbough et. al. The Unified Modeling Language Reference Manual, Addison-Wesley, 1999 Sommerville, Software Engineering, Addison-Wesley, 1995
Method of instruction	seminars
Examination	written exam
Language of instruction	german
Name of lecturer	Streng, Möncke

## 13. Operating Systems I

Course: IF-I-B13

4 H/W

4. Semester

5 ECTS-Credits

### Objectives

This course covers the tasks of an operating system as well as basic concepts pertaining to their execution and examples of the implementation in important, current operating systems. Topics covered include:

- Processes and threads
- Interrupts
- Scheduling
- Synchronisation methods
- Memory management
- file systems and input and output systems

Prerequisites	IF-I-B05: IT Systems I, IF-I-B06: IT Systems II IF-I-B21: Computer Architecture
Course objective	Knowledge of the fundamental internal functions of an operating system required to assess and select an operating system, write high-performance applications, as well as operate an IT system
Recommended literature	one of the standard works on operating systems, e.g. • Tanenbaum, Modern Operating Systems, Prentice Hall • Stallings, Operating Systems, Prentice Hall • Silberschatz et. al., Operating System Concepts, Addison Wesley
Method of instruction	seminars
Examination	written exam
Language of instruction	german or english
Name of lecturer	Vogt, Schnörr

## 14. Computer Networks I

Course: IF-I-B14

4 H/W

3. Semester

5 ECTS-Credits

### Objectives

- Basic terminology and concepts, network topologies and network classes
- Foundations of communication engineering
- Forms of communication
- Norms and specifications
- Setup of networks, active and passive network components
- Layered architecture and protocols
- Introduction to network security
- Foundations of network management
- Selected topics and recent developments

Prerequisites	basic phase of studies/preliminary examination
Course objective	introduction to the terminology and principles of network technology and protocols. Knowledge of the principles and applications of data communications.
Recommended literature	Tanenbaum, A. S.: Computernetzwerke, Prentice Hall Stein, E.: Rechnernetze und Internet, Fachbuchverlag Leipzig, Hanser. Lienemann, G.: TCP/IP - Grundlagen, Heise. Holzer, J.; Pflugmann, M.: TCP/IP-Internet intern, Data Becker. Olbricht, A.: Netze Protokolle Spezifikationen, Vieweg
Method of instruction	seminars with practical and theoretical exercises
Examination	written exam, practical proof of achievement (practicum work or presentation)
Language of instruction	german or english
Name of lecturer	Marke, Pleier, Böttcher, Mandl, Kirch-Prinz

## 15. Database Systems I

Course: IF-I-B15

4 H/W

3. Semester

5 ECTS-Credits

### Objectives

Seminars will cover:

- Foundations of database systems and architecture
- Database management systems, focussing on relational databases
- Database languages, particularly SQL
- Physical database organization
- Transaction and concurrency concepts, recovery methods
- Administration of database systems, access control aspects
- Database special topics

Prerequisites	none
Course objective	overview of architectures, processes and applications of database systems, knowledge of the most significant methods, techniques, processes and tools used with persistent data.
Recommended literature	<i>Hald, A.; Nevermann, W.</i> : Datenbank-Engineering für Wirtschaftsinformatiker, Vieweg, 1995 <i>Marsch, J.; Fritze, J.</i> : Erfolgreiche Datenbankanwendung mit SQL, Vieweg, 5.Auflage, 1999 <i>Meier, A.</i> : Relationale Datenbanken, Springer, 3.Auflage, 1998. <i>Pernul, G.; Unland, R.</i> : Datenbanken im Unternehmen, Oldenbourg, 2001. <i>Vossen, G.</i> : Datenbankmodelle, Datenbanksprachen und Datenbankmanagement-Systeme, Oldenbourg, 3.Auflage, 1999
Method of instruction	seminars with a practicum
Examination	written exam
Language of instruction	german
Name of lecturer	Schwenkert, Staudt

## 16. Algorithms and Data Structures I

Course: IF-I-B16

4 H/W

3. Semester

5 ECTS-Credits

### Objectives

This course covers abstract linear and hierarchical data types, the complexity of their operations, the choices of implementation, and their use in applications. In particular, this includes:

- Linear data structures (e.g. linear lists, sorted lists, constrained linear structures)
- Hierarchical data structures (e.g. k-ary trees, binary search trees, heaps, binary trees) along with their common operations (e.g. generating, inserting, deleting and searching) and applications.

Prerequisites	none
Course objective	The ability to assess the suitability of data structures and algorithms and the capability to implement them. The lab sessions will enable the students to competently apply object-oriented development methods and to use standard libraries.
Recommended literature	one of the standard works on algorithms and data structures, e.g.: <i>Nikolaus Wirth</i> , Algorithmen und Datenstrukturen, Teubner Verlag. <i>Sedgewick</i> , Algorithmen in C++, Addison-Wesley Longman. <i>Brassard/Bratley</i> , Fundamentals of Algorithms, Prentice Hall
Method of instruction	seminars with a practicum
Examination	written exam
Language of instruction	german or english
Name of lecturer	Kirch-Prinz, Köhler

## 17. Privacy and IT Security I

Course: IF-I-B17

4 H/W

4. Semester

5 ECTS-Credits

### Objectives

Societal and legal principles of privacy and data protection, Foundations of constitutional and European law, Legal and technical terminology, Threats in the areas of communication and information, Current issues in administration and the economy, Legal regulations in the public and private sectors as well as professional secrecy, Organisational and technical aspects of privacy and IT-security, Theoretical security models, risk assessment, Foundations of encryption systems

Prerequisites	none
Course objective	Sensitivity toward privacy, insight into dangers and risks of data tempering, knowledge of the legal system of privacy, basic terminology of encryption.
Recommended literature	<i>Tinnefeld/Ehmann/Gerling</i> , Einführung in das Datenschutzrecht, Oldenbourg, München <i>IT-Grundschutz-Handbuch, BSI</i>
Method of instruction	seminars
Examination	written exam, 90 minutes
Language of instruction	german
Name of lecturer	Petri, Gerling, Schuster

## 18. Software Architecture

Course: IF-I-B18

4 H/W

after the preliminary exam

5 ECTS-Credits

### Objectives

This course covers the design and implementation of complex software systems for server applications. Both conceptual questions such as the design pattern, the OSI model, logic, presentation and the role of application servers as well as the technical aspects such as security, database connectivity, dynamic websites, J2EE and .NET are covered.

Prerequisites	Software development I und II (IF-I-B07 und IF-I-B08)
Course objective	The ability to design, implement and operate new server applications.
Method of instruction	seminars with practical exercises
Examination	written exam, term work
Language of instruction	german or english
Name of lecturer	Böttcher, Schiedermeier



## 19. Compiler

### Objectives

Overview of compiler phases

Course: IF-I-B19

Lexical analysis

4 H/W

- Regular expressions
- Non-deterministic finite automata
- Deterministic finite automata
- Use of (F)lex

7. Semester

5 ECTS-Credits

Syntax analysis

- Formal languages, grammar and derivatives
- Construction of top down parsers (LL parsers)
- First and follow loads
- Construction of bottom up parsers (LR parsers)

Semantic analysis

- Attributes and semantic actions
- S- and L-attributed grammars
- Static type testing
- Implementation of Bison (Yacc)

Generation of MIDDLEWARE

- 3 address code
- translation of expressions
- translation of control structures
- procedure invocations, stack frames, bonding semantics

Optimisation

- optimisation techniques

Code generation

Non-standard applications, e.g. in bioinformatics or linguistics

Prerequisites	Successful completion of Theoretical Computer Science I, Software Development I and II, Algorithms and Data Structures
Course objective	Knowledge of and ability to implement generating tools.
Recommended literature	<i>Wilhelm/Maurer</i> : Übersetzerbau, Springer, Berlin, 1997 <i>Aho/Ullmann/Sethi</i> : Compilers, Principles, Techniques and Tools, Addison-Wesley, Amsterdam, 1986, Reprint 2000
Method of instruction	seminars with practical exercises
Examination	written exam
Language of instruction	german
Name of lecturer	Schiedermeier, Ruckert, Möncke

## 20. Distributed Software Systems

### Objectives

Topics include:

- Motivation and foundations,
- Hardware and software architecture principles
- Principles and techniques of processes and threads as well as synchronisation and communication
- Programming network-, library-, high level language-, web-oriented
- Software engineering
- Security
- Particular forms of distributed software systems

Course.: IF-I-B20

4 H/W

6. Semester

5 ECTS-Credits

Prerequisites	basic phase of computer science programme of studies
Course objective	Knowledge of the foundation, problems, principles and techniques of distributed software systems as architectures, programming, software design, software engineering, security, particular forms.
Recommended literature	of the standard works on distributed systems, e.g.: <i>Michael Weber</i> : Verteilte Systeme, Spektrum <i>A. Tanenbaum, M. Steen</i> : Verteilte Systeme – Grundlagen und Paradigmen, Pearson Studium <i>G. Bengel</i> : Verteilte Systeme, Vieweg
Method of instruction	seminars with practical exercises
Examination	written exam
Language of instruction	german
Name of lecturer	Pleier

## 21. Computer Architecture

### Objectives

This course covers the principles and methods of analysis, implementation, assessment and classification of computer architectures. The core is made up of discussing architecture principles and characteristics of modern RISC and CISC (micro-)processors as instruction sets, superscalar architecture, pipelining, and cache organisation. Also discussed are the organising principles of multi-processor systems and important architecture models such as SMP systems or large-scale parallel systems by means of real-life examples.

Course: IF-I-B21

4 H/W

3. Semester

5 ECTS-Credits

Prerequisites	IF-I-B05: IT System I, IF-I-B06: IT-System II, IF-I-B09: Computer Science Theory I, IF-I-B10: Computer Science for Engineering
Course objective	Insight in the assembly and structures of current (micro-) processors and computer systems knowledge indispensable to the design of compilers and development of operating systems.
Recommended literature	<i>Hennessy, Patterson</i> : „Computer Architecture – A Quantitative Approach“, Morgan Kaufmann, 2003
Method of instruction	seminars with practical exercises
Examination	written exam
Language of instruction	german or english
Name of lecturer	Böttcher, Motsch

## 22. Computer Graphics and Image Processing

Course: IF-I-B22

4 H/W

6. Semester

5 ECTS-Credits

### Objectives

This course covers the application of and interrelationship between computer graphics and image processing.

Computer graphics:

- The rendering pipeline
- Geometric modelling
- Coordination systems and transformations
- Lighting and shading
- Texture mapping

Image processing:

- Digitisation and sampling theorem
- Gray scale and color images (color theory), image sequences
- Point operations (scaling, multi-thresholding, histogram algorithms)
- Filters in the spatial and frequency domain
- Feature extraction
- image segmentation and classification

Prerequisites	recommended: Integral transformations (IF-I-B24)
Course objective	An understanding of the fundamental processes of computer graphics and image processing.
Recommended literature	A. Nischwitz, P. Haberäcker: Masterkurs Computergrafik und Bildverarbeitung, Vieweg 2004
Method of instruction	seminars with practical exercises
Examination	written exam; practical proof of accomplishment (practicum work or presentation)
Language of instruction	german or english
Name of lecturer	Nischwitz, M. Fischer

## 23. Probability Theory and Statistics

Course: IF-I-B23

4 H/W

4. Semester

5 ECTS-Credits

### Objectives

This course will focus on random variables and probability distributions. These terms will be explored on the basis of the realm of mathematical probability. The course will discuss binomial, Poisson, normal, student, Fisher and hyper-geometric distributions as representative of discrete and continuous distributions. These distributions and their use for the testing of hypotheses are covered. In addition, the foundations of Parameter estimation and correlation analysis are taught.

Prerequisites	none
Course objective	The objective of this course is to impart an overview of statistics and stochastic processes.
Method of instruction	seminars
Examination	written exam,
Language of instruction	german
Name of lecturer	Hörwick, Zielke

## 24. Integral Transformations

Course: IF-I-B24

4 H/W

3. Semester

5 ECTS-Credits

### Objectives

In this course the foundations of Fourier-, Laplace-, and the Z-transformations are taught. With the help of these transformations linear differential calculus problems as well as certain common and partial differential equations are solved. The course also provides an overview of Walsh-, Wavelet- and Radon transformations. These transformations are required for special applications such as computer tomography tomography.

Prerequisites	Linear Algebra and Analysis modules
Course objective	Students will gain knowledge of the most important functional transformations and apply them to different areas such as: <ul style="list-style-type: none"> <li>• Analysis of linear systems</li> <li>• Control and feedback control systems</li> <li>• Image processing</li> <li>• Data compression</li> <li>• Signal processing</li> <li>• Analysis of time series</li> <li>• Spectral representation of stochastic processes.</li> </ul>
Recommended literature	D. Müller-Wichards: Transformationen und Signale. Teubner. Louis, Maaß, Rieder: Wavelets. Teubner R. Brigola: Fourieranalysis, Distributionen und Anwendungen. Vieweg
Method of instruction	seminars with exercises
Examination	written exam
Language of instruction	german or english
Name of lecturer	Plöchinger, Zielke

## 25. Management of IT Projects

Course: IF-I-B25

4 H/W

4. Semester

5 ECTS-Credits

### Objectives

This course introduces students to basic management principles (e.g. in such areas as labour law, types of enterprise, organisation). In addition, skills required for the execution of projects are taught (e.g. accounting, investment, financing, and marketing). Also covered are aspects of IT project management (e.g. project planning, implementation, organisation, controlling; preliminary survey, cost effectiveness study).

Prerequisites	none
Course objective	Acquisition of essential managerial knowledge and skills in IT project management.
Method of instruction	seminars and a practicum
Examination	written exam
Language of instruction	german or english
Name of lecturer	N.N.

## 26. Numerical Analysis

Course: IF-I-B26

4 H/W

6. Semester

5 ECTS-Credits

### Objectives

- Introduction to scientific computing, e.g. Matlab or Scilab
- Error analysis, stability of algorithms
- Solving linear systems of equations (quadratic and over-determined)
- Solving non-linear systems of equations
- Interpolation and approximation
- Numerical differentiation and integration
- Numerical solution of ordinary differential equations
- Fast Fourier-Transformation

Prerequisites	Calculus, Linear Algebra (matrix calculations, Gaussian elimination)
Course objective	The objective of this course is to introduce the student to the design and analysis of methods and algorithms for solving mathematical problems in science and engineering. In addition, students will be introduced to scientific computing environment, such as Scilab or Matlab. <ul style="list-style-type: none"> <li>• Knowledge and classification of the most important problems and solutions</li> <li>• Reasonable understanding of state-of-the-art methods and how to proceed from there</li> <li>• Knowing and understanding the underlying theory</li> <li>• The ability to find, apply and adapt methods to problems</li> </ul>
Recommended literature	e.g. <i>M. Heath</i> , „Introduction to Scientific Computing“
Method of instruction	seminars
Examination	written exam
Language of instruction	german or english
Name of lecturer	Eich-Soellner, Plöchingner

## 27. Operations Research

Course: IF-I-B27

4 H/W

6. Semester

5 ECTS-Credits

### Objectives

Classic optimisation (one- and multidimensional, with and without constraints); linear programming (geometry, theorem of Danzig, simplex method, duality, transport and allocation problems); non-linear optimisation (production programme planning, convex and separate optimisation); decision trees (branch and bound); dynamic programming; queueing theory (stochastic processes, Poisson process, queueing models, single and multi-switch systems); network analysis (CPM)

Prerequisites	Analysis, Linear Algebra (Gaussian elimination)
Course objective	Ability to model optimisation problems; ability to classify the problem, select an appropriate solution method and solve smaller problems by hand.
Recommended literature	e.g. <i>Domschke/Drexel</i> , „Einführung in Operations Research“
Method of instruction	seminars
Examination	written exam
Language of instruction	german
Name of lecturer	Eich-Soellner, Plöchingner, Recknagel, Schwenkert

## 28. Differential Calculus in $\mathbb{R}^n$ and Differential Equations

Course: IF-I-B28

4 H/W

6. Semester

5 ECTS-Credits

### Objectives

This course covers real functions with several variables. Fundamental concepts such as:

- Partial derivation, gradient, direction derivative, tangent plane, Jacobian and Hessian
- Chain rules, the Schwarz theorem, Taylor series, linearization, necessary and sufficient conditions for extrema and saddle points.

In addition, the course covers various representations of plane curves. Also discussed are ordinary differential equations (ODEs: general and particular solutions (initial value problem) to first first order ODEs (separable and linear); several types of second order ODEs, in particular the general wave equation: insight into the theory of linear systems of ODEs.

Prerequisites	Linear Algebra and Calculus in $\mathbb{R}^1$
Course objective	Knowledge of the principles of calculus with several variables. This is the prerequisite of an understanding of many areas such as statistics, numerical analysis and operations research.
Recommended literature	<i>Meyberg, Vachenaer</i> : Höhere Mathematik 1 und 2. Springer <i>A. Avez</i> : Differential Calculus. J. Wiley and Sons
Method of instruction	seminars with exercises
Examination	written exam
Language of instruction	german or english
Name of lecturer	Plöchingner, Recknagel

## 29. Theoretical Computer Science II

Course: IF-I-B29

4 H/W

6. or 7. Semester

5 ECTS-Credits

### Objectives

This course covers selected topics from theoretical computer science. The precise topics will be announced well before the beginning of course.

Prerequisites	IF-I-B09: Computer Science Theory I
Course objective	Enriched knowledge of selected topics from theoretical computer science
Recommended literature	be announced depending on the precise topics covered.
Method of instruction	seminars
Examination	oral exam
Language of instruction	german
Name of lecturer	Vogt

### 30. Technical Computer Science II

Course: IF-I-B30

4 H/W

6. or 7. Semester

5 ECTS-Credits

#### Objectives

This course covers the physical principles underlying computer science engineering, in other words electromagnetism, solid state physics, semiconductor physics, optoelectronics, as well as the structure and modes of operation of electronic devices (diodes, transistors, etc). This is followed by a discussion of the assembly of logical gates from electronic devices. The course complements the physics foundations in Computer Science for Engineering I which started at the gate level.

The course may optionally cover developments in quantum computing.

Prerequisites	basic phase of studies/preliminary exam.
Course objective	an understanding of the physics principles underlying computer science engineering.
Recommended literature	<i>Tietze, Schenk</i> : Halbleiterbauelemente, Springer <i>Rudden, Wilson</i> : Elementare Festkörperphysik und Halbleiterelektronik, Spektrum Akademischer Verlag (engl. Originaltitel: Elements of Solid State Physics) <i>Schiffmann, Schmitz</i> : Technische Informatik, Band 1, Springer
Method of instruction	seminars with theoretical and practical exercises
Examination	oral exam
Language of instruction	german or english
Name of lecturer	Marke, Motsch, Nischwitz

### 31. Software Engineering II

Course: IF-I-B31

4 H/W

6. or 7. Semester

5 ECTS-Credits

#### Objectives

Enrichment in the fields:

- Verification and testing
- CASE tools
- Development of real-time systems
- Quality control
- Configuration management
- Middleware and client-server systems

Prerequisites	Software Engineering I
Course objective	General overview, acquiring practical experience through examples
Recommended literature	same as for Software Engineering I as well as literature from magazines and books relevant to focus
Method of instruction	seminars with practical experience
Examination	oral exam
Language of instruction	german
Name of lecturer	Streng, Möncke

### 32. Operating Systems II

Kurs Nr.: IF-I-B32

4 H/W

6. or 7. Semester

5 ECTS-Credits

#### Objectives

This course covers selected topics pertaining to current operating systems issues. The precise topics will be announced well before the beginning of the course.

Prerequisites	IF-I-B013: Operating Systems I
Course objective	Enriched knowledge of specific aspects of modern operating systems relevant to practice.
Recommended literature	Will be announced pending the concrete course contents
Method of instruction	seminars with practical exercises
Examination	oral exam
Language of instruction	german or english
Name of lecturer	Vogt

### 33. Computer Networks II

Course: IF-I-B33

4 H/W

6. or 7. Semester

5 ECTS-Credits

#### Objectives

Expansion on topics from Networks I. Planning and operation of computer networks, network security and network management including network diagnosis and the tools that requires. Treatment of current issues and a view toward future trends.

Prerequisites	Networks I (IF-I-B14)
Course objective	An understanding of network engineering and processes. Enriched understanding of protocols as well as security problems. Ability to plan, analyse and operate computer networks.
Recommended literature	<i>Tannenbaum</i> : Computernetzwerke, Prentice Hall <i>Stein</i> : Rechnernetze und Internet, Fachbuchverlag Leipzig, Hanser <i>TCP/IP-Grundlagen</i> , Lienemann, Heise
Method of instruction	seminars
Examination	oral exam
Language of instruction	german or english
Name of lecturer	Marke, Pleier, Mandl, Kirch-Prinz

### 34. Database Systems II

Course: IF-I-B34

4 H/W

6. or 7. Semester

5 ECTS-Credits

#### Objectives

The practical part of this course expands on the student's knowledge of application development (among others Views, SQL and Stored Procedures). It also covers the essential aspects of implementing database systems leading to a greater understanding of the user point of view. Elements of relational algebra and query optimization, physical database organization, coordination of multiple users as well as aspects of data security and protection are introduced. The course concludes with a view towards post-relational database systems.

Prerequisites	Database Systems I (IF-I-B15)
Course objective	Enhancing the knowledge on theoretical foundations of database systems, a deeper knowledge in the area of implementing database systems in practice.
Method of instruction	seminars with a practicum
Examination	oral exam
Language of instruction	german
Name of lecturer	Schwenkert, Staudt



### 35. Algorithms and Data Structures II

Course: IF-I-B35

4 H/W

6. or 7. Semester

5 ECTS-Credits

#### Objectives

This course covers data types representing graphs and data structures used for external storage media. Its focus is on the complexity of related algorithms, implementation choices, and applications. Specifically, topics include:

- Graph data structures (e.g. multigraphs, digraphs, graphs)
- Hash techniques (e.g. static hashing, adaptive hashing)
- Index structures (e.g. primary and secondary indices, cluster indices, and multi-level indices)

Prerequisites	IF-I-B16 Algorithms and Data Structures I
Course objective	Knowledge of standard methods and techniques to solve common problems in graph theory and in the organisation of external data structures. Capability to find solutions and implement them. The lab sessions will foster the use of object-oriented development methods.
Recommended literature	one of the standard works on algorithms and data structures, e.g.: <i>R.H. Güting, S. Dieker: Datenstrukturen und Algorithmen</i> , Teubner Verlag <i>Elmasri, Navathe: Fundamentals of Database Systems</i> , Addison-Wesley <i>Gio Wiederhold: Dateiorganisation in Datenbanken</i> , McGraw-Hill
Method of instruction	seminars with a practicum
Examination	oral exam
Language of instruction	german or english
Name of lecturer	Kirch-Prinz, Köhler

### 36. Privacy and IT Security II

Course: IF-I-B36

4 H/W

6. or 7. Semester

5 ECTS-Credits

#### Objectives

Security considerations of operating systems. Modes of operation, technical implementation and corporate management of security measures (implementation of encryption methods, firewalls, authorisation concepts, etc.).

Special topics in data protection.  
Case studies on selected topics.

Prerequisites	Privacy and IT security II (IF-I-B17)
Course objective	Enriched knowledge of the organisational and technical aspects of IT security and in special topics of data protection, ability to address privacy concerns in a practical manner.
Recommended literature	<i>Tinnefeld/Ehmann/Gerling: Einführung in das Datenschutzrecht</i> , Oldenbourg, München <i>BSI-Grundschutzhandbuch</i>
Method of instruction	seminars
Examination	written exam
Language of instruction	german
Name of lecturer	Beier, Ehmann, Gerling, Schuster

### 37. Departmental Compulsory Electives

Course: IF-I-B37

4 each H/W

as of the 4<sup>th</sup> semester

5 each ECTS-Credits

#### Objectives

- A number of departmental compulsory electives are offered each semester from which students may choose freely
- The total number of ECTS credits must at least total the amount of ECTS credits listed in the lecture schedule

Prerequisites	none
Course objective	acquisition of technical knowledge in specialised areas of computer science
Recommended literature	depends on the topic
Method of instruction	seminars
Examination	written exam
Language of instruction	german or english

### 38. Bachelor Thesis

Course: IF-I-B38

7. Semester

15 ECTS-Credits

#### Objectives

Independent development of a solution for a practice-oriented problem using a scientific and methodical approach.

Prerequisites	computer science knowledge comparable to 6 semesters
Course objective	a thesis
Recommended literature	books which will introduce the student to scientific work
Method of instruction	independent study (with direction and supervision)
Examination	Bachelor's thesis
Language of instruction	german or english
Name of lecturer	all

### 39. Practical Study Semester

Course: IF-I-B39

5. Semester

25 ECTS-Credits

#### Objectives

Collaboration in selected fields of computer science:

- Software development (e.g. analysis, design, programming, testing)
- Project management or implementation

Prerequisites	all courses of the basic phase of studies
Course objective	Educational objectives: Knowledge of operational processes in the field of computer science by working hands-on as a prospective computer scientist. Encouragement of the collaboration between the university and industry by maintaining contact with companies providing vocational training.
Method of instruction	vocational training at the company
Examination	practicum report and transcript
Language of instruction	german



**40. Course Accompanying the Practical Study Semester**

Course: IF-I-B40

4 H/W

during the practical study semester (5. Semester)

5 ECTS-Credits

**Objectives**

This course is made up of seminars and immersion in the field relevant to the practicum.  
 • During the seminars, students give short presentations on their practical work and moderate the discussion that follows.  
 • A project in hardware or low level programming is included in the supplementary practical concentration area

Prerequisites	none
Course objective	The seminars aim to enrich the experience gained during the practicum as well as to instil self-confidence in that experience. In addition to solving problems related to the project and its implementation, immersion in the field relevant to the practicum promotes leadership and teamwork skills.
Recommended literature	to-date literature will be announced during the course.
Method of instruction	seminars with a practicum
Examination	colloquium
Language of instruction	german or english
Name of lecturer	Kirch-Prinz, Schiedermeier, Abmayer

**1. Privacy and Data Protection**

Course: IF-Z-BDO1

4 H/W

5 ECTS-Credits

**Objectives**

- Societal and legal principles of privacy and data protection
- legal and technical terminology
- the line between data security and privacy
- balancing the mandates of privacy and data security
- Threats in the areas of communication and information
- Current issues in administration and the economy
- Legal regulations in the public and private sectors as well as professional secrecy
- Organisational and technical aspects of privacy

Prerequisites	none
Course objective	Sensitivity toward privacy needs, insight into the dangers and risks of data manipulation and forgery, knowledge of the legal systems surrounding privacy and the ability to judge situations based on the complex legal systems involved.
Recommended literature	Tinnefeld/Ehmann/Gerling, Einführung in das Datenschutzrecht, Oldenbourg, München Magazines: Datenschutz und Datensicherheit, Vieweg, Wiesbaden; Computer und Recht; Dr. Otto Schmidt, Köln; Simitis, Kommentar zum BDSG, Nomos, Baden-Baden
Method of instruction	seminars
Examination	written exam
Language of instruction	german
Name of lecturer	Beier, Ehmann, Möncke, Petri, Schuster

**2. IT-Security**

Course: IF-Z-BDO2

4 H/W

5 ECTS-Credits

**Objectives**

- Principles, motivation for, and objectives of IT-security
- Threats and typical attack scenarios
- Concepts and methods of security management
- Principles, mechanisms, systems used for authentication, authorisation, administration and auditing
- Selected examples and practical application areas

Prerequisites	Principles of IT systems (networks, hardware, operating systems, applications)
Course objective	An understanding of problems, principles, concepts and mechanisms ensuring IT security.
Recommended literature	The most current literature covering IT-security; articles from journals and conferences will be used. Claudia Eckert: IT- Sicherheit. Konzepte, Verfahren, Protokolle, Oldenbourg, München
Method of instruction	lectures with discussions and exercises
Examination	written exam
Language of instruction	german
Name of lecturer	Gerling, Pleier

### 3. Business Law

Course: IF-Z-BDO3

4 H/W

6 ECTS-Credits

#### Objectives

- The legal system
- Legal regulations of commercial law (particularly from sections of the German Civil Code pertaining to general parts, laws of obligations, and property laws)
- Introduction to selected case studies
- Particular problem statements in the area of telecommunications as well as software production and licensing

Prerequisites	none
Course objective	Knowledge of the legal principles of commercial law as well as the acquisition of methods to assess the facts of a case and systematically solve simple cases.
Recommended literature	<i>Textbook:</i> Lorenz/Riehm, Lehrbuch zum neuen Schuldrecht, Beck, München, 2002 <i>Medicus:</i> Schuldrecht I Allgemeiner Teil, Beck, München, 2002 <i>Commentary:</i> Palandt, Kommentar zum BGB, Beck, München, (current edition).
Method of instruction	lectures with discussion
Examination	written exam
Language of instruction	german
Name of lecturer	Möncke

### 4. Practical Studies in Privacy and Data Protection

Course: IF-Z-BDO4

2 H/W

as of the 6 semester

3 ECTS-Credits

#### Objectives

Selected legal, organisational and technical case studies from real-world business setting of a data protection official.

Prerequisites	Privacy and Data Protection (IF-Z-BD01)
Course objective	Ability to make legal, organisational and technical assessments of data protection problems.
Method of instruction	practicum
Examination	term work and presentation
Language of instruction	german
Name of lecturer	Gerling, Schuster

### 5. Current Issues in Data Protection

Course: IF-Z-BDO5

2 H/W

3 ECTS-Credits

#### Objectives

Concrete threats to privacy and the media, current protection mechanisms

Prerequisites	Privacy and Data Protection (IF-Z-BD01)
Course objective	knowledge of the current European data protection laws, applicability to real-world business situations
Recommended literature	Announced at lecture time.
Method of instruction	seminars
Examination	term work
Language of instruction	german
Name of lecturer	Petri, Tinnefeld