

# Syllabus Book

## Master of Science Computer Science and Communications Engineering

## Master of Science in Computer Science and Communications Engineering

V	Ü	P	S	Cr
40	21	1	0	117

1.	Computer Architecture	Basermann	e	2	1	0	0	5
	Communication Networks	Jung	d	2	1	0	0	5
	Mathematics C2 (Numerical Mathematics)	Schreiber	e	2	2	0	0	6
	Non-Technical Subject 1	NN		2	0	0	0	2
	Non-Technical Subject 2	NN		2	0	0	0	2
	Security, Safety and Reliability of Digital Systems	Hunger Geisselhardt Kochs	d	2	1	0	0	5
	Elective 1	NN		2	1	0	0	4
Sum:				14	6	0	0	29

2.	Advanced Computer Architecture	Hunger Basermann	e	2	1	0	0	5
	Information Theory	Müller	d	2	2	0	0	5
	Coding Theory	Czylwik	e	2	1	0	0	4
	Communications 2	Czylwik	d	2	2	0	0	5
	Security in Computer Networks	Geisselhardt	e	2	1	0	0	4
	Switched Networks	Geisselhardt	e	2	2	0	0	6
Sum:				12	9	0	0	29

3.	Multidimensional Signals	Bruck	d	2	1	0	0	5
	Advanced Mobile Communications	Jung	e	2	1	0	0	4
	Communications 3	Czylwik	d	2	1	0	0	4
	Non-Technical Subject 3	NN		2	0	0	0	2
	Distributed Systems	Hoppe	d	2	1	1	0	6
	Elective 2	NN		2	1	0	0	4
	Elective 3	NN		2	1	0	0	4
Sum:				14	6	1	0	29

4.	Master Thesis	NN		0	0	0	0	30
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Sum: 0 0 0 0 30

## Description of the degree course

<b>name of the degree course</b>			<b>shorthand expression of degree course</b>
Master of Science in Computer Science and Communications Engineering			
<b>type</b>	<b>period of study</b>	<b>SWS</b>	<b>ECTS-Credits</b>
Master	4	62	117
<b>description</b>			
<p>The Master degree course “Computer Science and Communications Engineering” combines branches of computer science and communications engineering which were separately dealt with in the past. In addition to in-depth lectures in electrical engineering, computer science and information technology a profiled training particularly in data processing, information technology and communication networks follows. Graduates have good career prospects in management positions of the IT industry or the opportunity of doctoral studies at a German university or abroad.</p> <p>The activities of the graduates particularly lie in the cross-sectional fields of communications technology in the sense of combining computer and communications engineering and their application in the development of new systems and services. This results in the following fields:</p> <ul style="list-style-type: none"> <li>• Analysis, project development and evaluation of mobile radio and wireless information systems</li> <li>• Conception and development of modern services and the integration of services (e.g. in the fields of communication networks, distributed systems and multimedia)</li> <li>• System analysis and conception of application systems with higher proportion being the processing and transmission of signals, e.g. in communication networks, in process controlling or medical technology</li> <li>• Here big internationally active companies come into play as possible employers. In addition to positions in small and medium scale enterprises, also freelance activities (e.g. as consulting engineers) and occupations as self employed entrepreneurs (e.g. development of special system solutions) come into play.</li> </ul>			

# Modul- und lecture catalogue

<b>modul name</b>	<b>shorthand expression of module</b>
<b>Thesis</b>	
<b>course coordinator</b>	<b>faculty</b>
Prof. Dr.-Ing. Axel Hunger Prof. Dr.-Ing. Uwe Maier Prof. Dr.-Ing. Paul Josef Mauk Prof. Dr.-Ing. Klaus Solbach Prof. Dr. rer. nat. Jan-Dirk Herbell	-
<b>used in degree course</b>	
<ul style="list-style-type: none"> <li>• Master of Science in Computer Engineering</li> <li>• Master of Science in Computer Science and Communications Engineering</li> <li>• Master of Science in Control and Information Systems</li> <li>• Master of Science in Electrical and Electronic Engineering (Communications Engineering)</li> <li>• Master of Science in Electrical and Electronic Engineering (Power and Automation)</li> <li>• Master of Science in Mechanical Engineering (Water Resources and Environmental Engineering)</li> <li>• Master of Science in Mechanical Engineering (Production and Logistics)</li> <li>• Master of Science in Mechanical Engineering (Mechatronics)</li> </ul>	

nr	courses	semester	sws	workload	ECTS-credits
1	Master Thesis	4	0	0	30
<b>total</b>			<b>0</b>	<b>0</b>	<b>30</b>

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<b>modul name</b>	<b>shorthand expression of module</b>
Thesis	
<b>lecture name</b>	<b>shorthand expression of lecture</b>
<b>Master Thesis</b>	
<b>lecturer</b>	<b>department</b>
NN	

<b>semester</b>	<b>cycle</b>	<b>language</b>	<b>requirements</b>
4			

<b>SWS</b>	<b>presence hours</b>	<b>self-study hours</b>	<b>workload</b>	<b>ECTS-Credits</b>
0	0	0	0	30

<b>description</b>
<b>kind of examination</b>
<b>literature</b>
<b>remark</b>

<b>modul name</b>	<b>shorthand expression of module</b>
<b>Advanced Computer Engineering</b>	
<b>course coordinator</b>	<b>faculty</b>
Prof. Dr.-Ing. Axel Hunger	-
<b>used in degree course</b>	
<ul style="list-style-type: none"> <li>• Master of Science in Computer Engineering</li> <li>• Master of Science in Computer Science and Communications Engineering</li> </ul>	

<b>nr</b>	<b>courses</b>	<b>semester</b>	<b>sws</b>	<b>workload</b>	<b>ECTS-credits</b>
1	Advanced Computer Architecture	2	3	150	5
2	Computer Architecture	1	3	150	5
<b>total</b>			<b>6</b>	<b>300</b>	<b>10</b>

<b>description:</b>
<p>This module describes and deepens the construction and the functional method of computer systems. Modern concepts of computer architecture are dealt with, with whose help the efficient computer systems and computer networks can be developed. Distributed computer architecture will also be introduced.</p>

<b>modul name</b>	<b>shorthand expression of module</b>
Advanced Computer Engineering	
<b>lecture name</b>	<b>shorthand expression of lecture</b>
<b>Advanced Computer Architecture</b>	
<b>lecturer</b>	<b>department</b>
Prof. Dr.-Ing. Axel Hunger Dr.-Ing. Achim Basermann	

<b>semester</b>	<b>cycle</b>	<b>language</b>	<b>requirements</b>
2		English	

<b>SWS</b>	<b>presence hours</b>	<b>self-study hours</b>	<b>workload</b>	<b>ECTS-Credits</b>
3	45	105	150	5

<b>description</b>
<p>This course offers an understanding of modern concepts of computer architecture which allow the construction of high performing computer systems and networks. In a first step, concepts are introduced which enable modern computers to overcome the limitations of the traditional von-Neumann concept of designing computers, e.g. pipelining, superscalar and vector architectures. Based on these concepts, distributed computer architectures are explained including arrays of computers as well as different types of loosely and tiedly coupled CPUs. In this context, permutation networks are introduced as special aspects of highly specialized and performing computer arrays. Another topic is cache coherency in parallel systems. Finally, modern supercomputers and their properties are discussed, and a survey of current developments in the area of "Grid Computing" is given.</p>
<b>kind of examination</b>
<p>According to § 17 of the examination regulation the type and duration of the examination will be defined from the lecturer before the semester starts. Therefore an examination can be a written test with a length of 30 to 120 minutes or an oral examination with a length of 30 to 60 minutes. The language of the examination is the same as the language of the lecture.</p>
<b>literature</b>
<p>1. D.E.Culler, J.P.Singh, A.Gupta Parallel Computer Architecture: A Hardware/Software Approach Morgan Kaufmann, 1999, ISBN 1-55860-343-3</p> <p>2. J.L.Hennessy, D.A.Patterson Computer Architecture: A Quantitative Approach Morgan Kaufmann Publishers, Inc., 3rd edition, 2003</p>
<b>remark</b>



<b>modul name</b>	<b>shorthand expression of module</b>
Advanced Computer Engineering	
<b>lecture name</b>	<b>shorthand expression of lecture</b>
<b>Computer Architecture</b>	
<b>lecturer</b>	<b>department</b>
Dr.-Ing. Achim Basermann	

<b>semester</b>	<b>cycle</b>	<b>language</b>	<b>requirements</b>
1		English	

<b>SWS</b>	<b>presence hours</b>	<b>self-study hours</b>	<b>workload</b>	<b>ECTS-Credits</b>
3	45	105	150	5

<b>description</b>
<p>This course covers two aspects of computer organization: Operating systems and management of resources on the one hand and fundamentals of computer architecture on the other hand. The principles of operating systems are explained and illustrated by functions of UNIX and MS-DOS. Memory management systems are discussed concerning the hierarchy from mass storage to cache memories as well as principles like paging, segmenting, and virtual addresses. The presentation of the principles of computer architecture focuses on considerations for the design of hardware.</p>
<b>kind of examination</b>
<p>According to § 17 of the examination regulation the type and duration of the examination will be defined from the lecturer before the semester starts. Therefore an examination can be a written test with a length of 30 to 120 minutes or an oral examination with a length of 30 to 60 minutes. The language of the examination is the same as the language of the lecture.</p>
<b>literature</b>
<ol style="list-style-type: none"> <li>1. V.Claus, A.Schwill: Duden Informatik Dudenverlag, 1993</li> <li>2. A.S.Tanenbaum: Moderne Betriebssysteme Hanser, 1994 (1992)</li> <li>3. A.Silberschatz, P.B.Galvin: Operating System Concepts Addison-Wesley, 1994</li> <li>4. H.Kopetz: Real-Time Systems Kluwer, 1997</li> <li>5. J.L.Hennessy, D.A.Patterson: Computer Architecture: A Quantitative Approach Morgan Kaufmann, 2003</li> <li>6. J.Gulbins: UNIX Springer, 1988</li> </ol>

7. D.Zöbel, W.Albrecht: Echtzeitsysteme  
Thomson Publishing, 1995

8. P.Herrmann: Rechnerarchitektur  
Vieweg, 1998

9. Real-Time-Systems  
Proc. IEEE, Jan. 1994

**remark**

<b>modul name</b>	<b>shorthand expression of module</b>
<b>Advanced mathematical and communication Theories</b>	
<b>course coordinator</b>	<b>faculty</b>
Prof. Dr.-Ing. Axel Hunger Prof. Dr.-Ing. Klaus Solbach	-
<b>used in degree course</b>	
<ul style="list-style-type: none"> <li>• Master of Science in Computer Science and Communications Engineering</li> </ul>	

nr	courses	semester	sws	workload	ECTS-credits
1	Communications 2	2	4	150	5
2	Information Theory	2	4	150	5
3	Mathematics C2 (Numerical Mathematics)	1	4	180	6
<b>total</b>			<b>12</b>	<b>480</b>	<b>16</b>

<b>description:</b>
<p>This module contains different advanced supplements to the previously imparted mathematical and computer-orientated fundamentals. An enlargement of mathematical fundamentals with regard to the numerical mathematics, an expansion of information technological theories and a continuation of information theoretical theories rank among these.</p>

<b>modul name</b>	<b>shorthand expression of module</b>
Advanced mathematical and communication Theories	
<b>lecture name</b>	<b>shorthand expression of lecture</b>
<b>Communications 2</b>	
<b>lecturer</b>	<b>department</b>
Prof. Dr.-Ing. Andreas Czylik	

<b>semester</b>	<b>cycle</b>	<b>language</b>	<b>requirements</b>
2		German	

<b>SWS</b>	<b>presence hours</b>	<b>self-study hours</b>	<b>workload</b>	<b>ECTS-Credits</b>
4	60	90	150	5

<b>description</b>
Introduction Probability; Random variables; Functions of a random variable; Two random variables, sequences of random variables; Stochastic processes; Transformation of stochastic processes by systems
<b>kind of examination</b>
According to § 17 of the examination regulation the type and duration of the examination will be defined from the lecturer before the semester starts. Therefore an examination can be a written test with a length of 30 to 120 minutes or an oral examination with a length of 30 to 60 minutes. The language of the examination is the same as the language of the lecture.
<b>literature</b>
A. Papoulis: Probability, random variables, and stochastic processes
<b>remark</b>

<b>modul name</b>	<b>shorthand expression of module</b>
Advanced mathematical and communication Theories	
<b>lecture name</b>	<b>shorthand expression of lecture</b>
<b>Information Theory</b>	
<b>lecturer</b>	<b>department</b>
Dr.-Ing. Dietmar Petras	

<b>semester</b>	<b>cycle</b>	<b>language</b>	<b>requirements</b>
2		German	

<b>SWS</b>	<b>presence hours</b>	<b>self-study hours</b>	<b>workload</b>	<b>ECTS-Credits</b>
4	60	90	150	5

<b>description</b>
<b>kind of examination</b>
According to § 17 of the examination regulation the type and duration of the examination will be defined from the lecturer before the semester starts. Therefore an examination can be a written test with a length of 30 to 120 minutes or an oral examination with a length of 30 to 60 minutes. The language of the examination is the same as the language of the lecture.
<b>literature</b>
Vorlesungsmanuskript
<b>remark</b>

<b>modul name</b>	<b>shorthand expression of module</b>
Advanced mathematical and communication Theories	
<b>lecture name</b>	<b>shorthand expression of lecture</b>
<b>Mathematics C2 (Numerical Mathematics)</b>	
<b>lecturer</b>	<b>department</b>
Prof. Dr. rer. nat. Wolfgang Schreiber	

<b>semester</b>	<b>cycle</b>	<b>language</b>	<b>requirements</b>
1		English	

<b>SWS</b>	<b>presence hours</b>	<b>self-study hours</b>	<b>workload</b>	<b>ECTS-Credits</b>
4	60	120	180	6

<b>description</b>
1 Error Analysis Representation of numbers, Floating-point-numbers, Rounding errors, Error Propagation, Error propagation in arithmetic operations, Condition numbers 2 Nonlinear equations The method of Bisection, The secant method, Newton's method, Fixed point iteration, Polynomial equations, Systems of nonlinear equations, Newton's method for systems 3 Systems of Linear Equations The LR and Cholesky Decomposition, The LR-Decomposition, The Cholesky Decomposition, Gauss Elimination and Back-Substitution, Pivoting strategies, The QR Decomposition, Data fitting; Least square problems, Iterative solutions, Jacobi Iteration (total-step-method), Gauss-Seidel-Iteration (single-step-method), Convergence properties 4 Finding Eigenvalues The Power method, Localizing eigenvalues , The QR-method, Hessenberg matrices 5 Ordinary Differential Equations Basic analytic methods, Separation of variables, Linear differential equations, One-step-methods, Euler's Method, Midpoint Euler, Two-stage-models, Runge-Kutta-methods 6 Polynoniial Interpolation Lagrange form of Interpolation Polynomial, Interpolation Error, Divided Differences, Spline Interpolation
<b>kind of examination</b>
According to § 17 of the examination regulation the type and duration of the examination will be defined from the lecturer before the semester starts. Therefore an examination can be a written test with a length of 30 to 120 minutes or an oral examination with a length of 30 to 60 minutes. The language of the examination is the same as the language of the lecture.
<b>literature</b>
·1 Gautschi, W. Numerical Analysis, Birkhäuser. ·2 Hammerlin und Hoffmann. Numerische Mathematik, Springer. ·3 Householder. A.S. Principles of Numerical Analysis, Dover Publications. ·4 Kincaid,D. and Cheney, W. Numerical Analysis, Brooks/Cole Publishing. ·5 Locher. Numerische Mathematik für Informatiker. ·6 Philipps,C. and Cornelius, B. Computational Numerical Methods, Ellis Hoorwood. ·7 Stoer, J. and Burlisch, R. Introduction to numerical Analysis.
<b>remark</b>

<b>modul name</b>	<b>shorthand expression of module</b>
<b>Advanced Communications Engineering</b>	
<b>course coordinator</b>	<b>faculty</b>
Prof. Dr.-Ing. Klaus Solbach	-
<b>used in degree course</b>	
<ul style="list-style-type: none"> <li>• Master of Science in Computer Science and Communications Engineering</li> </ul>	

<b>nr</b>	<b>courses</b>	<b>semester</b>	<b>sws</b>	<b>workload</b>	<b>ECTS-credits</b>
1	Advanced Mobile Communications	3	3	120	4
2	Communication Networks	1	3	150	5
3	Communications 3	3	3	120	4
4	Distributed Systems	3	4	180	6
<b>total</b>			<b>13</b>	<b>570</b>	<b>19</b>

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<b>modul name</b>	<b>shorthand expression of module</b>
Advanced Communications Engineering	
<b>lecture name</b>	<b>shorthand expression of lecture</b>
<b>Advanced Mobile Communications</b>	
<b>lecturer</b>	<b>department</b>
Prof. Dr.-Ing. habil. Peter Jung	

<b>semester</b>	<b>cycle</b>	<b>language</b>	<b>requirements</b>
3		English	

<b>SWS</b>	<b>presence hours</b>	<b>self-study hours</b>	<b>workload</b>	<b>ECTS-Credits</b>
3	45	75	120	4

<b>description</b>
The lecture discusses the current R&D projects carried out by the Department of Communication Technologies. Hence, the lecture comprises the following subject areas: • Integration of Wireless Multimedia Applications • Infrastructure Aspects of Wireless Communication Systems • New Technologies of Signal Demodulation (sifirX) • Reconfigurable Radio (Software Defined Radio, SDR) • Smart Antennas for Future Wireless Communications • Transceiver Techniques for Systems Beyond 3G
<b>kind of examination</b>
According to § 17 of the examination regulation the type and duration of the examination will be defined from the lecturer before the semester starts. Therefore an examination can be a written test with a length of 30 to 120 minutes or an oral examination with a length of 30 to 60 minutes. The language of the examination is the same as the language of the lecture.
<b>literature</b>
<ul style="list-style-type: none"> <li>- P. Jung: Analyse und Entwurf digitaler Mobilfunksysteme. Stuttgart: Teubner, 1997.</li> <li>- F. Jondral: Nachrichtensysteme. Weil der Stadt: Schlembach, 2001.</li> <li>- J.G. Proakis, M. Salehi: Grundlagen der Kommunikationstechnik. Boston: Pearson, 2004.</li> <li>- A.V. Oppenheim, R.W. Schaffer, J.R. Buck: Zeitdiskrete Signalverarbeitung, 2. Aufl., Boston: Pearson, 2004.</li> <li>- J.-R. Ohm, H.D. Lüke: Signalübertragung. 8. Aufl., Berlin: Springer, 2002.</li> <li>- K.D. Kammeyer, V. Kühn: MATLAB in der Nachrichtentechnik. Weil der Stadt: Schlembach, 2001.</li> <li>- B. Meffert, O. Hochmuth: Werkzeuge der Signalverarbeitung. München: Pearson, 2004.</li> <li>- M. Wuschke: UMTS. Stuttgart: Teubner, 2003.</li> <li>- B. Walke, M.P. Althoff, P. Seidenberg: UMTS - Ein Kurs. Weil der Stadt: Schlembach, 2001.</li> <li>- T. Giebel: Grundlagen der CMOS-Technologie. Stuttgart: Teubner, 2001.</li> <li>- M. Werner: Digitale Signalverarbeitung mit MATLAB. 2. Aufl., Wiesbaden: Vieweg, 2003.</li> <li>- M.G. Di Benedetto, G. Giancola: Understanding Ultra Wide Band Radio Fundamentals. Upper Saddle River: Prentice Hall, 2004.</li> <li>- N. Dahnoun: Digital Signal Processing Implementation using the TMS 320C6000 DSP Platform. Upper Saddle River: Prentice Hall, 2000.</li> <li>- P.S.R. Diniz, E.A.B. da Silva, S.L. Netto: Digital Signal Processing. Cambridge: Cambridge University Press, 2002.</li> </ul>



- S. Lin, D. Costello: Error Control Coding. 2. Aufl., Boston: Pearson, 2004.
- R.E. Blahut: Algebraic Codes for Data Transmission. Cambridge: Cambridge University Press, 2003.
- A.S. Tanenbaum: Computer Networks. 4. Aufl. Boston: Pearson, 2003.
- X. Wang, H.V. Poor: Wireless Communication Systems. Upper Saddle River: Prentice Hall, 2004.
- T.H. Lee: The Design of CMOS Radio-Frequency Integrated Circuits. Cambridge: Cambridge University Press, 2004.
- S. Verdú: Multiuser Detection. Cambridge: Cambridge University Press, 1998.
- E. G. Larsson, P. Stoica: Space-Time Block Coding for Wireless Communications. Cambridge: Cambridge University Press, 2003.
- A. Paulraj, R. Nabar, D. Gore: Introduction to Space-Time Wireless Communications. Cambridge: Cambridge University Press, 2003.
- H.P.E. Stern, S.A. Mahmoud: Communication Systems. Upper Saddle River: Prentice Hall, 2004.
- J.H. McClellan, R.W. Schafer, M.A. Yoder: Signal Processing First. Upper Saddle River: Prentice Hall, 2003.
- V.F. Fusco: Foundations of Antenna Theory and Techniques. Upper Saddle River: Prentice Hall, 2005.

**remark**

<b>modul name</b>	<b>shorthand expression of module</b>
Advanced Communications Engineering	
<b>lecture name</b>	<b>shorthand expression of lecture</b>
<b>Communication Networks</b>	
<b>lecturer</b>	<b>department</b>
Prof. Dr.-Ing. habil. Peter Jung	

<b>semester</b>	<b>cycle</b>	<b>language</b>	<b>requirements</b>
1		German	

<b>SWS</b>	<b>presence hours</b>	<b>self-study hours</b>	<b>workload</b>	<b>ECTS-Credits</b>
3	45	105	150	5

<b>description</b>
In the lecture "Kommunikationsnetze" an overview over the basics of digital communication is given. For this the following themes are treated: - Basic terms - Hierarchical structures of network functions (OSI-layered model) - Methods for point-to-point communication - Multiple access protocols - Methods for reliable data transmission - Routing and flow control - Queuing theory
<b>kind of examination</b>
According to § 17 of the examination regulation the type and duration of the examination will be defined from the lecturer before the semester starts. Therefore an examination can be a written test with a length of 30 to 120 minutes or an oral examination with a length of 30 to 60 minutes. The language of the examination is the same as the language of the lecture.
<b>literature</b>
·1 M. Bossert, M. Breitbach: Digitale Netze. Stuttgart: Teubner, 1999. ·2 W. Stehle: Digitale Netze. Weil der Stadt: Schlembach, 2001.
<b>remark</b>

<b>modul name</b>	<b>shorthand expression of module</b>
Advanced Communications Engineering	
<b>lecture name</b>	<b>shorthand expression of lecture</b>
<b>Communications 3</b>	
<b>lecturer</b>	<b>department</b>
Prof. Dr.-Ing. Andreas Czylik	

<b>semester</b>	<b>cycle</b>	<b>language</b>	<b>requirements</b>
3		German	

<b>SWS</b>	<b>presence hours</b>	<b>self-study hours</b>	<b>workload</b>	<b>ECTS-Credits</b>
3	45	75	120	4

<b>description</b>
Introduction; Analog communication systems; Amplitude modulation; Angle modulation; Equivalent baseband systems; Bandpass noise; Digital communication systems; Modulation schemes; Receiver techniques; Channels with intersymbol interference; Synchronisation; Transmission channels; Elektrical waveguides; Optical waveguides; Radio channels
<b>kind of examination</b>
According to § 17 of the examination regulation the type and duration of the examination will be defined from the lecturer before the semester starts. Therefore an examination can be a written test with a length of 30 to 120 minutes or an oral examination with a length of 30 to 60 minutes. The language of the examination is the same as the language of the lecture.
<b>literature</b>
·1 S. Haykin: Communication systems; ·2 J. G. Proakis: Digital communications; ·3 S. Benedetto, E. Biglieri, and V. Castellani: Digital transmission theory
<b>remark</b>

<b>modul name</b>	<b>shorthand expression of module</b>
Advanced Communications Engineering	
<b>lecture name</b>	<b>shorthand expression of lecture</b>
<b>Distributed Systems</b>	
<b>lecturer</b>	<b>department</b>
Prof. Dr. rer. soc. Heinz Ulrich Hoppe	

<b>semester</b>	<b>cycle</b>	<b>language</b>	<b>requirements</b>
3		German	Data structures and algorithms; object-oriented programming

<b>SWS</b>	<b>presence hours</b>	<b>self-study hours</b>	<b>workload</b>	<b>ECTS-Credits</b>
4	60	120	180	6

<b>description</b>
The first section deals with basic concepts and definitions such as "distributed system", client-server and peer-to-peer architectures, concurrency and synchronisation, replication. Section 2 is dedicated to technical foundations and principles which include: - System models and architectures, - Communication protocols and layers, - Operating system level support (incl. threads and processes), - Communication mechanisms (incl. RMI and CORBA), - Synchronisation, - Replication and consistency. In the latter subsections, also formal analyses of algorithms in distributed systems are covered. Section 3 elaborates on formal methodology by introducing Petri nets and different types of agent models. The forth and last section is dedicated to CSCW and CSCL applications. A number of examples are presented and several classification principles are elaborated. Design and evaluation methodologies are covered in a broad overview.
<b>kind of examination</b>
According to § 17 of the examination regulation the type and duration of the examination will be defined from the lecturer before the semester starts. Therefore an examination can be a written test with a length of 30 to 120 minutes or an oral examination with a length of 30 to 60 minutes. The language of the examination is the same as the language of the lecture.
<b>literature</b>
<ul style="list-style-type: none"> <li>·1 Coulouris/Dollimore/Kindberg: Distributed Systems - Concepts and Design, Addison-Wesley 2001 (3rd edition).</li> <li>·2 Tannenbaum/van Steen: Distributed Systems - Principles and Paradigms, Prentice Hall 2002.</li> <li>·3 Borghoff/Schlichter: Rechnergestützte Gruppenarbeit (in German), Springer 1998.</li> </ul>
<b>remark</b>

<b>modul name</b>	<b>shorthand expression of module</b>
Coding	
<b>course coordinator</b>	<b>faculty</b>
Prof. Dr.-Ing. Klaus Solbach	-
<b>used in degree course</b>	
• Master of Science in Computer Science and Communications Engineering	

nr	courses	semester	sws	workload	ECTS-credits
1	Coding Theory	2	3	120	4
2	Multidimensional Signals	3	3	150	5
<b>total</b>			<b>6</b>	<b>270</b>	<b>9</b>

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<b>modul name</b>	<b>shorthand expression of module</b>
Coding	
<b>lecture name</b>	<b>shorthand expression of lecture</b>
<b>Coding Theory</b>	
<b>lecturer</b>	<b>department</b>
Prof. Dr.-Ing. Andreas Czylik	

<b>semester</b>	<b>cycle</b>	<b>language</b>	<b>requirements</b>
2		English	

<b>SWS</b>	<b>presence hours</b>	<b>self-study hours</b>	<b>workload</b>	<b>ECTS-Credits</b>
3	45	75	120	4

<b>description</b>
Introduction; Information theory; Channel coding in digital communication systems; Algebraic foundations for coding; Block codes; Convolutional codes; Coding techniques; Outlook
<b>kind of examination</b>
According to § 17 of the examination regulation the type and duration of the examination will be defined from the lecturer before the semester starts. Therefore an examination can be a written test with a length of 30 to 120 minutes or an oral examination with a length of 30 to 60 minutes. The language of the examination is the same as the language of the lecture.
<b>literature</b>
<ul style="list-style-type: none"> <li>· H. Schneider-Obermann: Kanalcodierung;</li> <li>· B. Friederichs: Kanalcodierung;</li> <li>· M. Bossert: Kanalcodierung</li> </ul>
<b>remark</b>

<b>modul name</b>	<b>shorthand expression of module</b>
Coding	
<b>lecture name</b>	<b>shorthand expression of lecture</b>
<b>Multidimensional Signals</b>	
<b>lecturer</b>	<b>department</b>
Dr.-Ing. Guido Bruck	

<b>semester</b>	<b>cycle</b>	<b>language</b>	<b>requirements</b>
3		German	

<b>SWS</b>	<b>presence hours</b>	<b>self-study hours</b>	<b>workload</b>	<b>ECTS-Credits</b>
3	45	105	150	5

<b>description</b>
Fundamentals - Units and quantities of photometry - Principle of the electronic image recording, –transmission and –reproduction - Limits of the human visual system - The use of limits of the human visual system for irrelevancy reduction Linear image distortions by detection and reproduction devices The Fourier-Transformation of two- and multidimensional signals The two- and multidimensional sampling The videosignal Colourimetry
<b>kind of examination</b>
According to § 17 of the examination regulation the type and duration of the examination will be defined from the lecturer before the semester starts. Therefore an examination can be a written test with a length of 30 to 120 minutes or an oral examination with a length of 30 to 60 minutes. The language of the examination is the same as the language of the lecture.
<b>literature</b>
<ul style="list-style-type: none"> <li>· Bernath, K.W.: Grundlagen der Fernseh-System und Schaltungstechnik Verlag: Springer-Verlag, Berlin, Heidelberg ... 1982</li> <li>· Bernath, K.W.: Technik des Fernsehens Verlag: Springer-Verlag, Berlin, Heidelberg ... 1986</li> <li>· Dillenburger, W.: Einführung in die Fernsehtechnik, Band 1 und 2 Verlag: Schiele &amp; Schön, Berlin 1975</li> <li>· Lang, Heinwig : Farbmeterik und Farbfernsehen Verlag: Oldenbourg, München 1978</li> <li>· Mäusl, Rudolf : Fernsehtechnik Verlag: Hüthig, Heidelberg 1991</li> <li>· Morgenstern, B.: Farbfernsehetechnik Verlag: Teubner, Stuttgart 1989</li> <li>· Richter, Manfred : Einführung in die Farbmeterik Verlag: deGruyter, 1981</li> <li>· Schönfelder, H.: Fernsehetechnik Teil 1 und 2 Verlag: Justus von Liebig Verlag, Darmstadt 1973</li> <li>· Schröder, H.: Mehrdimensionale Signalverarbeitung Verlag: B.G. Teubner, Stuttgart 1998</li> <li>· Schröder, F.; Theile, R.; Wendt, G.: Fernsehetechnik, 1. Teil, 2. Teil</li> </ul>

Verlag: Springer-Verlag, Berlin, Heidelberg ... 1956  
· Telefunken, verschiedene Autoren: Farbfernsehtechnik, Band I und II  
Verlag: Elitera, Berlin 1973  
· Theile, R.: Fernsehtechnik Band 1  
Verlag: Springer-Verlag, Berlin, Heidelberg ... 1973  
· Welland, K.: Farbfernsehen  
Verlag: Franzis-Verlag, München 1966  
· Wendland, Broder : Fernsehtechnik Band 1: Grundlagen  
Verlag: Hüthig, Heidelberg 1988  
· Wendland, Broder; Schröder, Hartmut : Fernsehtechnik Band 2  
Verlag: Hüthig, Heidelberg 1991  
· Cattermole, Kenneth W.: Determinate theory of signals and waves 1985  
· Papoulis, Athanasios: Systems and transforms with applications in optics  
Verlag: McGraw-Hill, New York 1968  
· Dudgeon, Dan E.: Multidimensional digital signal processing  
Verlag: Prentice-Hall, Englewood Cliffs 1984  
· Crochiere, Ronald E., Lawrence, Rabiner: Multirate digital signal processing  
Verlag: Prentice Hall, Englewood Cliffs 1983

**remark**



<b>modul name</b>	<b>shorthand expression of module</b>
<b>Non-Technical Subjects</b>	
<b>course coordinator</b>	<b>faculty</b>
Prof. Dr.-Ing. Axel Hunger Prof. Dr.-Ing. Uwe Maier Prof. Dr.-Ing. Paul Josef Mauk Prof. Dr.-Ing. Klaus Solbach Prof. Dr. rer. nat. Jan-Dirk Herbell	-
<b>used in degree course</b>	
<ul style="list-style-type: none"> <li>• Master of Science in Computer Engineering</li> <li>• Master of Science in Computer Science and Communications Engineering</li> <li>• Master of Science in Control and Information Systems</li> <li>• Master of Science in Electrical and Electronic Engineering (Communications Engineering)</li> <li>• Master of Science in Electrical and Electronic Engineering (Power and Automation)</li> <li>• Master of Science in Mechanical Engineering (Water Resources and Environmental Engineering)</li> <li>• Master of Science in Mechanical Engineering (Production and Logistics)</li> <li>• Master of Science in Mechanical Engineering (Mechatronics)</li> </ul>	

nr	courses	semester	sws	workload	ECTS-credits
1	Non-Technical Subject 1	1	2	60	2
2	Non-Technical Subject 2	1	2	60	2
3	Non-Technical Subject 3	3	2	60	2
<b>total</b>			<b>6</b>	<b>180</b>	<b>6</b>

<b>description:</b>
<p>This module gives Master-students the opportunity to demonstrate their participation in non-technical subjects. Students are able to choose from all offers of the University Duisburg-Essen, e.g. language courses or lectures on business administration and sociology and culture.</p>

<b>modul name</b>	<b>shorthand expression of module</b>
Non-Technical Subjects	
<b>lecture name</b>	<b>shorthand expression of lecture</b>
<b>Non-Technical Subject 1</b>	
<b>lecturer</b>	<b>department</b>
NN	

<b>semester</b>	<b>cycle</b>	<b>language</b>	<b>requirements</b>
1			

<b>SWS</b>	<b>presence hours</b>	<b>self-study hours</b>	<b>workload</b>	<b>ECTS-Credits</b>
2	30	30	60	2

<b>description</b>
<b>kind of examination</b>
According to § 17 of the examination regulation the type and duration of the examination will be defined from the lecturer before the semester starts. Therefore an examination can be a written test with a length of 30 to 120 minutes or an oral examination with a length of 30 to 60 minutes. The language of the examination is the same as the language of the lecture.
<b>literature</b>
<b>remark</b>

<b>modul name</b>	<b>shorthand expression of module</b>
Non-Technical Subjects	
<b>lecture name</b>	<b>shorthand expression of lecture</b>
<b>Non-Technical Subject 2</b>	
<b>lecturer</b>	<b>department</b>
NN	

<b>semester</b>	<b>cycle</b>	<b>language</b>	<b>requirements</b>
1			

<b>SWS</b>	<b>presence hours</b>	<b>self-study hours</b>	<b>workload</b>	<b>ECTS-Credits</b>
2	30	30	60	2

<b>description</b>
<b>kind of examination</b>
According to § 17 of the examination regulation the type and duration of the examination will be defined from the lecturer before the semester starts. Therefore an examination can be a written test with a length of 30 to 120 minutes or an oral examination with a length of 30 to 60 minutes. The language of the examination is the same as the language of the lecture.
<b>literature</b>
<b>remark</b>

<b>modul name</b>	<b>shorthand expression of module</b>
Non-Technical Subjects	
<b>lecture name</b>	<b>shorthand expression of lecture</b>
<b>Non-Technical Subject 3</b>	
<b>lecturer</b>	<b>department</b>
NN	

<b>semester</b>	<b>cycle</b>	<b>language</b>	<b>requirements</b>
3			

<b>SWS</b>	<b>presence hours</b>	<b>self-study hours</b>	<b>workload</b>	<b>ECTS-Credits</b>
2	30	30	60	2

<b>description</b>
<b>kind of examination</b>
According to § 17 of the examination regulation the type and duration of the examination will be defined from the lecturer before the semester starts. Therefore an examination can be a written test with a length of 30 to 120 minutes or an oral examination with a length of 30 to 60 minutes. The language of the examination is the same as the language of the lecture.
<b>literature</b>
<b>remark</b>

<b>modul name</b> <b>Advanced Network Technology</b>	<b>shorthand expression of module</b>
<b>course coordinator</b> Prof. Dr.-Ing. Axel Hunger	<b>faculty</b> -
<b>used in degree course</b>	
<ul style="list-style-type: none"> <li>• Master of Science in Computer Engineering</li> <li>• Master of Science in Computer Science and Communications Engineering</li> </ul>	

nr	courses	semester	sws	workload	ECTS-credits
1	Security in Computer Networks	2	3	120	4
2	Security, Safety and Reliability of Digital Systems	1	3	150	5
3	Switched Networks	2	4	150	6
<b>total</b>			<b>10</b>	<b>420</b>	<b>15</b>

<b>description:</b>
In this module, besides the systematically approach to software development, the basic concept of distributed systems will be given. Finally the computer-supported groupwork and the developing processes necessary for this will be dealt with.

<b>modul name</b>	<b>shorthand expression of module</b>
Advanced Network Technology	
<b>lecture name</b>	<b>shorthand expression of lecture</b>
<b>Security in Computer Networks</b>	
<b>lecturer</b>	<b>department</b>
Prof. Dr.-Ing. Walter Geisselhardt	

<b>semester</b>	<b>cycle</b>	<b>language</b>	<b>requirements</b>
2		English	

<b>SWS</b>	<b>presence hours</b>	<b>self-study hours</b>	<b>workload</b>	<b>ECTS-Credits</b>
3	45	75	120	4

<b>description</b>
This lecture will include the following topics: Introduction (network structure, security measures at ISO/OSI layers, what's security, safety, privacy ?), Hacking, Firewalls, Viruses, Worms & Trojans, Access Control Lists (ACLs), safe passwords, DoS-attacks, Attacks in general, spoofing, eavesdropping, Intrusion detection, Cryptography, Steganography and digital Watermarking.
<b>kind of examination</b>
According to § 17 of the examination regulation the type and duration of the examination will be defined from the lecturer before the semester starts. Therefore an examination can be a written test with a length of 30 to 120 minutes or an oral examination with a length of 30 to 60 minutes. The language of the examination is the same as the language of the lecture.
<b>literature</b>
<ul style="list-style-type: none"> <li>·1 R. Oppliger : Internet and Intranet Security, (Artech House, 1998)</li> <li>·2 W. Stallings : Cryptography and Network Security, (Prentice Hall, Upper Saddle River, 1999)</li> <li>·3 A.S. Tanenbaum : Distributed Systems, (Prentice Hall, 2002)</li> <li>·4 D. Kosiur : Virtual Private Networks, (Wiley, 1998)</li> <li>·5 B. Schneier : Angewandte Kryptographie, (Addison Wesley, München, 1996) // Applied Cryptography, (John Wiley &amp; Sons, 1996)</li> <li>·6 R.K. Nichols, P.C. Lekkas : Wireless Security, (McGraw-Hill, 2002)</li> <li>·7 S. Katzenbeisser, F.A.P. Petitcolas : Information Hiding, (Artech House, Norwood, 2000)</li> </ul>
<b>remark</b>

<b>modul name</b>	<b>shorthand expression of module</b>
Advanced Network Technology	
<b>lecture name</b>	<b>shorthand expression of lecture</b>
<b>Security, Safety and Reliability of Digital Systems</b>	
<b>lecturer</b>	<b>department</b>
Prof. Dr.-Ing. Axel Hunger Prof. Dr.-Ing. Walter Geisselhardt Prof. Dr.-Ing. Hans-Dieter Kochs	

semester	cycle	language	requirements
1		German	

SWS	presence hours	self-study hours	workload	ECTS-Credits
3	45	105	150	5

<b>description</b>
<p>Part 1 shows general aspects of network security. First different cryptographic algorithms are described, then the principles of IPSec and SSL are shown and last but not least the young field of quantum computing and quantum cryptography is introduced. Part 2 IIa) Introduction into the classical theory on reliability. The notions of reliability and availability are being outlined, and the most common reliability measures in conjunction with their typical distribution-functions are being presented. Reliability schematic diagrams are being used to model the availability-function of technical systems and to estimate their reliability. IIb) Hardware Reliability of digital circuits. This section emphasizes on the causes of hardware faults in digital circuits and the resulting effects. Based on the classical stuck-at fault model, fault-simulation procedures for combinational circuits are being presented. Also, measures to increase the fault-tolerance of digital circuits are being discussed. IIc) Software Reliability. The last section spots on the life cycle of software and the various development-procedures in software design. The effects of hardware faults onto the software are being emphasized, and the method of signature-monitoring in software is being presented in detail. Part 3 is an introduction to dependability (reliability and safety) of technical systems. The following chapters are outlined in detail: 1) Introduction of dependability theory, 2) Introduction of basic probability theory, 3) Markovian processes, 4) Minimal cut method and approximation procedures.</p>
<b>kind of examination</b>
<p>According to § 17 of the examination regulation the type and duration of the examination will be defined from the lecturer before the semester starts. Therefore an examination can be a written test with a length of 30 to 120 minutes or an oral examination with a length of 30 to 60 minutes. The language of the examination is the same as the language of the lecture.</p>
<b>literature</b>
<p>Teil 1 / Part 1:  ·1 W. Stallings : Cryptography and Network Security, (Prentice Hall, Upper Saddle River, 1999, ISBN 0-13-869017-0)  ·2 B. Huber : Der Quantencomputer, (url: <a href="http://pluslucis.univie.ac.at/FBA/FBA00/huber/">http://pluslucis.univie.ac.at/FBA/FBA00/huber/</a>)  Teil 2 / Part 2:</p>

Teil 3 / Part 3:

·1 H.-D. Kochs, 1984: Zuverlässigkeit elektrotechnischer Anlagen. Springer-Verlag, Berlin, Heidelberg. ISBN 3-540-13475-1 und ISBN 0-387-13475-1.

·2 Weitere umfangreiche und neue Literaturangaben sind zu finden in: Mitteilungen der Fachgruppe Fehlertolerierende Rechensysteme. Nr. 30. Dezember 2002. ISSN 0724-5319. Dieser Band gibt auch einen Überblick über die Arbeiten und Aktivitäten im Germansprachigen Raum. Dieser Band ist zu beziehen über: Dr. Karl-Erwin Großpietsch, FhG - AiS, Schloss Birlinghoven, D-53754 St. Augustin, Email: grosspietsch"ad"ais.fraunhofer.de

**remark**



<b>modul name</b>	<b>shorthand expression of module</b>
Advanced Network Technology	
<b>lecture name</b>	<b>shorthand expression of lecture</b>
<b>Switched Networks</b>	
<b>lecturer</b>	<b>department</b>
Prof. Dr.-Ing. Walter Geisselhardt	

<b>semester</b>	<b>cycle</b>	<b>language</b>	<b>requirements</b>
2		English	

<b>SWS</b>	<b>presence hours</b>	<b>self-study hours</b>	<b>workload</b>	<b>ECTS-Credits</b>
4	60	90	150	6

<b>description</b>
1. Introduction 1.1 Postulated Bandwidth for Telecommunication 1.2 Computer Network 1.2.1 Local Networks 1.2.2 WAN 1.3 Examples of LANs 2. Telecommunication 2.1 Digitizing Information Representations 2.2 Digitizing Transmission Technology (TDM, PCM, PDH, SDH) 2.3 Digitizing Switching Technology Through-connection-/Conduction Intermediation, Memory/Communication Intermediation, Package Intermediation (datagrams, virtual connection) 2.4 ISDN 3. Systems Theory of Telecommunication The OSI-Layer Model, TCP/IP Protocol Reference Model The ATM Protocol Reference Model 4. The ATM-Switching Technology 4.1 Features of ATM, Cell Format 4.2 The ATM Modulation Layer Realization of ATM-Functions as ASICS 4.3 The ATM-Layer 4.4 The Physical Layer 4.5 Intermediation and Routing of cells in ATM Networks 4.6 ATM Switch Units 5. Design of Communication Systems Languages
<b>kind of examination</b>
According to § 17 of the examination regulation the type and duration of the examination will be defined from the lecturer before the semester starts. Therefore an examination can be a written test with a length of 30 to 120 minutes or an oral examination with a length of 30 to 60 minutes. The language of the examination is the same as the language of the lecture.
<b>literature</b>
·1 F. Kaderali Digitale Kommunikationstechnik II, Vieweg, 1995 ·2 R.Kiefer Digitale Übertragung in SDH- und PDH-Netzen, expert Verlag, 1996 (43 YCT 3097) ·3 R. Händel, M. N. Huber, S. Schröder ATM Networks, Addison-Wesley, 1995 (43YCT2952) ·4 A. S. Tanenbaum Computer Networks, Prentice Hall, 1996; in German 1998 ·5 W. Stallings High-Speed Networks, Prentice Hall, 1998 ·6 G. Held Ethernet Networks, Wiley, 1998 ·7 G. Held Data Communications Networking Devices, Wiley, 1998
<b>remark</b>