Fakultät für Mathematik und Informatik
Masterstudiengang Embedded Systems

UNIVERSITÄT DES SAARLANDES

Module Descriptions

Master Program
Embedded Systems

(01.10.2017)

Rs.-Sem.	Modul	CP	SWS
Core Courses (Mandatory Elective Courses)			
1-3	Aufbau- und Verbindungstechnik I	4	3
1-3	Automation Systems	4	3
1-3	Compiler Construction	9	6
1-3	Computational Electromagnetics 1	4	3
1-3	Computational Electromagnetics 2	4	3
1-3	Computer Architecture	9	6
1-3	Data Networks	9	6
1-3	Digital Signal Processing	6	4
1-3	Distributed Systems	9	6
1-3	Einführung in die elektromagnetische Feldsimulation	4	3
1-3	Elektrische Antriebe	4	3
1-3	Messtechnik und Sensorik	6	4
1-3	Elektronik / Bauelemente	3	2
1-3	High Speed Electronics	4	3
1-3	High Frequency Engineering	4	3
1-3	Embedded Systems	9	6
1-3	Future Media Internet	9	6
1-3	Image Processing and Computer Vision	9	6
1-3	Mikroelektronik 2	4	3
1-3	Mikroelektronik 3	4	3
1-3	Mikroelektronik 4	4	3
1-3	Mikromechanische Bauelemente	4	3

1-3	Mikrotechnologie	4	3
1-3	Pattern and Speech Recognition	6	4
1-3	Operating Systems	9	6
1-3	Security	9	6
1-3	Software Engineering	9	6
1-3	Statistical Natural Language Processing	6	4
1-3	Systemtheorie und Regelungstechnik 1	6	4
1-3	Systemtheorie und Regelungstechnik 2	5	3
1-3	Telecommunications 1	9	6
1-3	Telecomminications 2	9	6
1-3	Theoretische Elektrotechnik 2	5	3
1-3	Verification	9	6

Advanced Courses (Elective Courses)			
2-3	Automata, Games and Verification	6	4
2-3	Automated Debugging	6	4
2-3	Computer Graphics II	9	6
2-3	Differential Equations in Image Processing and Computer Vision	9	6
2-3	Introduction to Image Acquisition Methods	4	2
2-3	Correspondence Problems in Computer Vision	6	4
2-3	Automatic Planning	9	4
2-3	Antenna Theory 1	5	
2-3	Soft Control	4	3
1-3	Seminar	7	3
4	Master-Seminar	12	5
4	Master Thesis	30	
1-3	Tutor	4	2
1-3	Soft Skill	4 o. 6	2 o. 4
1 - 3	Language Courses	4 o. 6	2 o. 4

Aufbau- und Verbindungstechnik I					
Studiensem. **1 - 3**	Regelstudiensem. **3**	Turnus **WS**	Dauer **1 Semester**	SWS **3**	ECTS-Punkte **4**

Modulverantwortliche/r Prof. Dr.-Ing. habil. Steffen Wiese

Dozent/inn/en Prof. Dr.-Ing. habil. Steffen Wiese

Zuordnung zum Curriculum Bachelor Eingebettete Systeme, WP Stammvorlesungen
Master Embedded Systeme, WP Stammvorlesungen

Zulassungsvoraussetzungen Keine formale Voraussetzungen

Leistungskontrollen / Prüfungen Übungsbetrieb / mündliche oder schriftliche Abschlussprüfung

Lehrveranstaltungen / SWS Vorlesung: 2 SWS
Übung: 1 SWS

Arbeitsaufwand Vorlesung 15 Wochen à 2 SWS = 30 h
Übung 15 Wochen à 1 SWS = 15 h
Vor- und Nachbearbeitung = 45 h
Prüfungsvorbereitung = 30 h

Gesamtaufwand = 120 h

Modulnote Note der Klausur bzw. der mündlichen Prüfung

Lernziele/Kompetenzen

Das Ziel der Lehrveranstaltung besteht darin, die Studierenden in das Gebiet der Aufbau- und Verbindungstechnik der Elektronik einzuführen. Dabei sollen grundlegende Kenntnisse über Verfahren und technologische Abläufe zur Herstellung elektronischer Aufbauten vermittelt werden sowie die Spezifika der in der industriellen Fertigung eingesetzten Verbindungstechnologien diskutiert werden.

Inhalt

- Einführung in die Problematik der Herstellung elektronischer Aufbauten
- Architektur elektronischer Aufbauten (Hierarchischer Aufbau, Funktion der Verbindungsebenen)
- Erste Verbindungsebene (Die-Bonden, Drahtbonden, Flip-Chip- und Trägerfilmtechnik)
- Zweite Verbindungsebene (Bauelementeformen, Leiterplatten, Dickschichtsubstrate)
- Verbindungstechniken (Kaltpressschweißen, Löten, Kleben)

Weitere Informationen
Unterrichtssprache: deutsch
Literaturhinweise: Bekanntgabe zu Beginn der Vorlesung

Automation Systems					**AS**
Studiensem. **1 - 3**	Regelstudiensem. **3**	Turnus **SS**	Dauer **1 Semester**	SWS **3**	ECTS-Punkte **4**

Modulverantwortlicher	Prof. Dr.-Ing. Georg Frey
Dozent	Prof. Dr.-Ing. Georg Frey
Zuordnung zum Curriculum	Bachelor Eingebettete Systeme, WP Stammvorlesungen Master Embedded Systeme, WP Stammvorlesungen
Zulassungsvoraussetzungen	Keine formalen Voraussetzungen
Leistungskontrollen / Prüfungen	Benotete mündliche oder schriftliche Prüfung
Lehrveranstaltungen / SWS	2 SWS Vorlesung; 1 SWS Übung
Arbeitsaufwand	Gesamt 120 Stunden, davon • Präsenzzeit Vorlesung 15 Wochen à 2 SWS = 30 Stunden • Präsenzzeit Übung 15 Wochen à 1 SWS = 15 Stunden • Vor- und Nachbereitung Vorlesung und Übung = 45 Stunden • Prüfungsvorbereitung = 30 Stunden
Modulnote	Prüfungsnote

Educational objectives

Automation Systems is based on the fundamentals of discrete-event systems and networks. Students will acquire:

- detailed knowledge of describing and designing discrete-event systems for control applications;
- understanding of the specific challenges occurring in distributed (networked) automation systems as well as the knowledge of appropriate methods for the modeling and the analysis of automation networks.

Content: Logic Control and Networked Automation Systems

- Signals and Communication in Automation Systems
- Introduction to Logic Control
- Design and realization of logic control systems
- Domain specific languages (IEC 61131)
- Formal specification using Petri Nets
- Verification and Validation (V&V)
- Software quality
- Communication in Automation: Real-time and Dependability
- Application: Industrial Ethernet Solutions and CAN-Bus
- Application: Automotive Networks (LIN, CAN, FlexRay, MOST)
- Analysis of Networked Automation Systems
- Design of Distributed Controllers (IEC 61499)

Weitere Informationen

Unterrichtssprache: Englisch

Literaturhinweise: Literatur wird in der Vorlesung zur Verfügung gestellt bzw. bekannt gegeben.

Compiler Construction					CS 561 / CC
Studiensem.	Regelstudiensem.	Turnus	Dauer	SWS	ECTS-Punkte
1 - 3	3	At least once every two years	1 Semester	6	9

Modulverantwortliche/r Prof. Dr. Sebastian Hack

Dozent/inn/en Prof. Dr. Sebastian Hack

Zuordnung zum Curriculum Bachelor Eingebettete Systeme, WP Stammvorlesungen
Master Embedded Systeme, WP Stammvorlesungen

Zulassungsvoraussetzungen For graduate students: none

Leistungskontrollen / Prüfungen

- Regular attendance of classes and tutorials
- Written exam at the end of the course, theoretical exercises, and compiler-laboratory project.
- A re-exam takes place during the last two weeks before the start of lectures in the following semester.

Lehrveranstaltungen / SWS Lecture 4 h (weekly)
Tutorial 2 h (weekly)
Tutorials in groups of up to 20 students

Arbeitsaufwand 270 h = 90 h of classes and 180 h private study

Modulnote Wird aus Leistungen in Klausuren, Übungen und praktischen Aufgaben ermittelt. Die genauen Modalitäten werden vom Modulverantwortlichen bekannt gegeben.

Lernziele / Kompetenzen

The students learn, how a source program is lexically, syntactically, and semantically analyzed, and how they re translated into semantically equivalent machine programs. They learn how to increase the efficiency by semantics-preserving transformations. They understand the automata-theoretic foundations of these tasks and learn, how to use the corresponding tools.

Inhalt

Lexical, syntactic, semantic analysis of source programs, code generation for abstract and real machines, efficiency-improving program transformations, foundations of program analysis.

Weitere Informationen

Unterrichtssprache: Englisch

Literaturhinweise:
Bekanntgabe jeweils vor Beginn der Vorlesung auf der Vorlesungsseite im Internet.

Computational Electromagnetics 1					Abk. **CEM 1**
Studiensem. **1 - 3**	Regelstudiensem. **3**	Turnus **Every WS**	Dauer **1 semester**	SWS **3**	ECTS-Punkte **4**

Modulverantwortliche/r Romanus Dyczij-Edlinger

Dozent/inn/en Romanus Dyczij-Edlinger

Zuordnung zum Curriculum
Bachelor Eingebettete Systeme, WP Stammvorlesungen
Master Embedded Systeme, WP Stammvorlesungen

Zulassungsvoraussetzungen
None.
Recommended: a first course in Electromagnetics (e.g. Theoretische Elektrotechnik)

Leistungskontrollen / Prüfungen
Programming projects during the semester.
Written or oral final exam.

Lehrveranstaltungen / SWS
Computational Electromagnetics 1
Lecture 2 h (weekly)
Tutorial 1 h (weekly)

Arbeitsaufwand
Classes: 45 h
Private studies: 75 h
Total: 120 h

Modulnote
Programming projects: 50 %
Final exam: 50 %

Lernziele/Kompetenzen
To master selected topics in numerical linear algebra.
To know how to pose linear (initial-) boundary value problems of classical electrodynamics.
To understand the principles of differential and integral equation methods.

Inhalt
Selected topics in numerical linear algebra
Linear (initial-) boundary value problems of classical electrodynamics
Numerical methods
- Finite difference method / finite integration technique
- Finite element method
- Boundary element method

Weitere Informationen Lecture notes (in English), project assignments, old exams, and selected solutions are available online.

Unterrichtssprache: Students may choose between German or English.

Literaturhinweise: See lecture notes.

Computational Electromagnetics 2					**CEM 2**
Studiensem. **1 - 3**	Regelstudiensem. **3**	Turnus **Every SS**	Dauer **1 semester**	SWS **3**	ECTS-Punkte **4**

Modulverantwortliche/r	Romanus Dyczij-Edlinger
Dozent/inn/en	Romanus Dyczij-Edlinger
Zuordnung zum Curriculum	Bachelor Eingebettete Systeme, WP Stammvorlesungen Master Embedded Systeme, WP Stammvorlesungen
Zulassungsvoraussetzungen	None. Recommended: Computational Electromagnetics 1
Leistungskontrollen / Prüfungen	Oral final exam: student presentations of selected topics from current research papers.
Lehrveranstaltungen / SWS	Computational Electromagnetics 2 Lecture 2 h (weekly) Tutorial 1 h (weekly)
Arbeitsaufwand	Classes: 45 h Private studies: 75 h Total: 120 h
Modulnote	Final exam: 100 %

Lernziele/Kompetenzen

To gain a deep understanding of finite element techniques for time-harmonic electromagnetic fields. Students are familiar with essential theoretical and implementation aspects of modern finite element methods and able to study advanced research papers on their own.

Inhalt

Functional analytical and geometric foundations
Modal analysis of electromagnetic cavities
Modal analysis of driven time-harmonic fields
Analysis of driven time-harmonic fields
Special modeling techniques
Advanced numerical solution methods

Weitere Informationen Lecture notes are available online.

Unterrichtssprache: Students may choose between German or English.

Literaturhinweise: Each section of lecture notes contains list of references.

Computer Architecture					**CS 558 / CAR**
Studiensem.	Regelstudiensem.	Turnus	Dauer	SWS	ECTS-Punkte
1 – 3	3	At least once every two years	1 Semester	6	9

Modulverantwortliche/r Prof. Dr. W.-J. Paul

Dozent/inn/en Prof. Dr. W.-J. Paul

Zuordnung zum Curriculum Bachelor Eingebettete Systeme, WP Stammvorlesungen
Master Embedded Systeme, WP Stammvorlesungen

Zulassungsvoraussetzungen For graduate students: none

Leistungskontrollen / Prüfungen Studying:
Students should listen to the lectures, read the lecture notes afterwards and understand them. They should solve the exercises alone or in groups. Students must present and explain their solutions during the tutorials.
Exams:
Students who have solved 50 % of all exercises are allowed to participate in an oral exam at the end of the semester.

Lehrveranstaltungen / SWS Lecture 4 h (weekly)
Tutorial 2 h (weekly)
Tutorials in groups of up to 20 students

Arbeitsaufwand 270 h = 90 h of classes and 180 h private study

Modulnote Wird aus Leistungen in Klausuren, Übungen und praktischen Aufgaben ermittelt. Die genauen Modalitäten werden vom Modulverantwortlichen bekannt gegeben.

Lernziele / Kompetenzen

After attending this lecture students know how to design pipelined processors with interrupt mechanisms, caches and MMUs. Given a benchmark they know how to analyse, whether a change makes the processor more or less cost effective.

Inhalt

General comment: constructions are usually presented together with correctness proofs

- Complexity of Architectures
  - Hardware cost and cycle time
  - Compilers and benchmarks
- Circuits

  - Elementary computer arithmetic
  - Fast adders
  - Fast multipliers
- Sequential processor design
  - DLX instruction set
  - Processor design
- Pipelining
  - Elementary pipelining
  - Forwarding
  - Hardware-Interlock
- Interrupt mechanisms
  - Extension of the instruction set
  - Interrupt service routines
  - hardware construction
- Caches
  - Specification including consistency between instruction and data cache
  - Cache policies
  - Bus protocol
  - Hardware construction (k-way set associative cache, LRU replacement, realisation of bus protocols by automat)
- Operating System Support
  - Virtual and Physical machines
  - Address translation
  - Memory management unit (MMU) construction
  - Virtual memory simulation

Weitere Informationen

Unterrichtssprache: Englisch

Literaturhinweise:
Bekanntgabe jeweils vor Beginn der Vorlesung auf der Vorlesungsseite im Internet.

Data Networks					**CS 554 / DN**
Studiensem. **1 - 3**	Regelstudiensem. 3	Turnus At least once every two years	Dauer 1 Semester	SWS 6	ECTS-Punkte 9

Modulverantwortliche/r Prof. Dr. Holger Hermanns

Dozent/inn/en Prof. Dr. Holger Hermanns

Zuordnung zum Curriculum
Bachelor Eingebettete Systeme,
WP Stammvorlesungen
Master Embedded Systeme, WP Stammvorlesungen

Zulassungsvoraussetzungen For graduate students: none

Leistungskontrollen / Prüfungen

- Regular attendance of classes and tutorials
- Qualification for final exam through mini quizzes during classes
- Possibility to get bonus points through excellent homework
- Final exam
- A re-exam takes place during the last two weeks before the start of lectures in the following semester.

Lehrveranstaltungen / SWS
Lecture 4 h (weekly)
Tutorial 2 h (weekly)
Tutorials in groups of up to 20 students

Arbeitsaufwand 270 h = 90 h of classes and 180 h private study

Modulnote
Wird aus Leistungen in Klausuren, Übungen und praktischen Aufgaben ermittelt. Die genauen Modalitäten werden vom Modulverantwortlichen bekannt gegeben.

Lernziele / Kompetenzen

After taking the course students have

- a thorough knowledge regarding the basic principles of communication networks,
- the fundamentals of protocols and concepts of protocol,
- Insights into fundamental motivations of different pragmatics of current network solutions,
- Introduction to practical aspects of data networks focusing on internet protocol hierarchies

Inhalt

Introduction and overview
Cross section:

- Stochastic Processes, Markov models,
- Fundamentals of data network performance assessment
- Principles of reliable data transfer
- Protokols and their elementary parts
- Graphs and Graphalgorithms (maximal flow, spanning tree)
- Application layer:
- Services and protocols
- FTP, Telnet
- Electronic Mail (Basics and Principles, SMTP, POP3, ..)
- World Wide Web (History, HTTP, HTML)
- Transport Layer:
- Services and protocols
- Addressing
- Connections and ports
- Flow control
- QoS
- Transport Protocols (UDP, TCP, SCTP, Ports)
- Network layer:
- Services and protocols
- Routing algorithms
- Congestion Control
- Addressing
- Internet protocol (IP)
- Data link layer:
- Services and protocols
- Medium access protocols: Aloha, CSMA (-CD/CA), Token passing
- Error correcting codes
- Flow control
- Applications: LAN, Ethernet, Token Architectures, WLAN, ATM
- Physical layer
- Peer-to-Peer and Ad-hoc Networking Principles

Weitere Informationen

Unterrichtssprache: Englisch

Literaturhinweise:
Bekanntgabe jeweils vor Beginn der Vorlesung auf der Vorlesungsseite im Internet.

Digital Signal Processing

Semester	Reference semester	Term	Duration	Weekly hours	Credits
1 - 3	**3**	**SS**	**1 Semester**	**4**	**6**

Responsible lecturer Prof. Dr. Dietrich Klakow

Lecturer(s) Prof. Dr. Dietrich Klakow

Level of the unit
Bachelor Eingebettete Systeme, WP Stammvorlesungen
Master Embedded Systeme, WP Stammvorlesungen

Entrance requirements
For graduate students: none
Recommended: Sound knowledge of mathematics as tought in engineering, computer science or physics.

Assessment / Exams
Regular attendance of classes and tutorials
Presentation of a solution during a tutorial
Final exam (30 minutes, oral)

Course type / Weekly hours 2 h lecture and 2 h Tutorial

Total workload
Classes: 60 h
Problem solving and private studies 120 h
Total:180 h

Grading Final Exam Mark

Aims/Competences to be developed

The students will acquire knowledge of the basics methods in digital signal processing as well as gain experience in how to use them on practical data.

Content

- Signal Representation (e.g jpg, wav, ...)
- Microphone arrays
- Feature Extraction from Audio
- Feature Extraction from Images
  - Color
  - Texture
  - Edge
- Simple Classification Algorithms
- Feature Transforms
  - Karhunen Loeve Transform
  - Linear Discriminant Analysis
- Noise Suppression and Filtering
  - Wiener Filter
  - Spectral subtraction
- Speech Coding (PCM, CELP, LPC)

For some chapter practical examples like source localisation or musical genre classification are used.

Additional information
Used Media: Powerpoint slides, whiteboard

Language: German or English

Literature:
Dietrich W. R. Paulus, Joachim Hornegger "Applied Pattern Recognition", Vieweg
Peter Vary, Ulrich Heute, Wolfgang Hess "Digitale Sprachsignalverarbeitung", Teubner Verlag
Xuedong Huang, Hsiao-Wuen Hon "Spoken Language Processing", Prentice Hall

Distributed Systems					**DS**
Studiensem. **1 - 3**	Regelstudiensem. 3	Turnus At least once every two years	Dauer 1 Semester	SWS 6	ECTS-Punkte 9

Modulverantwortliche/r Prof. Peter Druschel, Ph.D.

Dozent/inn/en Prof. Peter Druschel, Ph.D.
Allen Clement, Ph.D.

Zuordnung zum Curriculum Bachelor Eingebettete Systeme, WP Stammvorlesungen
Master Embedded Systeme, WP Stammvorlesungen

Zulassungsvoraussetzungen Operating systems or concurrent programming.

Leistungskontrollen / Prüfungen

- Regular attendance at classes and tutorials.
- Successful completion of a course project in teams of 2 students. (Project assignments due approximately every 2 weeks.)
- Passing grade on 2 out of 3 written exams: midterm, final exam, and a re-exam that takes place during the last two weeks before the start of lectures in the following semester.
- Final course grade: 50% project, 50% best 2 out of 3 exams.

Lehrveranstaltungen / SWS Lecture 4 h (weekly)
Tutorial 2 h (weekly)

Arbeitsaufwand 270 h = 90 h of classes and 180 h private study

Modulnote Wird aus Leistungen in Klausuren, Übungen und praktischen Aufgaben ermittelt. Die genauen Modalitäten werden vom Modulverantwortlichen bekannt gegeben.

Lernziele / Kompetenzen

Introduction to the principles, design, and implementation of distributed systems

Inhalt
- Communication: Remote procedure call, distributed objects, event notification, Inhalt dissemination, group communication, epidemic protocols.
- Distributed storage systems: Caching, logging, recovery, leases.
- Naming. Scalable name resolution.
- Synchronization: Clock synchronization, logical clocks, vector clocks, distributed snapshots.
- Fault tolerance: Replication protocols, consistency models, consistency versus availability trade-offs, state machine replication, consensus, Paxos, PBFT.
- Peer-to-peer systems: consistent hashing, self-organization, incentives, distributed hash tables, Inhalt distribution networks.
- Data centers. Architecture and infrastructure, distributed programming, energy efficiency.

Weitere Informationen

Unterrichtssprache: Englisch

Literaturhinweise:
Bekanntgabe jeweils vor Beginn der Vorlesung auf der Vorlesungsseite im Internet.

Einführung in die elektromagnetische Feldsimulation					**EMSim**
Studiensem. **1 – 3**	Regelstudiensem. **3**	Turnus **jährlich**	Dauer **1 Semester**	SWS **3**	ECTS-Punkte **4**

Modulverantwortliche/r	Prof. Dr. R. Dyczij-Edlinger
Dozent/inn/en	Prof. Dr. R. Dyczij-Edlinger
Zuordnung zum Curriculum	Bachelor Eingebettete Systeme, WP Stammvorlesungen Master Embedded Systeme, WP Stammvorlesungen
Zulassungsvoraussetzungen	keine
Leistungskontrollen / Prüfungen	Computerimplementierungen, mündliche Prüfung
Lehrveranstaltungen / SWS	Einführung in die elektromagnetische Feldsimulation / 2+1 SWS (Vorlesung+Übung)
Arbeitsaufwand	Präsenz: 45 h Vor- / Nachbereitung 45 h Prüfungsvorbereitung 30 h GESAMT 120 h
Modulnote	Computerimplementierungen 40 % Mündliche Prüfung 60 %

Lernziele/Kompetenzen

Studierende sind in der Lage, wichtige Klassen von Feldproblemen zu klassifizieren und kennen typische Fallbeispiele aus Wärmelehre, Akustik und Elektrodynamik. Sie sind mit den Gemeinsamkeiten und besonderen Eigenheiten der resultierenden Typen von (Anfangs-)Randwert-Problemen vertraut, und verstehen die Grundlagen von Differenzial- und Integralgleichungsverfahren zur numerischen Lösung von Problemstellungen der klassischen Maxwellschen Theorie.

Inhalt

Numerische lineare Algebra (Eigenwert-, Singulärwert-, QR- und LR-Zerlegungen, schwach besetzte Matrizen, Krylov-Unterraum-Verfahren); ausgesuchte lineare Randwert- und Anfangsrandwertprobleme (sachgemäß und unsachgemäß gestellte Probleme, elliptische, parabolische, hyperbolische und unklassifizierte Gleichungen); Separationsansätze; Konsistenz, Stabilität und Konvergenz numerischer Verfahren; Finite-Differenzen-Methoden (Diskretisierung, Anfangs- und Randbedingungen, explizite und implizite Zeitintegrationsverfahren, Stabilitätsanalyse); Variationsmethoden (Euler-Lagrange-Gleichungen, essentielle und natürliche Randbedingungen, Ritzsches Verfahren); Methode der gewichteten Residuen (Kollokation, Galerkin, Galerkin-Bubnow); Finite-Elemente-Methoden (Diskretisierung, Formfunktionen, Elementmatrizen, Einbringen von Randbedingungen und Quellen); Integralgleichungsmethoden (Greensche Funktionen, Klassifizierung); Randelemente-Methoden (Diskretisierung, Singularitäten)

Weitere Informationen

Vorlesungsskripten erhältlich, Übungsbeispiele und alte Prüfungen vom Internet abrufbar.
Treffethen, Bau: Numerical Linear Algebra; Demmel: Applied Numerical Linear Algebra; Farlow: Partial Differential Equations for Scientists and Engineers; Courant, Hilbert: Methoden der mathematischen Physik; Stakgold: Green's Functions and Boundary Value Problems; Strang, Fix: An Analysis of the Finite Element Method; Grossmann, Roos: Numerik partieller Differentialgleichungen; Bossavit, Alain: Computational Electromagnetism

Elektrische Antriebe					**EA**
Studiensem. **1 - 3**	Regelstudiensem. **3**	Turnus **Jedes WS**	Dauer **1 Semester**	SWS **3**	ECTS-Punkte **4**

Modulverantwortliche/r	Prof. Dr.-Ing. Matthias Nienhaus	
Dozent/inn/en	Prof. Dr.-Ing. Matthias Nienhaus	
Zuordnung zum Curriculum	Bachelor Eingebettete Systeme, WP Stammvorlesungen Master Embedded Systeme, WP Stammvorlesungen	
Zulassungsvoraussetzungen	Keine formalen Voraussetzungen	
Leistungskontrollen / Prüfungen	Benotete Prüfung (Klausur)	
Lehrveranstaltungen / SWS	Vorlesung: 2 SWS, Übung: 1 SWS	
Arbeitsaufwand	Präsenzzeit Vorlesung 15 Wochen á 2 SWS Präsenzzeit Übung 15 Wochen á 1 SWS Vor- und Nachbereitung Vorlesung und Übung Klausurvorbereitung	30 h 15 h 45 h 30 h
	Summe	120 h (4 CP)
Modulnote	Klausurnote	

Lernziele/Kompetenzen

Es werden die Grundlagen zu Aufbau, Wirkungsweise und Betriebsverhaltens von Gleichstrom-, Synchron- und Asynchronmaschinen sowie deren elektrische Ansteuerung vermittelt. Studierende erwerben Basiswissen für eine anforderungsgerechte Spezifikation und Auswahl elektrischer Antriebe.

Inhalt

- Physikalische Grundlagen
- Gleichstrommaschinen
- Asynchronmaschinen
- Synchronmaschinen
- Ansteuerungen

Weitere Informationen

Unterrichtssprache: Deutsch

Literaturhinweise:
Merz, H., Lipphardt, G.: Elektrische Maschinen und Antriebe, VDE, 2009
Fischer, R.: Elektrische Maschinen, Hanser, München, 2009
Riefenstahl, U.: Elektrische Antriebssysteme, Vieweg+Teubner, 2010

Messtechnik und Sensorik					**MTS**
Studiensem. **1 -3**	Regelstudiensem. **3**	Turnus **jährlich**	Dauer **1 Semester**	SWS **4**	ECTS-Punkte **6**

Modulverantwortliche/r	Prof. Dr. rer. nat. Andreas Schütze
Dozent/inn/en	Prof. Dr. rer. nat. Andreas Schütze und Mitarbeiter
Zuordnung zum Curriculum	Bachelor Eingebettete Systeme, WP Stammvorlesungen Master Embedded Systeme, WP Stammvorlesungen
Zulassungsvoraussetzungen	Keine formalen Voraussetzungen
Leistungskontrollen / Prüfungen	benotete Klausur, zusätzlich benotete Hausaufgaben zum Erwerb von Bonuspunkten für die Klausur
Lehrveranstaltungen / SWS	4 SWS, V3 Ü1
Arbeitsaufwand	Vorlesung + Übungen 15 Wochen 4 SWS 60h Vor- und Nachbereitung 60h Klausurvorbereitung 60 h
Modulnote	Klausurnote

Lernziele/Kompetenzen

Erlangung von Grundkenntnissen über den Messvorgang an sich (Größen, Einheiten, Messunsicherheit) sowie über die wesentlichen Komponenten vor allem digitaler elektrischer Messsysteme. Kennen lernen verschiedener Methoden und Prinzipien für die Messung nicht-elektrischer Größen; Bewertung unterschiedlicher Methoden für applikationsgerechte Lösungen. Vergleich unterschiedlicher Messprinzipien für gleiche Messgrößen inkl. Bewertung der prinzip-bedingten Messunsicherheiten und störender Quereinflüsse sowie ihrer Kompensationsmöglichkeiten durch konstruktive und schaltungstechnische Lösungen.

Inhalt

Messtechnik:
- Einführung: Was heißt Messen?; Größen und Einheiten (MKSA- und SI-System);
- Fehler, Fehlerquellen, Fehlerfortpflanzung, Messunsicherheit nach GUM;
- Messen von Konstantstrom, -spannung und Widerstand;
- Gleich- und Wechselstrombrücken;
- Mess- und Rechenverstärker (Basis: idealer Operationsverstärker);
- Grundlagen der Digitaltechnik (Logik, Gatter, Zähler);
- AD-Wandler (Flashwandler, sukzessive Approximation, Dual-Slope-Wandler);
- Digitalspeicheroszilloskop;

Sensorik:
- Temperaturmessung;
- Strahlungsmessung (berührungslose Temperaturmessung);
- magnetische Messtechnik: Hall- und MR-Sensoren;
- Messen physikalischer (mechanischer) Größen:
    - Weg & Winkel
    - Kraft & Druck (piezoresistiver Effekt in Metallen und Halbleitern)
    - Beschleunigung &Drehrate (piezoelektrischer Effekt, Corioliseffekt)
    - Durchfluss (Vergleich von 6 Prinzipien)

Weitere Informationen

Unterrichtssprache deutsch;
Vorlesungsfolien, Übungsaufgaben und Musterlösungen zum Kopieren und Downloaden

Übungen in Kleingruppen (14-täglich) mit korrigierten Hausaufgaben.

Literatur:
E. Schrüfer: „Elektrische Messtechnik“, Hanser Verlag, München, 2004
H.-R. Tränkler: „Taschenbuch der Messtechnik“, Verlag Oldenbourg München, 1996
W. Pfeiffer: „Elektrische Messtechnik“, VDE-Verlag Berlin, 1999
R. Lerch, Elektrische Messtechnik, Springer Verlag, neue Auflage 2006
J. Fraden: „Handbook of Modern Sensors“, Springer Verlag, New York, 1996
T. Elbel: „Mikrosensorik“, Vieweg Verlag, 1996
H. Schaumburg; „Sensoren“ und „Sensoranwendungen“, Teubner Verlag Stuttgart, 1992 und 1995
J.W. Gardner: „Microsensors – PrinciplesandApplications“, John Wiley&Sons, Chichester, UK, 1994.

Ein besonderer Schwerpunkt in der Sensorik liegt auf der Betrachtung miniaturisierter Sensoren und Sensortechnologien.

Elektronik / Bauelemente					ENK
Studiensem. **1 – 3**	Regelstudiensem. **3**	Turnus **jährlich**	Dauer **1 Semester**	SWS **2**	ECTS-Punkte **3**

Modulverantwortliche/r Prof. Dr.-Ing. Michael Möller

Dozent/inn/en Prof. Dr.-Ing. Michael Möller
Prof. Dr.-Ing. habil. Steffen Wiese

Zuordnung zum Curriculum Bachelor Eingebettete Systeme, WP Stammvorlesungen
Master Embedded Systeme, WP Stammvorlesungen

Zulassungsvoraussetzungen Keine formalen Voraussetzungen

Leistungskontrollen / Prüfungen Benotete Prüfungen Modulelementprüfungen

Lehrveranstaltungen / SWS 2 SWS

Arbeitsaufwand Präsenzzeit Vorlesung und Übung 15 Wochen à 2 SWS
zzgl. Vor- und Nachbereitung und Klausurvorbereitung
insgesamt 90h

Modulnote Gewichteter Mittelwert der Einzelnoten nach Studienordnung

Lernziele/Kompetenzen

Vorstellung von Konzepten und Aufbau aktiver und passiver elektronischer Bauelemente, Erlernung des Zusammenhangs zwischen physikalischem Grundprinzip, Kennlinie und schaltungstechnischer Funktion. Darstellung ausgewählter physikalischer Eigenschaften von charakteristischen Bauelement-Funktionswerkstoffen. Erlernen erster Bauelementanwendungen in einfachen Grundschaltungen. Vorstellung von Sonderbauelementen zur Energieversorgung und für die Leistungselektronik

Inhalt

.

- Einführung (Gegenstand der LV „Bauelemente“, Physikalische Funktionsbeschreibung von Bauelementen, Verarbeitung von Bauelementen, Zuverlässigkeit von Bauelementen)
- Diskrete aktive Bauelemente (Diode, Bipolartransistor, Feldeffekttransistor)
- Diskrete passive Bauelemente (Widerstände, Kapazitäten, Induktivitäten)
- Integrierte Schaltungen als Bauelemente (Analoge integrierte Schaltungen, Digitale integrierte Schaltungen)
- Bauelemente der Energieversorgung (Netzteil- und Spannungswandler-Komponenten, Elektrochemische Generatoren, Batterien, Akkumulatoren, Brennstoffzellen, Photovoltaische Generatoren, Thermoelektrische Generatoren, Elektromechanische Generatoren)
- Leistungsbauelemente (Der Logik- und der Leistungsteil in Schaltungen, Leistungstransistoren und –dioden, Thyristor, IGBT, Relais, Kühlkörper)

Weitere Informationen

Literatur

Beuth, Klaus: Bauelemente (Elektronik 2), Würzburg: Vogel 2010, 19. Aufl.
Möschwitzer, Albrecht: Mikroelektronik, Berlin: Verlag Technik 1987, 1. Aufl.
Möschwitzer, Albrecht: Einführung in die Elektronik, Berlin: Verlag Technik 1988, 6. Aufl.

High-Speed Electronics					
Semester	Reference semester	Term	Duration	Weekly hours	Credits
1 – 3	**3**	**WS**	**1 Semester**	**3**	**4**

Responsible lecturer Prof. Dr. M. Möller

Lecturer(s) Prof. Dr. M. Möller

Level of the unit
Bachelor Eingebettete Systeme, WP Stammvorlesungen
Master Embedded Systeme, WP Stammvorlesungen

Entrance requirements
For graduate students: none
Bachelor level in Electronics and Circuits

Assessment / Exams
Theoretical and practical (CAD examples) exercises
• Regular attendance of lecture and tutorial
• Final oral exam
• A re-exam takes place during the last two weeks before the start of lectures in the following semester.

Course type / Weekly hours
Lecture 2h (weekly)
Tutorial 1h (weekly)

Total workload 120 h = 45 h classes and 75 h private study

Grading Final exam mark

Aims/Competences to be developed

To know and understand limitations on maximum speed and performance of integrated circuits. To know and to be able to apply design methods and concepts to enhance speed and performance of a circuit. To be familiar with basic circuit stages and methods for combining them to gain a specific functionality and performance. To understand basic circuit concepts for high-speed data- and signal-transmission and –processing with special regard to the transmitter- and receiver-electronics. To be able to design such circuits. To acquire the fundamentals of circuit design as a preparation for the related hands-on training on “High-speed analogue circuit design”.

Content:

- Bipolar transistor model and properties at technological speed limit.
- Concept of negative supply voltage and differential signalling.
- Method of symbolic calculation and modelling of transistor stages.
- Basic electrical properties of transistor stages with special regard to high-frequency considerations.
- Concept of conjugate impedance mismatch.
- Functional stages for broadband operation up to 160 Gbit/s (e.g. photodiode–amplifier, modulator driver, linear and limiting gain stages and amplifier, circuits for gain control, equalizing and analogue signal processing, Multiplexer, Demultiplexer, logic gates(e.g. exor), phase detector, Oscillator (VCO), phase-locked-loop (PLL)).

Additional information

Used Media: Beamer, blackboard, lecture notes, Computer (CAD examples)

Language: English

Literature:

- Lecture notes
- High Speed Integrated Circuit Technology Towards 100 GHz Logic, M. Rodwell, World Scientific
- Intuitive Analog Circuit Design, Marc T. Thompson, Elsevier 2006
- Related articles from journals and conferences.

High-Frequency Engineering					
Semester **1 – 3**	Reference semester **3**	Term **WS**	Duration **1 Semester**	Weekly hours **3**	Credits **4**

Responsible lecturer Prof. Dr. M. Möller

Lecturer(s) Prof. Dr. M. Möller

Level of the unit Bachelor Eingebettete Systeme, WP Stammvorlesungen
Master Embedded Systeme, WP Stammvorlesungen

Entrance requirements For graduate students: none
Bachelor level in Electronics and Circuits

Assessment / Exams Theoretical and practical (CAD examples) exercises
- Regular attendance of lecture and tutorial
- Final oral exam
- A re-exam takes place during the last two weeks before the start of lectures in the following semester.

Course type / Weekly hours Lecture 2h (weekly)
Tutorial 1h (weekly)

Total workload 120 h = 45 h classes and 75 h private study

Grading Final exam mark

Aims/Competences to be developed
Acquiring basic knowledge on fundamental high-frequency and network-theory methods to characterize and model distributed and lumped element networks. Applying these methods to modelling, design and measurement of high-speed circuits. Introduction to general optimization criteria and optimization strategy. To prepare for hands-on training on “RF-circuits and measurement techniques”.

Content
Introduction:
Retardation, Skin-, Proximity-Effect, Signal path lengths, lumped and distributed properties, Interconnect and Transmission Line modelling

• Waves and S-parameters:
Generalised waves, power, reflection, Smith diagram, matching, S-parameters, ABCD-parameters, Signal flow graph methods.

• Network properties:
Tellegen theorem, linearity, reciprocity, symmetry, unitarity, modal network description (differential operation),

• Network measurement methods and components:
time domain reflectometry (TDR), line-coupler, power splitter/divider, Vector Network Analyzer (VNA)
• Electrical Noise
Noise processes, characterization and properties, network models

• Optimization criteria (e.g. noise, phase- and frequency response, linearity, stability, matching CMRR, PSRR, pulse fidelity, eye-diagram)

• Optimization strategy:
Trade-off, degees of freedom (DOF), Introducing DOFs by decoupling, optimization example

Additional information

Used Media: Beamer, blackboard, lecture notes, Computer (CAD examples)

Language: English

Literature:

- Lecture notes
- Hochfrequenztechnik 2, Zinke, Brunswig, 5. Auflage, Springer
- Microwave Engineering, David M. Pozar, 3rd ed., Wiley
- Grundlagen der Hochfrequenzmesstechnik, B. Schiek, Springer
- Rauschen, R. Müller, Springer
- Related articles from journals and conferences.

Embedded Systems					**CS 650 /ES**
Studiensem.	Regelstudiensem.	Turnus	Dauer	SWS	ECTS-Punkte
1 – 3	3	At least once every two years	1 Semester	6	9

Modulverantwortliche/r Prof. Bernd Finkbeiner, Ph.D

Dozent/inn/en Prof. Bernd Finkbeiner, Ph.D

Zuordnung zum Curriculum
Bachelor Eingebettete Systeme, Pflicht
Master Embedded Systeme, WP Stammvorlesungen

Zulassungsvoraussetzungen

Leistungskontrollen / Prüfungen

- Written exam at the end of the course.
- Demonstration of the implemented system.
- A re-exam takes place during the last two weeks before the start of lectures in the following semester.

Lehrveranstaltungen / SWS
Lecture 4 h (weekly)
Tutorial 2 h (weekly)
The course is accompanied by a laboratory project, in which a non-trivial embedded system has to be realized.

Arbeitsaufwand 270 h = 90 h classes and 180 h private study

Modulnote Wird aus Leistungen in Klausuren, Übungen und praktischen Aufgaben ermittelt. Die genauen Modalitäten werden vom Modulverantwortlichen bekannt gegeben.

Lernziele / Kompetenzen

The students should learn methods for the design, the implementation, and the validation of safety-critical embedded systems.

Inhalt

Embedded Computer Systems are components of a technical system, e.g. an air plane, a car, a household machine, a production facility. They control some part of this system, often called the plant, e.g. the airbag controller in a car controls one or several airbags. Controlling means obtaining sensor values and computing values of actuator signals and sending them.
Most software taught in programming courses is transformational, i.e. it is started on some input, computes the corresponding output and terminates. Embedded software is reactive, i.e. it is continuously active waiting for signals from the plant and issuing signals to the plant.
Many embedded systems control safety-critical systems, i.e. malfunctioning of the system will in general cause severe damage. In addition, many have to satisfy real-time requirements, i.e. their reactions to input have to be produced within fixed deadlines.
According to recent statistics, more than 99% of all processors are embedded. Processors in the ubiquitous PC are a negligible minority. Embedded systems have a great economical impact as most innovations in domains like avionics, automotive are connected to advances in computer control. On the other hand, failures in the design of such systems may have disastrous consequences for the functioning of the overall system. Therefore, formal specification techniques and automatic synthesis of software are used more than in other domains.
The course will cover most aspects of the design and implementation of embedded systems, e.g. specification mechanisms, embedded hardware, operating systems, scheduling, validation methods.

Weitere Informationen

Unterrichtssprache: Englisch

Literaturhinweise:
Bekanntgabe jeweils vor Beginn der Vorlesung auf der Vorlesungsseite im Internet.

Future Media Internet - FMI					
Studiensem.	Regelstudiensem.	Turnus	Dauer	SWS	ECTS-Punkte
1 - 3	3	WS	1 Semester	4V2Ü	9

Responsible Lecturer Prof. Dr.-Ing. Thorsten Herfet

Lecturer Prof. Dr.-Ing. Thorsten Herfet

Level of the unit / mandatory or not Bachelor Eingebettete Systeme, WP Stammvorlesungen
Master Embedded Systeme, WP Stammvorlesungen

Entrance requirements For graduate students: none

Assessment / Exams Weekly exercise sheets, two blocks, each one must be passed individually, oral exam at the end of the modul

Course Typ / weekly hours Extended Course, 4V2Ü

Total workload 9 CPs = 270 hrs for an average student

Grade of the module Graded absolute 1.0-n.b. and relative A-F

Aims / Competences to be developed

The course deals with Media Transport over the Internet. After the course students know how data- and mediatransport is solved in today's Internet and have a good understanding of so called erasure channels.
Besides the pure transport protocol design the course complements the fundaments laid in TCI and TCII be introducing state-of-the-art error codes (Van-der-Monde-Codes, Fountain Codes) and by engineering tasks like the design of a Digital PLL.

Content

The course introduces media transmission over packet channels, specifically the Internet. After establishing a Quality of Service framework built on ITU requirements the course models erasure channels without and with memory. Key characteristics like the channel capacity and the minimum redundancy information are derived.

The second part of the course introduces current media transport protocol suites (TCP, UDP, RTP, RTSP) and middleware (ISMA, DLNA, UPnP, DVB-IPI).

In the second half of the course audiovisual coders used in the Internet are introduced (H.264, AAC), state-of-the-art forward error coding schems (Van-der-Monde-Codes, Fountain Codes) are explained and essential elements like a Digital Phase-locked Loop are developed.

Additional Information

Teaching language: English

Literature:
The course will come with a self contained manuscript. The most essential monographs used for and referenced within the manuscript are available in the Computer Science Library of Saarland University.

Image Processing and Computer Vision					**CS 572 / IPCV**
Studiensem.	Regelstudiensem.	Turnus	Dauer	SWS	ECTS-Punkte
1 – 3	3	At least once every two years	1 Semester	6	9

Modulverantwortliche/r Prof. Dr. Joachim Weickert

Dozent/inn/en Prof. Dr. Joachim Weickert

Zuordnung zum Curriculum
Bachelor Eingebettete Systeme,
WP Stammvorlesungen
Master Embedded Systeme, WP Stammvorlesungen

Zulassungsvoraussetzungen For graduate students: none

Leistungskontrollen / Prüfungen

- Regular attendance of classes and tutorials.
- At least 50% of all possible points from the weekly assignments have to be gained to qualify fort he final exam.
- Passing the final exam
- A re-exam takes place during the last two weeks before the start of lectures in the following semester.

Lehrveranstaltungen / SWS
Lecture 4 h (weekly)
Tutorial 2 h (weekly)
Tutorials in groups of up to 20 students

Arbeitsaufwand 270 h = 90 h of classes and 180 h private study

Modulnote
Wird aus Leistungen in Klausuren, Übungen und praktischen Aufgaben ermittelt. Die genauen Modalitäten werden vom Modulverantwortlichen bekannt gegeben.

Lernziele / Kompetenzen

Broad introduction to mathematical methods in image processing and computer vision. The lecture qualifies students for a bachelor thesis in this field. Together with the completion of advanced or specialised lectures (9 credits at least) it is the basis for a master thesis in this field.

Inhalt

1. Basics
   1.1 Image Types and Discretisation
   1.2 Degradations in Digital Images
2. Image Transformations
   2.1 Fourier Transform
   2.2 Image Pyramids
   2.3 Wavelet Transform
3. Colour Perception and Colour Spaces

4. Image Enhancement
   4.1 Point Operations
   4.2 Linear Filtering
   4.3 Wavelet Shrinkage, Median Filtering, M-Smoothers
   4.4 Mathematical Morphology
   4.5 Diffusion Filtering
   4.6 Variational Methods
   4.7 Deblurring
5. Feature Extraction
   5.1 Edges
   5.2 Corners
   5.3 Lines and Circles
6. Texture Analysis
7. Segmentation
   7.1 Classical Methods
   7.2 Variational Methods
8. Image Sequence Analysis
   8.1 Local Methods
   8.2 Variational Methods
9. 3-D Reconstruction
   9.1 Camera Geometry
   9.2 Stereo
   9.3 Shape-from-Shading
10. Object Recognition
   10.1 Eigenspace Methods
   10.2 Moment Invariances

Weitere Informationen

Unterrichtssprache: Englisch

Literaturhinweise:
Bekanntgabe jeweils vor Beginn der Vorlesung auf der Vorlesungsseite im Internet.

Mikroelektronik 2					
Studiensem. **1 – 3**	Regelstudiensem. **3**	Turnus **Jedes SS**	Dauer **1 Semester**	SWS **3**	ECTS-Punkte **4**

Modulverantwortliche/r Prof. Dr.-Ing. Chihao Xu

Dozent/inn/en Prof. Dr.-Ing. Chihao Xu

Zuordnung zum Curriculum Bachelor Eingebettete Systeme, WP Stammvorlesungen
Master Embedded Systeme, WP Stammvorlesungen

Zulassungsvoraussetzungen Keine formalen Vorraussetzungen

Leistungskontrollen / Prüfungen Klausur am Semesterende

Lehrveranstaltungen / SWS
[ggf. max. Gruppengröße]
1 Vorlesung: 2SWS
1 Übung: 1SWS

Arbeitsaufwand
Präsenzzeit Vorlesung: 15 Wochen à 2 SWS = 30h
Präsenzzeit Übung: 14 Wochen à 1 SWS = 14 Stunden
Vor- und Nachbereitung Vorlesung und Übung: 46 Stunden
Klausurvorbereitung: 30 Stunden

Modulnote Aus Klausurnote

Lernziele/Kompetenzen
Verständnis der Abläufe bei Herstellungs- und Entwicklungsprozessen von integrierten Digitalschaltungen – CAD in der Mikroelektronik

Inhalt

- Wertschöpfungskette der Fertigung (Waferprozess, Montage, Testen)
- Einzelprozess-Schritte, Gehäuse, analoges Testen, Abgleich
- Abstraktionsebene in der ME (physikalisch, Symbol, Funktion), Y-Baum
- Entwurfsablauf, Entwurfsstile
- Tools für den Entwurf integrierter Schaltungen, Integration der Tools
- Schaltungssimulation (Prinzip, Numerik, Analysen incl. Sensitivity-, WC-, Monte-Carlo- und Stabilitätsanalyse)
- Logiksimulation (höhere Sprache, ereignisgesteuert, Verzögerung)
- Hardware Beschreibungssprache VHDL
- Logikoptimierung (Karnaugh Diagram, Technology Mapping) Test digitaler Schaltungen, design for testibility, Testmuster, Autotest
- Layout: Floorplanning, Polygone, Pcell/Cells, Generators, Design Rules, Constraints
- Parasitics, Backannotation, Matching, Platzierung und Verdrahtung, OPC

Weitere Informationen [Unterrichtssprache, Literaturhinweise, Methoden, Anmeldung]
Unterrichtssprache: deutsch
Literatur: Skriptum des Lehrstuhls zur Vorlesung, Vorlesungsfolien

Mikroelektronik 3					.
Studiensem. **1 – 3**	Regelstudiensem. **3**	Turnus **Jedes WS**	Dauer **1 Semester**	SWS **3**	ECTS-Punkte **4**

Modulverantwortliche/r Prof. Dr.-Ing. Chihao Xu

Dozent/inn/en Prof. Dr.-Ing. Chihao Xu

Zuordnung zum Curriculum Bachelor Eingebettete Systeme, WP Stammvorlesungen
Master Embedded Systeme, WP Stammvorlesungen

Zulassungsvoraussetzungen Keine formalen Vorraussetzungen

Leistungskontrollen / Prüfungen benotete mündliche Abschlussprüfung

Lehrveranstaltungen / SWS
[ggf. max. Gruppengröße]
Mikroelektronik III
1 Vorlesung: 2SWS
1 Übung: 1SWS

Arbeitsaufwand

Präsenzzeit Vorlesung 15 Wochen à 2 SWS:	30h
Präsenzzeit Übung 15 Wochen à 1 SWS:	15h
Vor- und Nachbereitung Vorlesung und Übung:	45h
Prüfungsvorbereitung:	30h
Summe:	120h (4CP)

Modulnote Abschlussprüfungsnote

Lernziele/Kompetenzen
Verständnisse und Kenntnisse im Verhalten, in der Beschreibung und im Entwurf integrierter analoger und mixed-signal CMOS-Schaltungen.

Inhalt
Vorlesung und Übung Mikroelektronik III
- Einführung in die Analogtechnik
- MOS-Technologie (Eigenschaften, Bauelemente Funktionale Sicht)
- MOS-Transitoren in Schaltungen (CMOS-Schaltungskomponenten)
- Frequenzgang der Verstärker (allgemein, Kapazität und Pol, Common Source, Kaskode, Rückkopplung)
- OP-Verstärker (Einstufiger- und Zweistufiger Verstärker, Ausgangsstufe, Kenngrößen)
- Referenzschaltungen (einfache Referenzschaltungen, Bandgap-Rferenz, Spannungsregler, I-Referenz, g_m-Referenz)
- Switched Capacitor Schaltungen (Swiched Capacitor (SC) Grundlagen, SC Integrator und Verstärker, SC Filter, Sample und Hold Schaltungen)
- AD-Wandler (Einführung, Komparator, paralleler AD-Wandler, sukzessive Approximation AD-Wandler, Integrierter Dual Slop AD-Wandler)
- DA-Wandler (Einführung, paralleler AD-Wandler, serieller DA-Wandler)

Weitere Informationen [Unterrichtssprache, Literaturhinweise, Methoden, Anmeldung]
Unterrichtssprache: deutsch
Literatur: Skriptum des Lehrstuhls zur Vorlesung, Vorlesungsfolien, weiterführende Literatur wird zu Beginn der ersten Vorlesung bekannt gegeben
Methoden: Information durch Vorlesung, Vertiefung durch Eigentätigkeit (Nacharbeiten, aktive Teilnahme an den Übungen)

Mikroelektronik 4					
Studiensem. **1 – 3**	Regelstudiensem. **3**	Turnus **Jedes SS**	Dauer **1 Semester**	SWS **3**	ECTS-Punkte **4**

Modulverantwortliche/r Prof. Dr.-Ing. Chihao Xu

Dozent/inn/en Prof. Dr.-Ing. Chihao Xu

Zuordnung zum Curriculum Bachelor Eingebettete Systeme, WP Stammvorlesungen
Master Embedded Systeme, WP Stammvorlesungen

Zulassungsvoraussetzungen Keine formalen Vorraussetzungen

Leistungskontrollen / Prüfungen Präsentation einer Arbeit und mündliche Befragung am Semesterende

Lehrveranstaltungen / SWS
[ggf. max. Gruppengröße]
1 Vorlesung: 2SWS
1 Übung: 1SWS

Arbeitsaufwand
Präsenzzeit Vorlesung: 15 Wochen à 2 SWS = 30 h
Präsenzzeit Übung: 14 Wochen à 1 SWS = 14 Stunden
Vor- und Nachbereitung Vorlesung und Übung: 46 Stunden
Klausurvorbereitung: 30 Stunden

Modulnote Abschlußprüfung

Lernziele/Kompetenzen

Wie Mikroelektronik in Systemen, insbesondere zur Ansteuerung reeller Anwendungen wie Displays eingesetzt wird. Es schließt Systempartitionierung, Design und Algorithmen ein.

Inhalt

- HV circuit (charge pump, level shifter, hv driver)
- Automotiver Lampentreiber
- Power Management (LDO, Schaltnetzteile)
- Low Power Design
- Licht, Farbe und Visuelle Effekte
- PM-LCD Display Steuerung
- AM-LCD Display (TFT) Steuerung
- PM-OLED Display Steuerung
- AM-OLED Display Steuerung
- Weitere Themen je nach Auswahl der Studierenden

Weitere Informationen [Unterrichtssprache, Literaturhinweise, Methoden, Anmeldung]

Unterrichtssprache: deutsch
Literatur: Vorlesungsfolien, Veröffentlichungen

Mikromechanische Bauelemente					**MM**
Studiensem. **1 – 3**	Regelstudiensem. **3**	Turnus **jährlich**	Dauer **1 Semester**	SWS **3**	ECTS-Punkte **4**

Modulverantwortliche/r	Prof. Dr. Helmut Seidel
Dozent/inn/en	Prof. Dr. Helmut Seidel
Zuordnung zum Curriculum	Bachelor Eingebettete Systeme, WP Stammvorlesungen Master Embedded Systeme, WP Stammvorlesungen
Zulassungsvoraussetzungen	Keine formalen Voraussetzungen
Leistungskontrollen / Prüfungen	Schriftlich oder mündlich
Lehrveranstaltungen / SWS	3 SWS, V2 Ü1

Arbeitsaufwand	Vorlesung + Übungen 15 Wochen 3 SWS	45 h
	Vor- und Nachbereitung	45 h
	Klausurvorbereitung	30 h
	GESAMT	120 h
Modulnote	Prüfungsnote	

Lernziele/Kompetenzen

Erlangen von Grundkenntnissen im Bereich Bauelemente der Mikrosystemtechnik mit Schwerpunkt in der Mikroaktorik; Einführung in die Mikrofluidik.

Inhalt

- Einführung, Marktübersicht
- Skalierungsgesetze
- Passive mechanische Bauelemente
- Prinzipien der Mikroaktorik (Elektrostatik, Magnetik, Piezoelektrik, Formgedächtnislegierungen)
- Aktive mechanische Bauelemente (Schalter, Relais, etc.)
- Passive fluidische Bauelemente
- Fluidische Aktoren (Ventile, Pumpen)
- Sensoren in der Fluidik

Weitere Informationen

Literatur:

Mescheder, Ulrich: "Mikrosystemtechnik - Konzepte und Anwendungen"
Büttgenbach, Stephanus: "Mikromechanik - Einführung in Technologie und Anwendungen"
Gerlach, G.; Dötzel, W.: "Grundlagen der Mikrosystemtechnik"
Menz, Wolfgang; Mohr, Jürgen: "Mikrosystemtechnik für Ingenieure"
M. Madou: Fundamentals of Microfabrication

Mikrotechnologie					**FT**
Studiensem. **1 – 3**	Regelstudiensem. **3**	Turnus **WS**	Dauer **1 Semester**	SWS **3**	ECTS-Punkte **4**

Modulverantwortliche/r	Prof. Dr. Helmut Seidel
Dozent/inn/en	Prof. Dr. Helmut Seidel und N. N.
Zuordnung zum Curriculum	Bachelor Eingebettete Systeme, WP Stammvorlesungen Master Embedded Systeme, WP Stammvorlesungen
Zulassungsvoraussetzungen	Keine formalen Voraussetzungen
Leistungskontrollen / Prüfungen	Mündliche oder schriftliche Prüfung
Lehrveranstaltungen / SWS	3 SWS, V2 Ü1
Arbeitsaufwand	Vorlesung + Übungen 15 Wochen 3 SWS 45 h Vor- und Nachbereitung 45 h Klausurvorbereitung 30 h GESAMT 120
Modulnote	Prüfungsnote

Lernziele/Kompetenzen

Erlangen von vertieften Grundkenntnissen in der Herstellungstechnologie von Mikrosystemen und mikroelektronischen Schaltkreisen mit Schwerpunkt in der Halbleitertechnologie

- Einführung, Technologieüberblick, Reinraumtechnik
- Materialien der Mikrosystemtechnik, Kristallografie
- Herstellung von kristallinem Silizium (Czochralski, Float-Zone)
- Thermische Oxidation und Epitaxie
- Schichtabscheidung: CVD (Chemical Vapor Deposition)
- Physikalische Schichtabscheidung: PVD (Physical Vapor Deposition)
- Dotiertechniken: Diffusion, Ionenimplantation, Annealing
- Lithografie: Kontakt- und Proximity-Belichtung, Waferstepper, Lacktechnik
- Nassätzen, Reinigen (isotrop, anisotrop, elektrochemisch)
- Trockenätzen: Ionenstrahlätzen, Reaktives Ionenätzen, Plasmaätzen
- Bulk-/Oberflächen-Mikromechanik,
- LIGA-Verfahren, Abformtechniken
- Waferbonden, Planarisierungstechniken (Chemisch-mechanisches Polieren)

Weitere Informationen

Literatur:

Mescheder, Ulrich: "Mikrosystemtechnik - Konzepte und Anwendungen"
Büttgenbach, Stephanus: "Mikromechanik - Einführung in Technologie und Anwendungen"
Gerlach, G.; Dötzel, W.: "Grundlagen der Mikrosystemtechnik"
Menz, Wolfgang; Mohr, Jürgen: "Mikrosystemtechnik für Ingenieure"

Pattern and Speech Recognition					PSR
Studiensem. **1 – 3**	Regelstudiensem. **3**	Turnus **Jedes WS**	Dauer **1 Semester**	SWS **4**	ECTS-Punkte **6**

Modulverantwortliche/r Prof. Dr. Dietrich Klakow

Dozent/inn/en Prof. Dr. Dietrich Klakow

Zuordnung zum Curriculum Bachelor Eingebettete Systeme, WP Stammvorlesungen
Master Embedded Systeme, WP Stammvorlesungen

Zulassungsvoraussetzungen Sound knowledge of mathematics as taught in engineering, computer science or physics.

Leistungskontrollen / Prüfungen Regular attendance of classes and tutorials
Presentation of a solution during a tutorial
Final exam (30 minutes, oral)

Lehrveranstaltungen / SWS Pattern and Speech Recognition Lecture &Tutorial

Arbeitsaufwand Lecture 2 h (weekly)
Tutorial 2 h (weekly)
Tutorials in groups of up to 15 students
180 h = 60 h of classes and 120 h private study

Modulnote Final exam

Lernziele/Kompetenzen
Theoretical knowledge of the basic machine learning algorithms
Ability to apply the learned methods to standard tasks

Inhalt
The leacture will closely follow the book by Christopher Bishops. Covered topics are
- Probability distributions
- Linear Models for regression
- Linear Models for Classification
- Kernel Methods
- Sparse Kernel Machines and Suport Vector Machines
- Graphical Models
- Mixture Models and the EM-Algorithm
- Sequential Data and Hidden Markov Models

Weitere Informationen

Used media: Powerpoint slides, whiteboard

Unterrichtssprache: English

Literaturhinweise: Christopher M. Bishop”Pattern Recognition and Machine Learning” , Springer

Operating Systems					**CS 551 / OS**
Studiensem.	Regelstudiensem.	Turnus	Dauer	SWS	ECTS-Punkte
1 – 3	3	At least once every two years	1 Semester	6	9

Modulverantwortlicher
Prof. Peter Druschel, Ph.D.

Dozent
Prof. Peter Druschel, Ph.D.
Björn Brandenburg, Ph.D.

Zuordnung zum Curriculum
Bachelor Eingebettete Systeme,
WP Stammvorlesungen
Master Embedded Systeme, WP Stammvorlesungen

Zulassungsvoraussetzungen
For graduate students: none

Leistungskontrollen / Prüfungen
Regular attendance at classes and tutorials
Successful completion of a course project in teams of 2 students
Passing 2 written exams (midterm and final exam)
A re-exam takes place during the last two weeks before the start of lectures in the following semester.

Lehrveranstaltungen /SWS
Lecture 4 h (weekly)
Tutorial 2 h (weekly)
Tutorials in groups of up to 20 students

Arbeitsaufwand
270 h = 90 h of classes and 180 h private study

Modulnote
Wird aus Leistungen in Klausuren, Übungen und praktischen Aufgaben ermittelt. Die genauen Modalitäten werden vom Modulverantwortlichen bekannt gegeben.

Lernziele / Kompetenzen

Introduction to the principles, design, and implementation of operating systems

Inhalt

Process management:
- Threads and processes, synchronization
- Multiprogramming, CPU Scheduling
- Deadlock

Memory management:
- Dynamic storage allocation
- Sharing main memory
- Virtual memory

I/O management:
- File storage management
- Naming
- Concurrency, Robustness, Performance

Virtual machines

Weitere Informationen

Unterrichtssprache: Englisch

Literaturhinweise:
Bekanntgabe jeweils vor Beginn der Vorlesusng auf der Vorlesungsseite im Internet

Security					**CS 559 / SEC**
Studiensem.	Regelstudiensem.	Turnus	Dauer	SWS	ECTS-Punkte
1 – 3	3	At least once every two years	1 Semester	6	9

Modulverantwortliche/r Prof. Dr. Matteo Maffei

Dozent/inn/en Prof. Dr. Michael Backes, Prof. Dr. Christian Hammer, Prof. Dr. Matteo Maffei

Zuordnung zum Curriculum Bachelor Eingebettete Systeme, WP Stammvorlesungen
Master Embedded Systeme, WP Stammvorlesungen

Zulassungsvoraussetzungen For graduate students: none

Leistungskontrollen / Prüfungen

- Regular attendance of classes and tutorials
- Passing the final exam
- A re-exam is normally provided (as written or oral examination).

Lehrveranstaltungen / SWS Lecture 4 h (weekly)
Tutorial 2 h (weekly)
Tutorials in groups of up to 20 students

Arbeitsaufwand 270 h = 90 h of classes and 180 h private study

Modulnote Wird aus Leistungen in Klausuren, Übungen und praktischen Aufgaben ermittelt. Die genauen Modalitäten werden vom Modulverantwortlichen bekannt gegeben.

Lernziele / Kompetenzen

The students will acquire a deep understanding and hands-on experience on a broad spectrum of attack and defense techniques for IT systems.

Inhalt

- Security principles
- Authentication and access control
- Network security
- Operating system security
- Web application security
- Malware
- Risk management
- Logging and log analysis
- Cryptographic protocols
- Security of information flow

Weitere Informationen

Unterrichtssprache: Englisch

Literaturhinweise:
Bekanntgabe jeweils vor Beginn der Vorlesung auf der Vorlesungsseite im Internet.

Software Engineering					CS 560 / SE
Studiensem.	Regelstudiensem.	Turnus	Dauer	SWS	ECTS-Punkte
1 – 3	3	At least once every two years	1 Semester	6	9

Modulverantwortliche/r Prof. Dr. Andreas Zeller

Dozent/inn/en Prof. Dr. Andreas Zeller

Zuordnung zum Curriculum Bachelor Eingebettete Systeme, WP Stammvorlesungen
Master Embedded Systeme, WP Stammvorlesungen

Zulassungsvoraussetzungen For graduate students: none

Leistungskontrollen / Prüfungen

- Successful project completion (including deliverables such as requirements, design, implementation)
- Successful project demonstration
- Regular attendance of classes
- Passing the final exam

Lehrveranstaltungen / SWS Lecture 2 h (weekly)
Project 4 h (weekly)
Project work in teams of 4–7 students

Arbeitsaufwand 270 h = 90 h of classes and 180 h private study

Modulnote Wird aus Leistungen in Klausuren und praktischen Aufgaben ermittelt. Die genauen Modalitäten werden vom Modulverantwortlichen bekannt gegeben.

Lernziele / Kompetenzen

The students know and apply modern software development techniques.

They are aware of systematic elicitation of requirements and how to document them.

They are aware of advanced quality assurance techniques such as test coverage, program analysis, and verification and know about the appropriate standards.

They know modern paradigms of programming and design, and know when to use them.

They know the standards of project management and project organization and can assess the state of given projects as well as suggest consequences to reach specific targets.

They apply these techniques in a project in small teams.

Lecture Inhalts

- Software Processes (Testing process, ISO 9000, maturity model, extreme programming)
- Modeling and design (requirements engineering, formal specification, proofs, model checking)
- Programming paradigms (aspect-oriented, generative, and component-based programming)
- Validation (Testing, Reliability assessment, tools)
- Software maintenance (configuration management, reengineering, restructuring)
- Project skills (organization, structure, estimations)
- Human resources (communication, assessment)
- Controlling (metrics, change requests, risk and quality management)

Weitere Informationen

Unterrichtssprache: Englisch

Literaturhinweise:
Bekanntgabe jeweils vor Beginn der Vorlesung auf der Vorlesungsseite im Internet.

Statistical Natural Language Processing					Abbrevation
Semester	Reference semester	Term	Duration	Weekly hours	Credits
5	**5**	**SS**	**1 Semester**	**4**	**6**

Responsible lecturer Prof. Dr. Dietrich Klakow

Lecturer(s) Prof. Dr. Dietrich Klakow

Level of the unit Bachelor Eingebettete Systeme, WP Stammvorlesungen
Master Embedded Systeme, WP Stammvorlesungen

Entrance requirements For graduate students: none

Assessment / Exams Written exam

Course type / Weekly hours 2 h lecture and 2 h Tutorial

Total workload Classes: 60 h
Problem solving and private studies 120 h
Total:180 h

Grading Final Exam Mark

Aims/Competences to be developed

Aquire core compenetencies in the mathemeatical basics of language processing and practice the implementation of essentioal methods.

Content

- language processing: basic terms
- mathematical foundations
- word sense disambiguation
- part-of-speech tagging
- named-entity recognition
- information retrieval
- text classification

Additional information

Language: English

Literature: Foundations of Statistical Natural Language Processing
Chris Manning and Hinrich Schütze

Systemtheorie und Regelungstechnik 1					SR1
Studiensem. **1 – 3**	Regelstudiensem. **3**	Turnus **jährlich**	Dauer **1 Semester**	SWS **4**	ECTS-Punkte **6**

Modulverantwortliche/r Prof. Dr.-Ing. habil. J. Rudolph

Dozent/inn/en Prof. Dr.-Ing. habil. J. Rudolph

Zuordnung zum Curriculum Bachelor Eingebettete Systeme, WP Stammvorlesungen
Master Embedded Systeme, WP Stammvorlesungen

Zulassungsvoraussetzungen Keine formalen Voraussetzungen

Leistungskontrollen / Prüfungen Schriftliche Prüfung

Lehrveranstaltungen / SWS Systemtheorie und Regelungstechnik 1: 4 SWS – 2V+2Ü

Arbeitsaufwand 180 h = 60 h Präsenz- und 120 h Eigenstudium

Modulnote Note der Prüfung

Lernziele/Kompetenzen

Verständnis für die systemtheoretischen Grundlagen linearer Systeme sowie für den Entwurf linearer Steuerungen und Regler.

Inhalt

Es werden lineare zeitinvariante Systeme (endlicher Dimension) mit je einer Eingangs- und einer Ausgangsgröße betrachtet.

- *Einführung:* Systembegriff und regelungstechnische Aufgabenstellungen, Linearität und Linearisierung, Zeitinvarianz, Eingangs-Ausgangs-Darstellung
- *Systeme niedriger Ordnung:* Trajektorienplanung, Steuerung, allgemeine Lösung, P-, PI-, PD- und PID-Regler, parametrische Unbestimmtheiten, Frequenzgang (Ortskurven und Bode-Diagramme)
- *Systeme beliebiger Ordnung:* Eingangs-Ausgangs-Darstellung, Regelungsform, Zustandskonzept, Beobachtbarkeits- und Beobachterform, Diagonalisierung und Jordan-Form, Phasenportrait für Systeme 2. Ordnung, Beobachtbarkeit, Stabilität (Definition, Ljapunov-Funktion, Ljapunov-Gleichung)

Der Lehrstoff wird in Vorlesungen und Übungen anhand technologischer Beispiele diskutiert und vertieft.

Weitere Informationen

Literaturhinweise:

[1] Föllinger, O., Regelungstechnik, Einführung in die Methoden und ihre Anwendung, Hüthig, Heidelberg (1994).
[2] Lunze, J., Regelungstechnik 1, Springer, Heidelberg (2007).
[3] Rugh, W. J., Linear System Theory, Prentice Hall, New Jersey (1993).
[4] Kailath, T., Linear Systems, Prentice-Hall, Englewood Cliffs (1980).

Neben einem ausgearbeiteten Skriptum werden umfangreiche Lösungen zu den Übungsaufgaben zur Verfügung gestellt. Außerdem besteht die Möglichkeit, das Erlernte an einem Versuchsstand praktisch anzuwenden und weiter zu vertiefen.

Systemtheorie und Regelungstechnik 2					SR2
Studiensem. **1 – 3**	Regelstudiensem. **3**	Turnus **jährlich**	Dauer **1 Semester**	SWS **3**	ECTS-Punkte **5**

Modulverantwortliche/r	Prof. Dr.-Ing. habil. J. Rudolph
Dozent/inn/en	Prof. Dr.-Ing. habil. J. Rudolph
Zuordnung zum Curriculum	Bachelor Eingebettete Systeme, WP Stammvorlesungen Master Embedded Systeme, WP Stammvorlesungen
Zulassungsvoraussetzungen	Keine formalen Voraussetzungen
Leistungskontrollen / Prüfungen	Schriftliche oder mündliche Prüfung
Lehrveranstaltungen / SWS	Systemtheorie und Regelungstechnik 2: 3 SWS – 2V+1Ü
Arbeitsaufwand	Vorlesung und Übung 45 h Vor- und Nachbereitung 60 h Prüfungsvorbereitung 45 h
Modulnote	Note der Prüfung

Lernziele/Kompetenzen

Verständnis für die systemtheoretischen Grundlagen linearer Systeme sowie für den Entwurf linearer Steuerungen, Regler und Beobachter.

Inhalt

Es werden allgemeine lineare zeitinvariante Systeme (endlicher Dimension) behandelt.

- *Einführung:*
  Systemdarstellung und Linearisierung
- *Analyse der Systemstruktur, Trajektorienplanung und Steuerung:*
  Polynom-Matrix-Darstellung, Autonomie und Spalten-Hermite-Form, Reduktion, Transformation, Basisgrößen, Kriterien für (Nicht-)Steuerbarkeit, Trajektorienplanung
- *Eingang und Zustand:*
  Wahl eines Eingangs, Zustandskonzept, Steuerbarkeitskriterien für Systeme in Zustandsdarstellung (z.B. Hautus-Kriterium, Kalman-Kriterium), Kalmansche Zerlegung
- *Regelung durch Zustandsrückführung:*
  Stabile Folgeregelung mittels Zustandsrückführung, Folgeregelung bei Messung einer Basis, Beobachterentwurf (Beobachtbarkeit, vollständige und reduzierte Beobachter)

Der Lehrstoff wird in Vorlesungen und Übungen anhand technologischer Beispiele diskutiert und vertieft.

Weitere Informationen

Literaturhinweise:

[1] Kailath, T., Linear Systems, Prentice-Hall, Englewood Cliffs (1980).
[2] Reinschke, K., Lineare Regelungs- und Steuerungstheorie, Springer, Berlin (2006).
[3] MacDuffee, C. C., The Theory of Matrices, Chelsea Publishing Company, New York (1946).
[4] Wolovich, W. A., Linear Multivariable Systems, Springer, New York (1974).

Neben einem ausgearbeiteten Skriptum werden umfangreiche Lösungen zu den Übungsaufgaben sowie Programme zur Simulation ausgewählter Systeme aus Vorlesung und Übung zur Verfügung.

Telecommunications I					TC I
Studiensem.	Regelstudiensem.	Turnus	Dauer	SWS	ECTS-Punkte
5	5 - 6	At least once every two years	1 Semester	6	9

Modulverantwortliche/r
Prof. Dr.-Ing. Thorsten Herfet

Dozent/inn/en
Prof. Dr.-Ing. Thorsten Herfet

Zuordnung zum Curriculum
Bachelor Eingebettete Systeme
Wahlpflicht I/Wahlpflicht Stammvorlesung
Master Embedded Systems, Stammvorlesung

Zulassungsvoraussetzungen
The lecture requires a solid foundation of mathematics (differential and integral calculus) and probability theory. The course will, however, refresh those areas indispensably necessary for telecommunications and potential intensification courses and by this open this potential field of intensification to everyone of you.

Leistungskontrollen / Prüfungen
Regular attendance of classes and tutorials
Passing the final exam in the 2nd week after the end of courses.
Eligibility: Weekly exercises / task sheets, grouped into two blocks corresponding to first and second half of the lecture. Students must provide min. 50% grade in each of the two blocks to be eligible for the exam.

Lehrveranstaltungen / SWS
Lecture 4 h (weekly)
Tutorial 2 h (weekly)
Tutorials in groups of up to 20 students

Arbeitsaufwand
270 h = 90 h of classes and 180 h private study

Modulnote
Final exam mark

Lernziele / Kompetenzen

Digital Signal Transmission and Signal Processing refreshes the foundation laid in "Signals and Systems" [Modulkennung]. Including, however, the respective basics so that the various facets of the introductory study period (Bachelor in Computer Science, Vordiplom Computer- und Kommunikationstechnik, Elektrotechnik or Mechatronik) and the potential main study period (Master in Computer Science, Diplom-Ingenieur Computer- und Kommunikationstechnik or Mechatronik) will be paid respect to.

Inhalt

As the basic principle, the course will give an introduction into the various building blocks that modern telecommu¬nication systems do incorporate. Sources, sinks, source and channel coding, modulation and multiplexing are the major keywords but we will also deal with dedicated pie¬ces like A/D- and D/A-converters and quantizers in a little bit more depth.
The course will refresh the basic transformations (Fou¬rier, Laplace) that give access to system analysis in the frequency domain, it will introduce derived transformations (z, Hilbert) for the analysis of discrete systems and modulation schemes and it will briefly introduce algebra on finite fields to systematically deal with error correction schemes that play an important role in modern communi¬cation systems.

Weitere Informationen

Unterrichtssprache: Englisch

Literaturhinweise:
Bekanntgabe jeweils vor Beginn der Vorlesung auf der Vorlesungsseite im Internet.

Telecommunications II					CS 650 / TC II
Studiensem.	Regelstudiensem.	Turnus	Dauer	SWS	ECTS-Punkte
1 – 3	**3**	**At least once every two years**	**1 Semester**	**6**	**9**

Modulverantwortliche/r Prof. Dr.-Ing. Thorsten Herfet

Dozent/inn/en Prof. Dr.-Ing. Thorsten Herfet

Zuordnung zum Curriculum Bachelor Eingebettete Systeme, WP Stammvorlesung
Master Embedded Systems, WP Stammvorlesung

Zulassungsvoraussetzungen Solid foundation of mathematics (differential and integral calculus) and probability theory. The course will build on the mathematical concepts and tools taught in TC I while trying to enable everyone to follow and to fill gaps by an accelerated study of the accompanying literature. "Signals and Systems" as well as "TC I - Digital Transmission and Signal Processing" are strongly recommended but not required.

Related core lecture TC I

Leistungskontrollen / Prüfungen Regular attendance of classes and tutorials Passing the final exam
Oral exam directly succeeding the course. Eligibility: Weekly excersises / task sheets, grouped into two blocks corresponding to first and second half of the lecture.
Students must provide min. 50% grade in each of the two blocks to be eligible for the exam.

Lehrveranstaltungen / SWS Lecture 4 h (weekly)
Tutorial 2 h (weekly)
Tutorials in groups of up to 20 students

Arbeitsaufwand 270 hours = 90 h classes and 180 h private study

Modulnote Final Exam Mark

Lernziele / Kompetenzen

TC II will deepen the students' knowledge on modern communications systems and will focus on wireless systems.
Since from a telecommunications perspective the combination of audio/visual data – meaning inherently high data rate and putting high requirements on the realtime capabilities of the underlying network – and wireless transmission – that is unreliable and highly dynamic with respect to the channel characteristics and its capacity – is the most demanding application domain.

Inhalt

As the basic principle the course will study and introduce the building blocks of wireless communication systems. Multiple access schemes like TDMA, FDMA, CDMA and SDMA are introduced, antennas and propagation incl. link budget calculations are dealt with and more advanced channel models like MIMO are investigated. Modulation and error correction technologies presented in Telecommunications I will be expanded by e.g. turbo coding and receiver architectures like RAKE and BLAST will be introduced. A noticeable portion of the lecture will present existing and future wireless networks and their extensions for audio/visual data. Examples include 802.11n and the terrestrial DVB system (DVB-T2).

Weitere Informationen

Unterrichtssprache: Englisch

Literaturhinweise:
Bekanntgabe jeweils vor Beginn der Vorlesung auf der Vorlesungsseite im Internet.

Theoretische Elektrotechnik 2					**TET2**
Studiensem. **1 – 3**	Regelstudiensem. **3**	Turnus **jährlich**	Dauer **2 Semester**	SWS **4**	ECTS-Punkte **5**

Modulverantwortliche/r	Prof. Dr. R. Dyczij-Edlinger
Dozent/inn/en	Prof. Dr. R. Dyczij-Edlinger
Zuordnung zum Curriculum	Bachelor Eingebettete Systeme, WP Stammvorlesungen Master Embedded Systeme, WP Stammvorlesungen
Zulassungsvoraussetzungen	Keine formalen Voraussetzungen
Leistungskontrollen / Prüfungen	Mündliche oder schriftliche Prüfung
Lehrveranstaltungen / SWS	2+2 SWS (Vorlesung + Übung)
Arbeitsaufwand	Präsenz: 60 h Vor- / Nachbereitung 60 h Prüfungsvorbereitung 30 h GESAMT 150 h
Modulnote	Theoretische Elektrotechnik II: mündliche oder schriftliche Prüfung

Lernziele/Kompetenzen

Dieser Kurs lehrt die mathematischen und physikalischen Grundlagen der klassischen Elektrodynamik und versetzt Studierende in die Lage, physikalische Beobachtungen in feldtheoretische Modelle umzusetzen. Der Modul vermittelt grundsätzliches Verständnis für Diffusions- und Wellenausbreitungseffekte und befähigt Studierende, einfache Wirbelstromprobleme und Übertragungsleitungen zu berechnen, die modalen Eigenschaften einfacher Wellenleiter und Resonatoren zu bestimmen und die Strahlungsfelder von Antennenstrukturen zu berechnen.

Inhalt

Elektromagnetische Felder im Frequenzbereich (Phasoren, Maxwell-Gleichungen, Poynting-Satz); Wirbelströme (Felddiffusion im Zeit- und Frequenzbereich, Relaxationszeit, Eindringtiefe, Beispiele); homogene Übertragungsleitungen (Wellengleichung, Telegraphengleichungen im Zeit- und Frequenzbereich, Ausbreitungseigenschaften, Phasen- und Gruppengeschwindigkeit, Dispersion, Smith-Diagramm, Beispiele); Wellenausbreitung in quellenfreien Gebieten (ebene Wellen im Zeit- und Frequenzbereich, Reflexion und Brechung, Brechungsindex, Totalreflexion, Brewster-Winkel); Anregung elektromagnetischer Wellen (retardierte Potenziale, Freiraum-Lösungen im Zeit- und Frequenzbereich, elektrischer und magnetischer Dipol, Dualität, vektorielles Huygensches Prinzip, Fernfeldnäherungen, Gruppenstrahler); verlustfreie homogene Wellenleiter (axiale Separation, Wellentypen, Ein-Komponenten-Vektorpotenziale, Modenorthogonalität, Dispersionsgleichung, Ausbreitungseigenschaften, Beispiele); verlustfreie homogene Resonatoren (Modenorthogonalität, Störungsrechnung, Beispiele);

Weitere Informationen

Vorlesungsskripte erhältlich, Übungsbeispiele und alte Prüfungen im Internet abrufbar.
Harrington R.F.: Time-Harmonic Electromagnetic Fields; Ramo S., Whinnery J.R., Van Duzer T.: Fields and Waves in Communication Electronics; Unger, H.G.: Elektromagnetische Theorie für die Hochfrequenztechnik Bd. 1 & 2; Zhan, K., Li, D.: Electromagnetic Theory for Microwaves and Optoelectronics; Balanis, C.A., Advanced Engineering Electromagnetics; Collin, R.E.: Field Theory of Guided Waves; Pozar, D.M.: Microwave Engineering. Jackson, J.J.: Klassische Elektrodynamik, Simonyi, K.: Theoretische Elektrotechnik; Feynman, R.P. Leighton, R.B., Sands, M: Vorlesungen über Physik, Bd. 2.

Verification					**CS 581 / VERI**
Studiensem.	Regelstudiensem.	Turnus	Dauer	SWS	ECTS-Punkte
1 – 3	3	At least once every two years	1 Semester	6	9

Modulverantwortliche/r Prof. Dr. Holger Hermanns

Dozent/inn/en Prof. Dr. Holger Hermanns,
Prof. Bernd Finkbeiner, Ph.D

Zuordnung zum Curriculum Bachelor Eingebettete Systeme,
WP Stammvorlesungen
Master Embedded Systeme, WP Stammvorlesungen

Zulassungsvoraussetzungen For graduate students: none

Leistungskontrollen / Prüfungen

- Regular attendance of classes and tutorials
- Passing the final exam
- A re-exam takes place during the last two weeks before the start of lectures in the following semester.

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Lehrveranstaltungen / SWS Lecture 4 h (weekly)
Tutorial 2 h (weekly)
Tutorials in groups of up to 20 students

Arbeitsaufwand 270 h = 90 h of classes and 180 h private study

Modulnote Wird aus Leistungen in Klausuren, Übungen und praktischen Aufgaben ermittelt. Die genauen Modalitäten werden vom Modulverantwortlichen bekannt gegeben.

Lernziele / Kompetenzen

The students become familiar with the standard methods in computer-aided verification. They understand the theoretical foundations and are able to assess the advantages and disadvantages of different methods for a specific verification project.
The students gain first experience with manual correctness proofs and with the use of verification tools.

Inhalt

- models of computation and specification languages: temporal logics, automata over infinite objects, process algebra
- deductive verification: proof systems (e.g., Floyd, Hoare, Manna/Pnueli), relative completeness, compositionality
- model checking: complexity of model checking algorithms, symbolic model checking, abstraction case studies

Weitere Informationen

Unterrichtssprache: Englisch

Literaturhinweise:
Bekanntgabe jeweils vor Beginn der Vorlesung auf der Vorlesungsseite im Internet.

Automata, Games and Verification, Advanced Course					CS 650 / AG&V
Studiensem. 1 - 3	Regelstudiensem. 3	Turnus At least once every two years	Dauer 1 Semester	SWS 4	ECTS-Punkte 6

Responsible Lecturer Prof. Bernd Finkbeiner, PhD

Lecturer Prof. Bernd Finkbeiner, PhD

Level of the unit / mandatory or not Master Embedded Systems

Entrance requirements

Assessment / Exams

- Regular attendance of classes and tutorial
- Final exam
- A re-exam takes place during the last two weeks before the start of lectures in the following semester.

Course Typ / weekly hours Lecture 2 h (weekly)
Tutorial 2 h (weekly)

Total workload 180 h = 60 h classes and 120 h private study

Grade of the module Will be determined by the performance in exams, tutor groups, and practical tasks. Details will be announced by the lecturer at the beginning of the course.

Aims / Competences to be developed

The students will gain a deep understanding of the automata-theoretic background of automated verification and program synthesis.

Content

The theory of automata over infinite objects provides a succinct, expressive and formal framework for reasoning about reactive systems, such as communication protocols and control systems. Reactive systems are characterized by their nonterminating behaviour and persistent interaction with their environment.

In this course we study the main ingredients of this elegant theory, and its application to automatic verification (model checking) and program synthesis.

- Automata over infinite words and trees (omega-automata)
- Infinite two-person games
- Logical systems for the specification of nonterminating behavior
- Transformation of automata according to logical operations

Additional Information

Teaching language: English

Literature:
Will be announced on the course website

Automated Debugging, Advanced Course					CS 650 / AutoD
Studiensem. 1 - 3	Regelstudiensem. 3	Turnus At least once every two years	Dauer 1 Semester	SWS 4	ECTS-Punkte 6

Responsible Lecturer	Prof. Dr. Andreas Zeller
Lecturer	Prof. Dr. Andreas Zeller
Level of the unit / mandatory or not	Master Embedded Systems
Entrance requirements	Programming skills as acquired at the Bachelor level
Assessment / Exams	• Project exercises during the course • Oral exam at end of course • A re-exam takes place during the last two weeks before the start of lectures in the following semester.
Course Typ / weekly hours	Lecture 2 h (weekly) Tutorial 2 h (weekly)
Total workload	180 h = 60 h classes and 120 h private study
Grade of the module	Will be determined by the performance in exams, tutor groups, and practical tasks. Details will be announced by the lecturer at the beginning of the course.

Aims / Competences to be developed

This is a course about bugs in computer programs, how to reproduce them, how to find them, and how to fix them such that they do not occur anymore. This course teaches a number of techniques that allow you to debug any program in a systematic, and sometimes even elegant way. Moreover, the techniques can widely be automated, which allows you to let your computer do most of the debugging.

Once you understand how debugging works, you won't think about debugging in the same way. Instead of seeing a wild mess of code, you will think about causes and effects, and you will systematically set up and refine hypotheses to track failure causes. Your insights may even make you set up your own automated debugging tool. All of this allows you to spend less time on debugging, which is why you're interested in automated debugging in the first place, right?

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Content

Questions this course addresses include:

- How can I reproduce failures faithfully?
- How can I isolate what's relevant for the failure?
- How does the failure come to be?
- How can I fix the program in the best possible way?

Additional Information

Teaching language: English

Literature:
Will be announced on the course website

Computer Graphics II, Advanced Course Realistic Image Synthesis					**CS 650 / CGII-RIS**
Studiensem.	Regelstudiensem.	Turnus	Dauer	SWS	ECTS-Punkte
1 - 3	3	At least once every two years	1 Semester	6	9

Responsible Lecturer	Prof. Dr. Philipp Slusallek
Lecturer	Prof. Dr. Philipp Slusallek
Level of the unit / mandatory or not	Master Embedded Systems
Entrance requirements	Related core lecture Computer Graphics
Assessment / Exams	• Theoretical and practical exercises (50% requirement for final exam) • Final oral exam • A re-exam takes place during the last two weeks before the start of lectures in the following semester.
Course Typ / weekly hours	Lecture 4 h (weekly) Tutorial 2 h (weekly)
Total workload	270 h = 90 h classes and 180 h private study
Grade of the module	Will be determined by the performance in exams, tutor groups, and practical tasks. Details will be announced by the lecturer at the beginning of the course.

Aims / Competences to be developed

At the core of computer graphics is the requirement to render highly realistic and often even physically accurate images of virtual 3D scenes. In this lecture students will learn about physically-based simulation techniques to compute the distribution of light in even complex environment. After this course students should be able to build their own highly realistic but also efficient rendering system.

Content

- Rendering and Radiosity Equation, Finite Elements
- Radiosity
- Monte Carlo Techniques
- Direct Illumination, Importance Sampling
- BRDF, Inversion Methods
- Distribution Ray Tracing and Path Tracing
- Theory of Variance Reduction
- Bidirectional Path Tracing, Instant Radiosity
- Density Estimation Methods
- Photon Mapping
- Rendering of Animations
- Motion Blur, Temporal Filtering
- Interactive Global Illumination
- Hardware Rendering Basics
- Advanced Hardware Rendering
- Measurements of BRDFs and Light Sources
- Relighting
- Tone Mapping, Perception

Additional Information

Teaching language: English

Literature:
Will be announced on the course website

Differential Equations in Image Processing and Computer Vision, Advanced Course					**CS 650 / DIC**
Studiensem.	Regelstudiensem.	Turnus	Dauer	SWS	ECTS-Punkte
1 - 3	3	At least once every two years	1 Semester	6	9

Responsible Lecturer Prof. Dr. Joachim Weickert

Lecturer Prof. Dr. Joachim Weickert

Level of the unit / mandatory or not Master Embedded Systems

Entrance requirements Related core lecture Computer Vision

Assessment / Exams

- Regular attendance of lecture and tutorial
- 50% of all possible points from weekly assignments to be eligible for the final exam are needed
- Passing the final exam or the re-exam
- The re-exam takes place during the last two weeks before the start of lectures in the following semester

Course Typ / weekly hours

Lecture 4 h (weekly)
Tutorial 2 h (weekly)
50% theoretical exercises and 50% practical programming assignments

Total workload 270 h = 90 h of classes and 180 h private study

Grade of the module Will be determined by the performance in exams, tutor groups, and practical tasks. Details will be announced by the lecturer at the beginning of the course.

Aims / Competences to be developed

Many modern techniques in image processing and computer vision make use of methods based on partial differential equations (PDEs) and variational calculus. Moreover, many classical methods may be reinterpreted as approximations of PDE-based techniques. In this course the students will get an in-depth insight into these methods. For each of these techniques,
they will learn the basic ideas as well as theoretical and algorithmic aspects. Examples from the fields of medical imaging and computer aided quality control will illustrate the various application possibilities.

Content

1. Introduction and Overview
2. Linear Diffusion Filtering
   2.1 Basic Concepts
   2.2 Numerics
   2.3 Limitations and Alternatives
3. Nonlinear Isotropic Diffusion Filtering
   3.1 Modeling
   3.2 Continuous Theory
   3.2 Semidiscete Theory
   3.3 Discrete Theory
   3.4 Efficient Sequential and Parallel Algorithms
4. Nonlinear Anisotropic Diffusion Filtering
   4.1 Modeling
   4.2 Continuous Theory
   4.3 Discrete Aspects
5. Parameter Selection
6. Variational Methods
   6.1 Basic Ideas
   6.2 Discrete Aspects
   6.3 TV Denoising, Equivalence Results
   6.4 Mumford-Shah Segmentation and Diffusion-Reaction Filters
7. Vector- and Matrix-Valued Images
8. Image Sequence Analysis
   8.1 Global Methods
   8.2 Local Methods
   8.3 Combined Local-Global Methods
   8.4 Numerical Techniques
9. Continuous-Scale Morphology
   9.1 Basic Ideas
   9.2 Applications
10. Curvature-Based Morphology
    10.1 Basic Ideas
    10.2 Applications

Additional Information

Teaching language: English

Literature:
Will be announced on the course website

Introduction to Image Acquisition Methods, Advanced Course					**CS 750 / IIAM**
Studiensem.	Regelstudiensem.	Turnus	Dauer	SWS	ECTS-Punkte
1 - 3	3	At least once every two years	1 Semester	2	4

Responsible Lecturer Prof. Dr. Joachim Weickert

Lecturer N. N.

Level of the unit / mandatory or not Master Embedded Systems

Entrance requirements Related core lecture Computer Vision

Assessment / Exams

- Written or oral exam at end of course
- A re-exam takes place during the last two weeks before the start of lectures in the following semester.

Course Typ / weekly hours Lecture 2 h (weekly)

Total workload 120 h = 30 h classes and 90 h private study

Grade of the module Will be determined by the performance in exams, tutor groups, and practical tasks. Details will be announced by the lecturer at the beginning of the course.

Aims / Competences to be developed

The course is designed as a supplement for image processing lectures, to be attended before, after or parallel to them.
Participants shall understand
- what are digital images
- how they are acquired
- what they encode and what they mean
- which limitations are introduced by the image acquisition.

This knowledge will be helpful in selecting adequate methods for processing image data arising from different methods.

Content
A broad variety of image acquisition methods is described, including imaging by virtually all sorts of electromagnetic waves, acoustic imaging, magnetic resonance imaging and more. While medical imaging methods play an important role, the overview is not limited to them.

Starting from physical foundations, description of each image acquisition method extends via aspects of technical realisation to mathematical modelling and representation of the data.

Additional Information

Teaching language: English

Literature:
Will be announced on the course website

Correspondence Problems in Computer Vision, Advanced Course					COPCV
Studiensem.	Regelstudiensem.	Turnus	Dauer	SWS	ECTS-Punkte
1 - 3	3	At least once every two years	1 Semester	4	6

Responsible Lecturer Prof. Dr. Joachim Weickert

Lecturer Prof. Dr. Joachim Weickert

Level of the unit / mandatory or not Master Embedded Systems

Entrance requirements Related core lecture Computer Vision,
Completed Mathematics for Computer Scientist lectures.

Assessment / Exams
- Regular attendence of lecture and tutorial
- Written or oral exam and the end of the course

Course Typ / weekly hours Lecture 2 h (weekly)
Tutorial 2 h (weekly)

Total workload 180 h = 60 h classes and 120 h private study

Grade of the module Will be determined by the performance in exams, tutor groups, and practical tasks. Details will be announced by the lecturer at the beginning of the course.

Aims / Competences to be developed

Correspondence problems are a central topic in computer vision. Thereby, one is interested in identifying and matching corresponding features in different images/views of the same scene. Typical corresondence problems are the estimation of motion information from consecutive frames of an image sequence (optic flow), the reconstruction of a 3-D scene from a stereo image pair and the registration of medical image data from different modalities (e.g. CT and MRT).
Central part of this lecture is the discussion of the most important correspondence problems as well as the modelling of suitable algorithms for solving them.

Content

1. Introduction and Overview
2. General Matching Concepts
   2.1 Block Matching
   2.2 Correlation Techniques
   2.3 Interest Points
   2.4 Feature-Based Methods
3. Optic Flow I
   3.1 Local Differential Methods
   3.2 Parameterisation Models
4. Optic Flow II
   4.1 Global Differential Methods
   4.2 Horn and Schunck
5. Optic Flow III
   5.1 Advanced Constancy Assumptions
   5.2 Large Motion
6. Optic Flow IV
   6.1 Robust Data Terms
   6.2 Discontinuity-Preserving Smoothness Terms
7. Optic Flow V
   7.1 High Accuracy Methods
   7.2 SOR and Lienar Multigrid
8. Stereo Matching I
   8.1 Projective Geometry
   8.2 Epipolar Geometry
9. Stereo Matching II
   9.1 Estimation of the Fundamental Matrix
10. Stereo Matching III
    10.1 Correlation Methods
    10.2 Variational Approaches
    10.3 Graph Cuts
11. Medical Image Registration
    11.1 Mutual Information
    11.2 Elastic and Curvature Based Registration
    11.3 Landmarks
12. Particle Image Velocimetry
    12.1 Div-Curl-Regularisation
    12.2 Incompressible Navier Stokes Prior

Additional Information

Teaching language: English

Literature:
Will be announced on the course website

Automatic Planning, Advanced Course					
Studiensem.	Regelstudiensem.	Turnus	Dauer	SWS	ECTS-Punkte
1-3	3	WS	1 Semester	4	9

Modulverantwortliche/r Prof. Dr.-Ing. Thorsten Herfet

Dozent/inn/en Prof. Dr.-Ing. Thorsten Herfet

Zuordnung zum Curriculum Bachelor Informatik
Master Informatik
Extended Courses

Zulassungsvoraussetzungen For graduate students: none

Leistungskontrollen / Prüfungen Weekly exercise sheets, two blocks, each one must be passed individually, oral exam at the end of the modul

Lehrveranstaltungen / SWS Extended Course, 4V2Ü

Arbeitsaufwand 9 CPs = 270 hrs for an average student

Modulnote Wird aus Leistungen in Klausuren, Übungen und praktischen Aufgaben ermittelt. Die genauen Modalitäten werden vom Modulverantwortlichen bekannt gegeben.

Lernziele / Kompetenzen

The students will gain a deep understanding of algorithms used in Automatic Planning for the efficient exploration of large state spaces, from both a theoretical and practical point of view. The programming exercises will familiarize them with the main implementation basis in Automatic Planning. The search algorithms are generic and are relevant also in other CS sub-areas in which large transition systems need to be analyzed.

Inhalt

Automatic Planning is one of the fundamental sub-areas of Artificial Intelligence, concerned with algorithms that can generate strategies of action for arbitrary autonomous agents in arbitrary environments. The course examines the technical core of the current research on solving this kind of problem, consisting of paradigms for automatically generating heuristic functions (lower bound solution cost estimators), as well as optimality-preserving pruning methods. Apart from understanding these techniques themselves, the course explains how to analyze, combine, and compare them.

Starting from an implementation basis provided, students implement their own planning system as part of the course. The course is concluded by a competition between these student systems.

Weitere Informationen

Unterrichtssprache: Englisch

Literaturhinweise:
Bekanntgabe jeweils vor Beginn der Vorlesung auf der Vorlesungsseite im Internet.

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Modul **Antenna Theory 1**					Abk. **ANT1**
Studiensem. **1-3**	Regelstudiensem. **3**	Turnus **WS**	Dauer **1 Semester**	SWS **3**	ECTS-Punkte **5**

Modulverantwortliche/r	Romanus Dyczij-Edlinger
Dozent/inn/en	Romanus Dyczij-Edlinger (Vorlesung) und Mitarbeiter (Übung)
Zuordnung zum Curriculum	Erweiterungsbereich Master Mechatronik Vertiefungsveranstaltung Master Computer- und Kommunikationstechnik Master Systems Engineering, Erweiterungsbereich
Zulassungsvoraussetzungen	DE: Keine. Studierende sollten eine Vorlesung über elektromagnetische Felder gehört haben. EN: None. Students are expected to have taken a course in electromagnetic fields.
Leistungskontrollen / Prüfungen	DE: Aufgaben und mündliche Prüfung EN: Homework and oral exam
Lehrveranstaltungen / SWS	DE: Vorlesung (2 SWS) und Übung (1 SWS) EN: Lectures (2 SWS) and recitations (1 SWS)

Arbeitsaufwand

DE:	EN:	
Vorlesung	Lectures	15 x 2h = 30h
Übung	Recitations	15 x 1h = 15h
Heimarbeit	Homework	15 x 5h = 75h
Prüfungsvorbereitung	Exam preparation	30h
SUMME	SUM	150h

Modulnote

DE: Aufgaben 30%, Prüfung 70%
EN: Homework 30%, Exam 70%

Lernziele/Kompetenzen

DE: Beherrschung der theoretischen Grundlagen von Antennen.
Kenntnis der Fachausdrücke zur Charakterisierung von Antennen.
Verständnis der Funktionsweise üblicher Antennenklassen und der Unterschiede zwischen ihnen.
Die Fähigkeit, für eine gegebene Anwendung die geeignete Art von Antenne zu wählen.
Beherrschung von Methoden zur quantitativen Auslegung von Antennen.
Elementares Wissen über Antennenmesstechnik.

EN: To master the theoretical foundations of antennas.
To know the standard terms for characterizing antennas.
To understand the working principles of and differences between widely used classes of antennas.
To be able to choose the proper type of antenna for a given application.
To master methods for quantitative antenna design.
To have a basic knowledge of antenna measurement techniques.

Inhalt:

DE: Theoretische Grundlagen; Definitionen und Terminologie; Übertragungsstrecke; Antennenklassifikation; Drahtantennen; Aperturantennen; Mikrostreifenleiterantennen; Gruppenstrahler; Reflektorantennen; Breitband- und frequenzunabhängige Antennen; Ansteuernetzwerke; Antennenmesstechnik; fortgeschrittene Theorie.

EN: Theoretical foundations; definitions and terminology; radio channel; antenna classification; wire antennas; aperture antennas; microstrip antennas; antenna arrays; reflector antennas; broadband and frequency-independent antennas; feeding networks; antenna measurements; advanced theory.

Weitere Informationen:
DE: Skript in englischer Sprache ist auf www.lte.uni-saarland.de erhältlich (Kennwort-geschützt).
EN: Lecture notes in English are available from www.lte.uni-saarland.de (password protected).

Unterrichtssprache:
DE: Studierende können zwischen Deutsch und Englisch wählen.
EN: Students may choose between English and German.

Literaturhinweise:
C. Balanis, Antenna Theory: Analysis and Design. 3rd edition. John Wiley & Sons, 2005.
J. Kraus, Antennas. 3rd edition. McGraw-Hill, 2001.
R. Elliot, Antenna Theory and Design. Revised edition. Wiley-IEEE Press, 2003.
R. Collin, Antennas and Radiowave Propagation. 4th edition. McGraw-Hill, 1985.
K. Klark, Antennen und Strahlungsfelder. 2nd edition. Vieweg. 2006.

Modul **Soft Control** (Rechnergestützte Methoden in der Automatisierungstechnik)					Abk. **RMA** (AT3)
Studiensem. **1-3**	Regelstudiensem. **3**	Turnus **WS**	Dauer **1 Semester**	SWS **3**	ECTS-Punkte **4**

Modulverantwortlicher	Prof. Dr.-Ing. Georg Frey
Dozent	Prof. Dr.-Ing. Georg Frey
Zuordnung zum Curriculum	Master Mechatronik, Kategorie Erweiterungsbereich Master Systems Engineering, Erweiterungsbereich
Zulassungsvoraussetzungen	Keine formalen Voraussetzungen
Leistungskontrollen / Prüfungen	Benotete Prüfung (Klausur)
Lehrveranstaltungen / SWS	2 SWS Vorlesung; 1 SWS Übung
Arbeitsaufwand	Gesamt 120 Stunden, davon • Präsenzzeit Vorlesung 15 Wochen à 2 SWS = 30 Std. • Präsenzzeit Übung 15 Wochen à 1 SWS = 15 Std. • Vor- und Nachbereitung Vorlesung und Übung = 45 Std. • Klausurvorbereitung = 30 Std.
Modulnote	Klausurnote

Lernziele/Kompetenzen

Die Lehrveranstaltung widmet sich den rechnergestützten Methoden in der Automatisierungstechnik. Hierunter sind sowohl neuere Ansätze zur Modellierung von Systemen als auch Verfahren zur Steuerung und Optimierung zu verstehen, die erst durch Rechnerunterstützung möglich sind. Die Studierenden kennen Vorteile, aber auch Grenzen der verschiedenen präsentierten Methoden und haben deren Anwendung im Rahmen der Übungen an Beispielen selbst erprobt.

Inhalt: Rechnergestützte Methoden in der Automatisierungstechnik

- Expertensysteme
- Fuzzy-Systeme: Anwendung: Fuzzy Control (FC)
- Neuronale Netze (NN): Anwendung: Identifikation und neuronale Regler
- Stochastische Optimierungsverfahren: Genetische Algorithmen (GA), Simulated Annealing (SA)
- Anwendung, Einsatzgebiete und Grenzen der vorgestellten Verfahren

Weitere Informationen

Unterrichtssprache: Deutsch

Literaturhinweise: Literatur wird in der Vorlesung zur Verfügung gestellt bzw. bekannt gegeben.

Seminar Changing Topics					**CS 500**
Studiensem.	Regelstudiensem.	Turnus	Dauer	SWS	ECTS-Punkte
1 - 3	3	jedes Semester	1 Semester	3	7

Responsible Lecturer Dean of studies and relevant Professor

Lecturer Professors oft he Department

Level of the unit / mandatory or not Master Embedded Systems

Entrance requirements Basic knowledge in the field of computer science under focus in the respective seminar.

Assessment / Exams

- Contributions to discussions
- Thematic talk
- Written elaboration
- Final oral examination on the entire scientific area spanned by the seminar

Course Typ / weekly hours Seminar 3 h (weekly) / groups of up to 20 students

Total workload 210 h = 60 h classes und 150 h private study

Grade of the module The modalities of the grading will be determined by the responsible professor

Aims / Competences to be developed

At the end of the course students have gained a thorough knowledge of current or foundational aspects of a specific area in computer science.

They attained competences in independently investigating, classifiying, summarizing, discussing, criticizing scientifc issues and presenting scientific findings.

Content

Practical exercising of

- Reflecting on scientific work,
- Analyzing and assessing scientific papers
- Composing scientific abstracts
- Discussing scientific work in a peer group
- Developing common standars for scientific work
- Presentation techniques

Specific focus according to the individual topic of the seminar.

Typical course progression:

- Preparatory meetings to guide selection of individual topics
- Repetitive meetings with discussions of selected contributions
- Talk and elaboration on one of the contributions

Oral exam on entire scientific area spanned by the seminar

Additional Information

Teaching language: English

Literatur:
According to the topic

Master Seminar					**CS 890**
Studiensem.	Regelstudiensem.	Turnus	Dauer	SWS	ECTS-Punkte
4	4	jedes Semester	1 Semester	5	12

Responsible Lecturer	Dean of Studies
Lecturer	Professors of the department
Level of the unit / mandatory or not	Master Embedded Systems
Entrance requirements	All mandatory modules except Master seminar and Master thesis
Assessment / Exams	• Presentation of a scientific article of adequate depth in the reading group • Active participation in the discussion in the reading group • Presentation of the planned thesis topic followed by a plenary discussion • Written description of the topic of the Master thesis
Course Typ / weekly hours	Seminar 3h per week (about 15 members)
Total workload	360 h • Hands-on training 2h per week (15 students) • Contact with supervisor 1h per week • Self-study 20h per week
Grade of the module	graded

Aims / Competences to be developed

The Master seminar sets the ground for carrying out independent research within the context of an appropriately demanding research area. This area provides sufficient room for developing own scientific ideas.

At the end of the Master seminar, the basics ingredients needed to embark on a successful Master thesis project have been explored and discussed with peers, and the main scientific solution techniques are established.

The Master seminar thus prepares the topic of the Master thesis. It does so while deepening the students’ capabilities to perform a scientific discourse. These capabilities are practiced by active participation in a reading group. This reading group explores and discusses scientifically demanding topics of a coherent subject area.

Content

The methods of computer science are systematically applied, on the basis of the "state-of-the-art".

Additional Information

Teaching language: English

Fakultät für Mathematik und Informatik
Masterstudiengang Embedded Systems

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Master Thesis					CS 899
Studiensem.	Regelstudiensem.	Turnus	Dauer	SWS	ECTS-Punkte
4	4	jedes Semester	1 Semester	2	30

Responsible Lecturer	Professors of the Department
Lecturer	Professors of the Department
Level of the unit / mandatory or not	Master Embedded Systems
Entrance requirements	Master Seminar
Assessment / Exams	Written elaboration in form of a scientific paper. It describes the scientific findings as well as the way leading to these findings.It contains justifications for decisions regarding chosen methods for the thesis and discarded alternatives. The student's own substantial contribution to the achieved results has to be evident. In addition, the student presents his work in a colloquium, in which the scientific quality and the scientific independence of his achievements are evaluated
Course Typ / weekly hours	
Total workload	900 h = 50 h contact hours, 850 h private studies
Grade of the module	graded

Aims / Competences to be developed

In the master thesis the student demonstrates his abilitiy to perform independent scientific work focusing on an adequately challenging topic prepared in the master seminar.

Content

In the master thesis the student demonstrates his abilitiy to perform independent scientific work focusing on an adequately challenging topic prepared in the master seminar.

Additional Information

Teaching language: English

Literature:
According to the topic

Tutor					
Studiensem.	Regelstudiensem.	Turnus	Dauer	SWS	ECTS-Punkte
1 - 3	3	jedes Semester	1 Semester		4

Responsible Lecturer Professors of the Department

Lecturer Professors of the Department

Level of the unit / mandatory or not Master Embedded Systems

Entrance requirements Each lecturer selects the tutors for his courses. A prerequisite for becoming a tutor is a very good grade in the relevant course, interest in didactics and an observable talent for didactical work.

Assessment / Exams The lecturer supervises tutors and gives them feedback regarding their contributions to weekly assignments (creating, finding sample solutions for exisiting eercises), answers to questions on the mailing list as well as correcting the exams.
The assistant of the course visits each tutorial once a semester and gives feedback to the tutor as well as to the lecturer. At the end of the semester each students evaluates the work of his/her tutor as a part of the course evaluation.

Course Typ / weekly hours Tutorial 2 h (weekly)
Tutoring groups of up to 20 students

Total workload	A tutor assists a course (usually basic or core lectures) for one semester. This includes the following tasks: 0) Learning the specific didactic aspects of the course matter (4h). 1) Moderating the weekly meetings (90 min each) of a tutorial group 2) Correction of weekly tests, taken in the group 3) Weekly office hours (90 min) for students attending the course. 4) Attending weekly team-meetings with all tutors and lecturers of the course (45 min) 5) Participation in developing sample exercise solutions of the weekly assignments (90 min weekly) 6) Answering incoming questions on the mailing list regarding topics of the course and the weekly assignments (60 min weekly) 7) Getting to grips with the contents of the current lecture (2h weekly) 8) Creating new exercises (1h weekly) 9) Supervising and correcting exams (midterm, final exam, re-exam, 12h each)
Grade of the module	ungraded

Aims / Competences to be developed

Tutors learn how courses are being organized and which methodical aims are being followed. They learn how to communicate complex scientific subject matters to larger groups and in individual meetings.

Before starting their work the students attend one or more colloquia in which they are introduced to the specific didactic aspects of the course matter.

In assisting the course, they learn how to adapt to the different background knowledge and intellectual capicities of the attending students. They get encouraged to communicate complex contexts in a concise and effective way. In addition they get used to communicating subject matters in English.

Content

See above

Additional Information

Teaching Language: Deutsch/Englisch

Soft Skill Seminar					**SSS**
Studiensem. 1 -3	Regelstudiensem. 3	Turnus	Dauer 1 Semester	SWS 2	ECTS-Punkte 4

Responsible Lecturer Jennifer Gerling

Lecturer Jennifer Gerling

Level of the unit / mandatory or not Master Embedded Systems

Entrance requirements

Assessment / Exams 2 hand in presentations
- your log
- application / cv / ad
- scientific text

Course Typ / weekly hours Blockseminar 120 h
40 h preparation / 40 h course / 40 h private study

Total workload 120 h

Grade of the module

Aims / Competences to be developed

1. Communication In this part, students learn about the meaning of communication in their every day professional and private life. After an introduction to communication theory including body language and verbal, non-verbal and vocal aspects of communication, there will be exercises dealing with body language, voice sound and team communication, as well as advice concerning communication techniques and handling conflicts.

2. Job Hunting Tailor-made for the students' needs, this is a theoretical and practical training for job application. Students learn about self-assessment, orientation, career planning and the actual application process. The layout and content of a CV and cover letter are discussed, as well as the structure of a job interview, rules concerning conduct and appearance, and advice for assessment centres. Students will enter realistic role play sessions with job interviews and an assessment centre.

3. Scientific Posters Scientists quite often have to present their work as a poster. This part covers the planning phase and the actual realisation, explaining rules for content and layout with respect to the target audience, the use of colours and illustrations, text formatting, as well as special requirements of the print medium as opposed to on-screen presentations. The students are shown examples of existing posters. Finally, they analyse a poster they brought themselves and correct it.

4. Presentation Skills Topics are: how to structure a presentation, designing PowerPoint slides, visual aids and technical equipment, handling questions, timing, dealing with nervousness, how to give proper feedback. Exercises deal with posture, breathing, voice and body language. Students give individual presentations and are video-taped by staff. They get individual feedback and can watch themselves on film. In a second session of presentations, the students can check on their improvement.

5. Time and Self Management Students learn to identify time wasters and to keep an activity log. They are taught how to set work priorities by classifying their goals and arranging them in 4 categories (Eisenhower principle); they learn about action plans and to-do-lists, as well as effective scheduling. Practical exercises introduce creativity techniques (brainstorming, mindmapping®, decision tree) and mnemo techniques.

6. Project Management The following issues are dealt with: the different planning phases, possible problems, communicating in the right way, defining targets, making vague ideas into specific parts of the plan, the right level of detail, network diagrams and Gantt charts, delegating work, guiding a team, risk management, bringing the project to a close, and post-project evaluation. The course also includes a practical exercise.

7. Scientific Writing. This part consists of a detailed lecture, as well as practical exercises and deals with the general structure of a paper and related issues. Students also learn about the process of publishing a paper: rules for submitting a manuscript, dealing with the reviewers' comments etc.

Content

See above

Additional Information

Teaching language:English

Literature:
According to the topic

Language Course					
Studiensem.	Regelstudiensem.	Turnus	Dauer	SWS	ECTS-Punkte
1 - 4	4		1 Semester	2 or 4	3 or 6

Responsible Lecturer Dr. Peter Tischer, head of the Language Center

Lecturer http://www.szsb.uni-saarland.de/mitarbeiter/

Level of the unit / mandatory or not
Bachelor Informatik
Master Informatik
For each language taught at the center, different levels are offered: beginner, intermediate and advanced level

Elective

Entrance requirements
For the beginners level: none
French, English, Spanish:
assessment test to ascertain the proficiency of each student
For all other courses on an advanced level: proof of other language courses or meeting with the lecturer.

Assessment / Exams
Usually exam at the end of the semester and regular attendance (at least 80 % of all classes).

Course Typ / weekly hours
Seminar with 2 - 4 hours of classes each week, independent study with monthly meetings or 4 week intensive courses with 4 h of classes each day.
Groups of 6 to 40 students

Total workload
90 h = 30 h classes and 60 h private study
180 h = 60 h classes and 120 h private study

Grade of the module ungraded

Aims / Competences to be developed

Language skills: grammar, vocabulary, conversation skills.

Content

Depending on course

Additional Information

Teaching language: German and taught language

Literature:
Depending on course

Language Course - German Language Course for Beginners					
Studiensem.	Regelstudiensem.	Turnus	Dauer	SWS	ECTS-Punkte
1 - 4	4		1 Semester	2 or 4	3 or 6

Responsible Lecturer NN

Lecturer NN

Level of the unit / mandatory or not 1.- 4. Semester / international Master students only
Elective

Entrance requirements none

Assessment / Exams Weekly assignments
One presentation
Exam at the end of the semester
Regular attendance (at least 75% of all classes)

Course Typ / weekly hours Seminar 6 h of classes each week
Groups of up to 20 students

Total workload 270 h = 90 h of classes and 180 h private study

Grade of the module ungraded

Aims / Competences to be developed

Students should develop basic skills in

- Reading / understanding German texts
- Understanding spoken German
- Conducting a German conversation
- German Grammar
- Writing German texts

Content

See above

Additional Information

Teaching language: German

Literature:
Depending on course

Language Course - German Language Course / all levels					
Studiensem.	Regelstudiensem.	Turnus	Dauer	SWS	ECTS-Punkte
1 - 4	4		1 Semester	2 or 4	3 or 6

Responsible Lecturer NN

Lecturer NN

Level of the unit / mandatory or not 1.-3. Semester / courses are offered each semester

Entrance requirements Language test to assesss the proficiency of the student

Assessment / Exams Weekly assignments
One presentation
Exam at the end of the semester
Regular attendance (at least 75% of all classes)

Course Typ / weekly hours Seminar 4 h of classes each week
Groups of up to 20 students

Total workload 180 h = 60 h of classes and 120 h private study

Grade of the module ungraded

Aims / Competences to be developed

Students should develop basic skills in

- Reading / understanding German texts
- Understanding spoken German
- Conducting a German conversation
- German Grammar
- Writing German texts

Content

See above

Additional Information

Teaching language:German

Literatur:
Depending on course