

Module: Real-Time Systems

Level	Master	Short Name	RTS
Responsible Lecturers	Blaurock, Ole, Prof. Dr.		
Department, Facility	Electrical Engineering and Computer Science		
Course of Studies	Computer Science/Software Engineering for Distributed Systems, Master		
Compulsory/elective	Elective	ECTS Credit Points	5
Semester of Studies	(Unspecified)	Semester Hours per Week	4
Length (semesters)	1	Workload (hours)	150
Frequency	WiSe	Presence Hours	60
Teaching Language	German	Self-Study Hours	90

The following section is filled only if there is **exactly one** module-concluding exam.

Exam Type		Exam Language	
Exam Length (minutes)		Exam Grading System	
Learning Outcomes			
Participation Prerequisites			

The previous section is filled only if there is **exactly one** module-concluding exam.

Consideration of Gender and Diversity Issues	<ul style="list-style-type: none"> ✓ Use of gender-neutral language (THL standard) ✗ Target group specific adjustment of didactic methods ✗ Making subject diversity visible (female researchers, cultures etc.)
Applicability	
Remarks	

Module Course: Real-Time Systems (Lecture)

(of Module: Real-Time Systems)

Course Type	Lecture	Form of Learning	Presence
Mandatory Attendance	no	ECTS Credit Points	3
Participation Limit		Semester Hours per Week	3
Group Size		Workload (hours)	90
Teaching Language	English	Presence Hours	45
Study Achievements ("Studienleistung", SL)		Self-Study Hours	45
SL Length (minutes)		SL Grading System	

The following section is filled only if there is a course-specific exam.

Exam Type	Written Exam	Exam Language	German/English
Exam Length (minutes)	90	Exam Grading System	One-third Grades
Learning Outcomes	After successful completion of this course, the students will have acquired the following competences: <ul style="list-style-type: none"> • Understanding of requirements specific to real-time systems. • Analysis and design of hard- and software of systems with real-time capabilities. • Modelling and implementation of real-time systems. 		
Participation Prerequisites			

The previous section is filled only if there is a course-specific exam.

Contents	<ul style="list-style-type: none"> • Presentation of selected real-time systems, classification of real-time systems. • Safety in real-time systems: Dependability, reliability, methods for analysis, fault models, redundant design. • Security in real-time systems. • Communication in systems with real-time capabilities. • Implementation of real-time systems: models of time, energy concerns, fields of applications, target platforms. • Real-time operating systems: Architecture, scheduling, resource management, synchronization, comparison with operating systems for systems without real-time capabilities, selected examples.
Literature	<ul style="list-style-type: none"> • Giorgio Buttazzo, Giuseppe Lipari, Luca Abeni und Marco Caccamo: Soft Real-Time Systems Predictability vs. Efficiency, Springer, 2005. • Giorgio Buttazzo: Hard Real-Time Computing Systems Predictable Scheduling Algorithms and Applications, Springer, 2011.

- Abraham Silberschatz, Peter B. Galvin, Greg Gagne: Operating System Concepts, 8th ed., Wiley, 2010.
- Andrew S. Tanenbaum, Herbert Bos: Modern Operating Systems, Pearson Education Limited, 2014.
- Hermann Kopetz: Real-Time Systems, Springer, 2011.

Remarks	
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Module Course: Real-Time Systems (Practical Training)

(of Module: Real-Time Systems)

Course Type	Practical Training	Form of Learning	Presence
Mandatory Attendance	yes	ECTS Credit Points	2
Participation Limit		Semester Hours per Week	1
Group Size	12	Workload (hours)	60
Teaching Language	English	Presence Hours	15
Study Achievements ("Studienleistung", SL)	Practical Training	Self-Study Hours	45
SL Length (minutes)		SL Grading System	Pass

The following section is filled only if there is a course-specific exam.

Exam Type	Project Work	Exam Language	German/English
Exam Length (minutes)		Exam Grading System	Pass
Learning Outcomes	The students are able to model and apply specific techniques to implement a real-time system.		
Participation Prerequisites			

The previous section is filled only if there is a course-specific exam.

Contents	The topics of the module are applied to a scenario with characteristic requirements and constraints, e.g. implementation of an online scheduler for real-time systems.
Literature	<ul style="list-style-type: none"> • Giorgio Buttazzo, Giuseppe Lipari, Luca Abeni und Marco Caccamo: Soft Real-Time Systems Predictability vs. Efficiency, Springer, 2005. • Giorgio Buttazzo: Hard Real-Time Computing Systems Predictable Scheduling Algorithms and Applications, Springer, 2011 • Abraham Silberschatz, Peter B. Galvin, Greg Gagne: Operating System Concepts, 8th ed., Wiley, 2010. • Andrew S. Tanenbaum, Herbert Bos: Modern Operating Systems, Pearson Education Limited, 2014. • Hermann Kopetz: Real-Time Systems, Springer, 2011.
Remarks	