Module title		SM Code
Microcontrollers		**MC**
Module lecturer	**Faculty**	
Prof. Dr. Detlef Jantz	Electrical Engineering and Information Technology	
Module language	**Number of SWS / WSH**	**ETCS credits**
English / German	4 SWS / WSH	5
Teaching format		
Seminar-based teaching with over 30% practical component		

Semester according to the study plan	
1st, 2nd, 3rd semester (Master)	
Attendance/classroom hours	**Additional independent study**
60 hours	Preparation and follow-up work: 90 hours
Type of examination / Requirements for the award of the credit points	
Written exam: 120 minutes	

Teaching content

Computer architectures and memory

Hardware-oriented programming of the ARM Cortex-M processor in assembler and C

- Overview of the ARM Cortex-M3/M4
- Memory organization, pipeline, stack, clock
- Instruction set
- Subroutines, macros, and interrupts
- Development environment

- Software creation process (compiler, assembler, linker)
- Finite state machines

Peripherals

- GPIOs
- SysTick and GPT timers
- A/D converters
- Serial interfaces (UART, SPI, I2C)

Lecture accompanying laboratory exercises with ARM Cortex-M3/4

- Getting to know the toolchain (Keil, GNU arm-none-eabi)
- Programming in assembler and C
- Debugging and troubleshooting - Possible independent work with eval boards and in the laboratory

Possible independent work with eval boards and in the laboratory

Learning objective: Professional competence

After successfully completing this module, students will be able to

- understand and apply the functionality of processors and microcontrollers (3)
- understand and develop assembler programs for ARM instruction sets (3)
- document code appropriately (flowcharts, comments) (2)
- perform hardware-related programming in assembler and C
- work with interrupt systems (2)
- understand how peripheral drivers work (1)
- understand how to divide complex (programming) tasks into modules and interfaces (1)

Literature

Recommended reading

- Yiu, J. (2010). *The Definitive Guide to the ARM Cortex-M3*. Elsevier

- Meier, H. *Microcomputertechnik*. Lecture notes, OTH Regensburg
- Graf, F. *Microcomputertechnik*. Lecture notes, OTH Regensburg
- Balbierer, N. *Microcomputertechnik*. Lecture notes, OTH Regensburg
- ARM. *ARMv7-M Architecture Reference Manual*. Device Documentation
- ARM. *ARM Cortex-M4 Technical Reference Manual*. Device Documentation
- ARM. *Procedure Call Standard for the ARM Architecture*. Device Documentation
- Valvano, J. (2015). *Introduction to ARM Cortex-M Microcontrollers*. (Vol. 1).

The numbers in brackets indicate the levels to be achieved: (1)-know | (2)-can | (3)-understand and apply