TECHNISCHE UNIVERSITÄT KAISERSLAUTERN

## Module Handbook

TUK MODHB Homapage

# Module INF-02-09-M-2

## Digital Systems and Computer Architecture (M, 8.0 LP)

## Module Identification

| Module Number | Module Name | CP (Effort) |
|---|---|---|
| INF-02-09-M-2 | *Digital Systems and Computer Architecture* | 8.0 CP (240 h) |

## Basedata

| | |
|---|---|
| **CP, Effort** | 8.0 CP = 240 h |
| **Position of the semester** | 1 Sem. in SuSe |
| **Level** | [2] Bachelor (Fundamentals) |
| **Language** | [DE] German |
| **Module Manager** | Schneider, Klaus, Prof. Dr. (PROF \| DEPT: INF) |
| **Lecturers** | Grimm, Christoph, Prof. Dr. (PROF \| DEPT: INF)<br>Schneider, Klaus, Prof. Dr. (PROF \| DEPT: INF)<br>Schürmann, Bernd, PD Dr.-Ing. (WMA \| DEPT: INF, GS) |
| **Area of study** | [INF-PFL] Mandatory Modules |
| **Reference course of study** | [INF-82.79-SG] B.Sc. Computer Science |
| **Livecycle-State** | [NORM] Active |

## Courses

| Type/SWS | Course Number | Choice in Module-Part | SL | PL | CP | Sem. |
|---|---|---|---|---|---|---|
| 4V+2U | INF-02-09-K-2 | P | U-Schein | PL1 | 8.0 | SuSe |

- About **[INF-02-09-K-2]**: Title: "Digital Systems and Computer Architecture"; Presence-Time: 84 h; Self-Study: 156 h
- About **[INF-02-09-K-2]**: The study achievement **"[U-Schein] proof of successful participation in the exercise classes (ungraded)"** must be obtained.

- It is a prerequisite for the examination for PL1.

## Examination achievement PL1

- Form of examination: **written exam (Klausur) (120-150 Min.)**
- Examination number: 60209 ("Digital Systems and Computer Architecture")

## Evaluation of grades

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

## Contents

**From [INF-02-09-K-2] Digital Systems and Computer Architecture:**

Coding and information theory:

- Concept of information
- Efficient prefix codes (Huffmann, Shannon-Fano, etc.)
- Redundant codes for error detection and correction

Computational arithmetic:

- Radix-B and B-complement numbers and their calculation methods
- Fixed point numbers and floating point numbers (IEEE 754)

Propositional logic:

- Syntax and Semantics
- Normal forms
- Binary decision diagrams

Combinatorial circuits (switching networks):

- Simple circuits for radix B and B-complement numbers
- Efficient circuits for radix B and B-complement numbers (e.g. Carry-Lookahead addition, Wallace multiplication, Goldschmidt division, etc.)
- Logic minimization: Quine/McCluskey method, Karnaugh/Veitch diagrams, symbolic logic minimization, etc.

Sequential circuits

- Transducers and acceptors
- Mealy vs. Moore machines
- Determinate and minimize finite automata
- State coding and sequential circuit synthesis with FlipFlops
- Formal verification of sequential circuits

Processor architecture

- Instruction set architecture
- Von-Neumann, Harvard architecture, RISC/CISC architectures
- Operating and control units
- Example: MIPS or ARM instruction set
- Assembler programming

## Competencies / intended learning achievements

- Students acquire the ability to describe and evaluate functional and non-functional requirements of computer systems and the ability to engineer computer systems using suitable design methods and tools.
- In particular, students are able to encode data efficiently, use methods of fault tolerance effectively, analyse and design

simple switching networks and sequential circuits up to a single-cycle processor and, in particular, understand the functioning of computer systems and their data processing.

## Literature

**From [INF-02-09-K-2] Digital Systems and Computer Architecture:**


- Skript.
- S.P. Dandamudi, Fundamentals of Computer Organization and Design, Springer, 2002.
- Giovanni De Micheli, Synthesis and Optimization of Digital Circuits, McGraw-Hill, 1994.
- Gary D. Hachtel and Fabio Somenzi, Logic Synthesis and Verification Algorithms, Kluwer, 1996.
- C. Hamacher, Z. Vranesic, S. Zaky, N. Manjikian; Computer Organization and Embedded Systems; McGraw Hill, 2012.
- K. Hwang; Computer Arithmetic, Principles, Architecture and Design; John Wiley and Sons; 1979.
- M. Lu; Arithmetic and Logic in Computer Systems; Wiley Interscience, 2004.
- C. Meinel and T. Theobald, Algorithms and Data Structures in VLSI Design: OBDD - Foundations and Applications, Springer, 1998.
- S. M. Mueller and W.J. Paul, Computer Architecture: Complexity and Correctness, Springer Verlag, 2000.
- Walter Oberschelp und Gottfried Vossen: Rechneraufbau und Rechnerstrukturen, Oldenbourg, 2006.
- B. Parhami, Computer Arithmetic - Algorithms and Hardware Designs, Oxford University Press, 2000.
- D.A. Patterson, J.L. Hennessy, Computer Organization Design - The Hardware Software Inferface, Morgan Kaufmann Publishers, 2014.
- Gerhard H. Schildt, Daniela Kahn, Christopher Kruegel, Christian Moerz: Einführung in die Technische Informatik, Springer, 2005.


## Requirements for attendance of the module (informal)

None

## Requirements for attendance of the module (formal)

None

## References to Module / Module Number [INF-02-09-M-2]

| Course of Study | Section | Choice/Obligation |
| --- | --- | --- |
| [INF-82.79-SG] B.Sc. Computer Science | [Compulsory Modules] Computer Science Systems | [P] Compulsory |
| [MV-82.103-SG] B.Sc. Mechanical Engineering | [Specialisation] Applied Computer Science (if chosen) | [P] Compulsory |
| [MAT-82.105-SG] B.Sc. Mathematics | [Subsidiary Topic] Subsidiary Subject (Minor) | [WP] Compulsory Elective |
| [WIW-82.176-SG] B.Sc. Business Administration and Engineering specialising in Computer Science | [Fundamentals] Field of study: Computer Science | [P] Compulsory |
| [WIW-82.?-SG#2021] B.Sc. Business Administration and Engineering specialising in Computer Science 2021 [2021] | [Specialisation] Field of Study: Computer Science | [P] Compulsory |
| [MV-82.103b-SG#2022] B.Sc. Maschinenbau 2022 [2022] | [Specialisation] Wahlpflichtbereich / Kompetenzfelder | [WP] Compulsory Elective |

| Module-Pool | Name |
| --- | --- |
| [MV-MB-2022-MPOOL-4] | Wahlplichtmodule Bachelor Maschinenbau |