Ruhr Master School
of Applied Sciences

Dieses Wahlpflichtmodul ist ein Angebot der:

Fachhochschule Dortmund
University of Applied Sciences and Arts

Master Embedded Systems for Mechatronics

Microelectronics & HW/SW-Co-Design

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University of Applied Sciences

STIFTUNG MERCATOR

Microelectronics & HW/SW-Co-Design (MOD2-02)

Code Number	Workload	Credits	Semester	Frequency	Duration
10220/21	180 h	6	Sem. 2	annually	1 Semester

1	Course Title	Contact hours	Self-Study	Planned Group Size
	Microelectronics & HW/SW-Co-Design	4 SWS / 60 h	120 h	25 students

2 Course Description

Digital Systems are the main hardware platform for embedded systems and the target of embedded SW development. A good knowledge and overview of available HW platforms is required. Furthermore, a concurrent engineering process (HW/SW Codesign) is used to develop state of the art embedded systems. The coordination of (more agile) SW development and (more V-model) HW development is a challenge. Digital system development is applying complex tools and tool chains. The goal of this module is to enable to students to select, to assess, and to develop digital target platforms for embedded systems.

3 Course Structure

1. Microelectronic Components for Embedded Systems
   a. DSP, Microcontroller
   b. FPGA
   c. ASIC, ASSP
   d. Memories
   e. Communication components (e.g. serial busses)
   f. PCB and standard circuits
2. Digital systems design methodologies and processes
   a. ESL concepts
   b. SystemC
   c. VHDL/Verilog
   d. Simulation and validation
   e. HW/SW partitioning
   f. Verification and test
   g. Synthesis (on FPGA)
3. Virtual Prototypes and HW/SW co-verification
4. Tools and Tool Chains
5. New Trends: Multicore/Manycore, SoC, 3D, MEMS

4 Parameters

- Course characteristics: compulsory
- Course frequency: every year - summer semester
- Capacity: 25 students
- Course admittance prerequisites: electronics, basics of embedded systems
- Skills trained in this course: theoretical, practical and methodological skills
- Assessment of the course: Oral Exam (30 min) at the end of the course (50%) and group work as homework (50%): SystemC or VHDL implementation, mapping on FPGA, demonstration and presentation
- Teaching staff: Prof. Dr. Peter Schulz, (Prof. Dr. Carsten Wolff)

5 Learning outcomes

5.1 Knowledge

- Knows microelectronic components of embedded systems
- Knows digital systems design methodology and processes

	• Knows tools and technologies for digital design • Knows concept of virtual prototype and its application in HW/SW Codesign 5.2 Skills • Can compose an embedded system out of microelectronic components • Can describe digital systems with SystemC or VHDL • Can run a digital simulation • Can assess synthesis and verification reports for simple designs • Can run test and debug sessions with FPGAs 5.3 Competence - attitude • Can set up HW/SW Codesign projects for embedded systems • Can choose and tailor the tool chain and methodology • Can present and demonstrate the design flow for a digital design project
6	**Teaching and training methods** • Lectures • Labs with: SystemC and VHDL simulation (Mentor), FPGA synthesis (Mentor or Synopsis) and FPGA implementation (Xilinx or Lattice). Access to tools and tool tutorials (Europractice tool chain)
7	**Course mapping** Input for: • MOD-E09 – System on Chip Design Requires: • MOD1-03 - Embedded Software Engineering Connects to: • MOD2-03 - R&D Project Management
8	**References** Documentation of Europractice – Mentor Graphics Tools and Cadence Tools Neil H.E. Weste, David Money Harris: “Integrated Circuit Design”, Pearson, 2011 Clive “Max” Maxfield (Editor): “FPGAs World Class Designs”, Newnes / Elsevier, 2009 Jack Ganssle (Editor): “Embedded Systems World Class Designs”, Newnes / Elsevier, 2008 Peter J. Ashenden: “Digital Design – An Embedded Systems Approach Using VHDL“, Morgan Kaufmann / Elsevier, 2008 Peter J. Ashenden: “The Designer’s Guide to VHDL 2nd Edition”, Morgan Kaufmann / Academic Press, 2002 Schaumont, Patrick: A Practical Introduction to Hardware/Software Codesign. Springer 2010 Bailey, Brian, Martin, Grant: ESL Models and their Application: Electronic System Level Design and Verification in Practice. Springer 2010