

Module Handbook (<https://modhb.uni-kl.de/>)

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## Module EIT-ISE-110-M-7

Neurocomputing (M, 4.0 LP)

### Module Identification

Module Number	Module Name	CP (Effort)
EIT-ISE-110-M-7	<i>Neurocomputing</i>	4.0 CP (120 h)

### Basedata

CP, Effort	4.0 CP = 120 h
Position of the semester	1 Sem. in WiSe
Level	[7] Master (Advanced)
Language	[EN] English
Module Manager	König, Andreas, Prof. Dr.-Ing. (PROF   DEPT: EIT) (/staff/343/)
Lecturers	König, Andreas, Prof. Dr.-Ing. (PROF   DEPT: EIT) (/staff/343/)
Area of study	[EIT-ISE] Integrated Sensor Systems
Reference course of study	[EIT-88.781-SG#2010] M.Sc. Electrical and Computer Engineering [2010] (/mhb/FB-EIT/cos-556/)
Lifecycle-State	[NORM] Active

### Courses

Type/SWS	Course Number	Choice in Module-Part	SL	PL	CP	Sem.
2V+1U	EIT-ISE-110-K-7 (/mhb/courses/EIT-ISE-110-K-7/)	P	PROJ-Schein	PL1	4.0	WiSe

- About [EIT-ISE-110-K-7]: Title: "Neurocomputing"; Presence-Time: 42 h; Self-Study: 78 h
- About [EIT-ISE-110-K-7]: The study achievement [PROJ-Schein] **proof of successful completion of the project(s)** must be obtained. It is a prerequisite for the examination for PL1.

### Examination achievement PL1

- Form of examination: **oral examination (30 Min.)**

- Examination Frequency: each semester

## Evaluation of grades

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

### Contents

**From [EIT-ISE-110-K-7] Neurocomputing (/mhb/courses/EIT-ISE-110-K-7/):**

- Introduction to the field of innovative computer architectures and systems for the technical implementation of biological information processing principles
- Presentation of diverse aims and solution concepts: Hardware for technical cognition systems, biological-technical interfaces, simulation and verification of models of biological evidence
- Rehearsal of relevant and commonly applied neural algorithms, including deep networks/deep-learning and analysis of computational requirements and operators
- Extension from amplitude-coded to spike-coded representation and processing
- Presentation and effect of potential simplification options for the regarded algorithms
- Basics of circuit technology (digital, analog, opto-elektronic/optisch) and related implementation technologies (CMOS, WSI, M(O)EMS, etc.) for neural hardware
- Overview of fundamental architectural principles of neurochips, -processors and -computers
- Assessment criteria and taxonomy for neural HW
- Presentation and detailed discussion of selected, representative implementations
- Outlook on new lines in the field, e.g., evolvable hardware, organic computing, and self-monitoring and repairing sensor systems

### Competencies / intended learning achievements

After completing this module you can...

- ... explain the concepts of dedicated neural and bio-inspired hardware and its application potential and limitations.
- ... explain the design principles of circuits with alternative signal representation and adaptive structures.
- ... explain the issues of supervised and unsupervised learning, host-based learning or on-line continuous learning systems.
- ... explain and master the effects of simplified implementations.
- ... explain fault-tolerance and robustness issues in conventional and neural computing systems.
- ... abstract contents/result to M(O)EMS/microsystems application.
- ... code and/or simulate a neural algorithm in Python, BRIAN, etc.
- ... compile (labeled) examples from application scenario, create data sets for training/validation/test, select and train a neural network, and apply it for newly measured data (live classification).
- ... use a neural computing device, e.g., analog or digital neural hardware, customizing it to application and data source, e.g., sensor, and execute real-time classification/processing.
- ... physically design and validate custom neurons, neural circuits, and neural systems in an established CMOS-process (with given background in microelectronics).

### Requirements for attendance (informal)

#### Modules:

- [EIT-DSV-531-M-4] Digital Signal Processing (M, 4.0 LP) (/mhb/modules/EIT-DSV-531-M-4/)
- [EIT-ISE-112-M-7] Sensor Signal Processing (M, 5.0 LP) (/mhb/modules/EIT-ISE-112-M-7/)
- [EIT-ISE-651-M-4] Technology and Design of Integrated Mixed-Signal Circuits and Systems (TESYS) (M, 5.0 LP) (/mhb/modules/EIT-ISE-651-M-4/)
- [EIT-ISE-701-M-2] Electronics I (M, 6.0 LP) (/mhb/modules/EIT-ISE-701-M-2/)
- [EIT-ISE-702-M-3] Electronics II (M, 4.0 LP) (/mhb/modules/EIT-ISE-702-M-3/)

### Requirements for attendance (formal)

None

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## References to Module / Module Number [EIT-ISE-110-M-7]

Course of Study	Section	Choice/Obligation
[EIT-88.781-SG#2010] M.Sc. Electrical and Computer Engineering [2010] (/mhb/FB-EIT/cos-556/)	Elective Subjects	[W] Elective Module
[EIT-88.A44-SG#2018] M.Sc. Media and Communication Technology [2018] (/mhb/FB-EIT/cos-568/)	Technical Elective Subjects	[W] Elective Module
[EIT-88.?-SG#2021] M.Sc. Electrical and Computer Engineering [2021] (/mhb/FB-EIT/cos-686/)	Technical Elective Modules	[W] Elective Module
[EIT-88.?-SG#2021] M.Sc. Media and Communication Technology [2021] (/mhb/FB-EIT/cos-688/)	Technical Elective Modules	[W] Elective Module
[EIT-88.A20-SG#2021] M.Sc. European Master in Embedded Computing Systems (EMECS) [2021] (/mhb/FB-EIT/cos-566/)	Elective Subjects	[W] Elective Module
[EIT-88.?-SG#2021] M.Sc. Automation and Control (A&C) [2021] (/mhb/FB-EIT/cos-676/)	Elective Modules	[W] Elective Module
[EIT-88.?-SG#2021] M.Sc. Embedded Computing Systems (ESY) [2021] (/mhb/FB-EIT/cos-677/)	Elective Subjects	[W] Elective Module