Technology
Arts Sciences
TH Köln

Course Manual ES

Embedded Systems

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General information

Long name	Embedded Systems
Approving CModule	ES_BaET, ES_BaTIN
Responsible	Prof. Dr. Tobias Krawutschke Professor Fakultät IME
Valid from	winter semester 2022/23
Level	Bachelor
Semester in the year	winter semester
Duration	Semester
Hours in self-study	78
ECTS	5
Professors	NF Hartung
Requirements	basic knowledge in computer engineering FSA and FSM Microcontroller structure and function Imperative Programming language (pref. C) Experiences in Program development using program development environments, e.g. Eclipse
Language	German
Separate final exam	No

Literature

W.Wolff: Computers as Compenents: Principles of Embedded System Design

Wieringa: Design Methods for reactive Systems

− Lecture / Exercises

Learning goals

Goal type	Description
Knowledge	analysis and specification methods functional decomposition behavior description object oriented description description of parallel behavior with Petri nets engineering of embedded systems hardware aspects Microcontroller SOC system on (programmable) chip use of I/O controllers serial interface parallel interface DMA energy awareness software aspects choice of programming language Assembler C C++ andere software system architecture singletasking Implementing a FSM (finite state machine) table based static function scheduling multitasking RTOS with an example Embedded Linux timing requirements Distributed embedded systems Basics of distributed systems communication system levelling basics of field busses basics of Internet of Things (IoT) programming distributed embedded systems

Expenditure classroom teaching

Type	Attendance (h/Wk.)
Lecture	2
Tutorial (voluntary)	2

Special requirements

None

Accompanying material	Lecture Slides Models and programming examples
Separate exam	Yes

Separate exam

Exam Type	EN Übungsaufgabe mit fachlich / methodisch eingeschränktem Fokus unter Klausurbedingungen lösen
Details	Check of knowledge and understanding of the course content
Minimum standard	Correct answer of at least 50% of the questions

− Lecture / Exercises

Learning goals

Goal type	Description
Skills	Teamwork: Development of an embedded system with dedicated function, e.g. control of a mechanical model, environmental sensor etc. Aim: building a prototype Steps 1. Description/Specification Task description taking the client's view in communication with client (= docent) 2. Hardware architecture recherche of suitable modules in technical documents 3. Modelling the solution 4. Implementation using modern PDE and standards, especially RTOS
Skills	mastering complex tasks with the team project planning and steering fulfilling tasks on time
Skills	Presentation of Development Task description Project intermediate presentation Result Documentation in project report Project description Project implementation User documentation Experiences

Expenditure classroom teaching

Type	Attendance (h/Wk.)
Project	1
Tutorial (voluntary)	2

Special requirements

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Accompanying material	Support materials HW/SW base system (µC / FPGA prototyping board) Materials for interfacing to the process/model Mechanical prototyping materials
Separate exam	Yes

Separate exam

Exam Type	EN Projektaufgabe im Team bearbeiten (z.B. im Praktikum)
Details	Grading of presentations, contribution to discussions, result and report
Minimum standard	Delivery and presentation of milestones in time, solution of parts of the overall project task

− Lecture / Exercises

Learning goals

Goal type	Description
Skills	Modelling of an Embedded System using well-known design methods for reactive systems
Skills	Writing Software for an embedded system using C on base of a HAL (hardware abstraction layer) or by using a RTOS

Expenditure classroom teaching

Type	Attendance (h/Wk.)
Exercises (whole course)	1
Exercises (shared course)	0
Tutorial (voluntary)	0

Special requirements

none

Accompanying material	Exercise tasks Small programming tasks Tool Tutorials
Separate exam	Yes

Separate exam

Exam Type	EN Übungsaufgabe mit fachlich / methodisch eingeschränktem Fokus unter Klausurbedingungen lösen
Details	tasks from the fields of ES modelling and programming. The students should proove that they got the ability to use the methods and tools
Minimum standard	Reaching at least 50% of the grading points