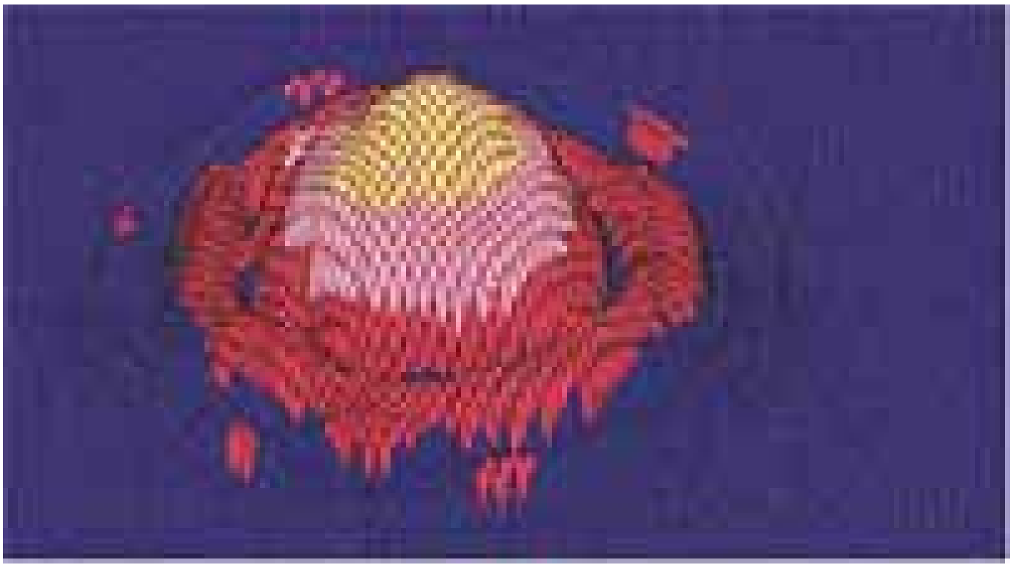
Technische Universität Hamburg-Harburg

Module Handbook

Master-Program
Information and Communication Systems



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Speciality Module I: Software for Information and Communication Systems

Elective Modules

Module: Computational Web

Course Units:

Title	*Type*	*Duration*
Computational Web	Lecture	2
Exercise: Computational Web	Exercise	1

Module Responsible:

Prof. Weberpals

Prerequisites:

None

Recommended Previous Knowledge:

Students are expected to have a solid knowledge of Software Engineering in general and of Java in particular.

Learning Outcomes:

A glimpse of the emerging Sementic Grid

ECTS Credit Points:

4

Mode of Examination:

Integral Examination

Performance Record:

Written examination

Workload in hours:

Contact Time: 42, Self-study: 78

Course Unit: Computational Web

Lecturer:

Prof. Weberpals

Language:

English

Period:

Winter Semester

Contents:

- Introduction to the Computational Web
- Grid Services Architecture
- Web Services Architecture
- Computational Web Services
- Future Trends
- The Semantic Grid

Reading Resources:

Students are expected to have a solid knowledge of Software Engineering in general and of Java in particular.

Module: Verified Software Systems

Course Units:

Title	*Type*	*Duration*
Verified Software Systems	**Lecture**	**2**
Exercise: Verified Software Systems	Exercise	2

Module Responsible:

Prof. Schupp

Prerequisites:

None

Recommended Previous Knowledge:

Discrete mathematics

Learning Outcomes:

Knowledge: Foundational theories, methods, and techniques for verifying software systems

Skills: Practical experience with relevant tools

Competencies: Assessing and applying different logics, methods, and tools

ECTS Credit Points:

5

Mode of Examination:

Integral Examination

Performance Record:

Written exam

Workload in hours:

Contact Time: 45, Self-study: 105

Course Unit: Verified Software Systems

Lecturer:

Prof. Schupp

Language:

English

Period:

Winter Semester

Contents:

Propositional logic, predicate logic, model checking, modal logic, program verification
Algorithms, modelling languages, tools

Reading Resources:

M. Huth, M. Ryan, Logic in Computer Science, Modeling and Reasoningabout Systems, Cambridge University Press, 200

Module: Software for Embedded Systems

Course Units:

Title	*Type*	*Duration*
Software for Embedded Systems	Lecture	2
Exercise: Software for Embedded Systems	Exercise	2

Module Responsible:

Prof. Turau

Prerequisites:

None

Recommended Previous Knowledge:

- Bachelor in Computer Science or electrical engineering
- programming language C
- Generally Comprehension of Microprocessors Learning

Learning Outcomes:

Knowledge: Basic Principles and Procedures for the Design of Software for Embedded Systems
Expertise: Analysis of Complex Activities with Temporal Constraints
Competencies: Modularization of Complex Systems

ECTS Credit Points:

5

Mode of Examination:

Integral Examination

Performance Record:

Written Examination

Workload in hours:

Contact Time: 45, Self-study: 105

Course Unit: Software for Emdedded Systems

Lecturer:

Prof. Turau

Language:

English

Period:

Summer Semester

Contents:

- Introduction to Embedded Systems
- Software Development for Embedded Systems
- Concurrent systems
- Realt Time
- Programming Embedded Systems
- Operating for Embedded Systems Reading

Reading Resources:

Peter Marwedel, Eingebettete Systeme, Springer Verlag, 2007
Peter Scholz, Softwareentwicklung eingebetteter Systeme, Springer Verlag, 2005
Peter Liggesmeyer, Dieter Rombach (Hrsg.): Software Engineering eingebetteter Systeme. Grundlagen - Methodik - Anwendungen. Spektrum Akademischer Verlag, 2005

Module: Software Analysis

Course Units:

Title	*Type*	*Duration*
Software Analysis	Lecture	2
Exercise: Software Analysis	Exercise	1

Module Responsible:

Prof. Schupp

Prerequisites:

None

Recommended Previous Knowledge:

Imperative and object-oriented programming; standard data structures in computer science; discrete mathematics.

Learning Outcomes:

*Knowledge:*Standard approaches, methods, and algorithms for automated program analysis
Skills: Practical experience with applications and tools
Competencies: Evaluation and assessment of different approaches and techniques

ECTS Credit Points:

4

Mode of Examination:

Integral Examination

Performance Record:

Written Examination

Workload in hours:

Contact Time: 42, Self-study: 48

Course Unit: Software Analysis

Lecturer:

Prof. Schupp

Language:

English

Period:

Summer Semester

Contents:

- Intermediate representations and models;
- Intraprocedural data flow analysis;
- Interprocedural analysis;
- Source-code analysis;
- Testing;
- Applications in program understanding

Reading Resources:

M. Pezze, M. Young, Software Testing and Analysis, Wiley 2008.
U. Khedker, A.Sanyal, B. Karkare, Data Flow Analysis. Theory and Practice. CRC Press 2009.

Module: Object-Oriented System Development in Process Automation

Course Units:

Title	*Type*	*Duration*
Oject-Oriented System Development in Process Automation	Lecture	2
Exercise: Oject-Oriented System Development in Process Automation	Exercise	2

Module Responsible:

Prof. W. Meyer

Prerequisites:

None

Recommended Previous Knowledge:

Basic knowledge in software engineering and programming, e.g. a procedural language.
Recommended though not mandatory: lecture ‘Industrial Process Automation’ by Prof. W. Meyer

Learning Outcomes:

Knowledge: Unified Modelling Language UML, Constraint based representation ILOG OPL, Object-oriented language Smalltalk
Abilities: Object-oriented modelling of complex planning systems with UML
Competence of Systems: Formal UML models for industrial pocesses
Problem Solving Competence: Evaluation of different problem representations, specially of constraint and object-based approaches for the industrial software package AIPLANNER
Social Competence: Social interaction within project groups for the realisation of software modules like the "Event-driven Simulator for industrial Transport Systems"

ECTS Credit Points:

5

Mode of Examination:

Integral Examination

Performance Record:

Written Examination

Workload in hours:

Contact Time: 45, Self-study: 105

Course Unit: Object-Oriented System Development in Process Automation

Lecturer:

Prof. W. Meyer

Language:

English

Period:

Summer Semester

Contents:

- Basic Definitions: Graphs and networks

- Problem Domain: Setup time minimization in Electronics Industry
- Application Software: AIPLANNER planning software package
- Object-oriented Modelling: Principles and methods
- Object-oriented Modelling Languages: UML and Poseidon
- Object-oriented Model: Remodelling AIPLANNER with UML
- Object-based Metrics: Measuring the quality of object-based software
- Constraint Programming: Time logics
- Agent Programming: UML extensions

Reading Resources:

J. Brauer: "Grundkurs Smalltalk - Objektorientierung von Anfang an". Vieweg Verlag, Wiesbaden 2003

B. Oestereich: "Objektorientierte Softwareentwicklung". Oldenbourg Verlag, München 1998

W. Meyer: "Expert Systems in Factory Management - Knowledge-based CIM". Ellis Horwood, New York 1990

Module: Foundations of Machine Learning and Data Mining

Course Units:

Title	*Type*	*Duration*
Foundations of Machine Learning and Data Mining	Lecture	2
Exercise: Foundations of Machine Learning and Data Mining	Exercise	1

Module Responsible:

Prof. R. Möller

Prerequisites:

None

Recommended Previous Knowledge:

Elementary knowledge in Computer Science and Mathematics as usual for a Master course.

Learning Outcomes:

- Knowledge foundational techniques, theories and methods of Machine Learning and Data Mining
- Capabilities for applying theory-based learning procedure in the context of industrial problems
- Skills for assessing the pros and cons of specific learning procedures

ECTS Credit Points:

4

Mode of Examination:

Integral Examination

Performance Record:

Written examination

Workload in hours:

Contact Time: 42, Self-study: 78

Course Unit: Foundations of Machine Learning and Data Mining

Lecturer:

Prof. R. Möller

Language:

English

Period:

Summer Semester

Contents:

- Introduction
- Learning from observations
- Inductive learning, introduction to learning decision trees
- Decision tree learning
- Information theory, information gain (ID3), extensions (C4.5), translating decision trees to rules
- Computational learning theory (PAC learning), incremental learning (version spaces)
- Uncertainty
- Bayesian networks
- Learning parameters of Bayesian networks
- BME, MAP, ML, EM algorithm
- Learning structures of Bayesian networks
- kNN-Classifier, neural network classifier, support vector machine (SVM) classifier
- Clustering

- Distance measures, k-means clustering, nearest neighbor clustering
- Knowledge in learning
- Inductive logic programming
- Learning of probabilistic relational models (PRMs)

Reading Resources:

Artificial Intelligence: A Modern Approach (Second Edition), Stuart Russel, Peter Norvig, Prentice Hall, 2003 Chapters 13-14, 18-21.

Introducion to Machine Learning Ethem Alpaydin, MIT Press, 2004

Module: Software Security

Course Units:

Title	*Type*	*Duration*
Software Security	Lecture	2
Exercise: Foundations of Machine Learning and Data Mining	Exercise	1

Module Responsible:

Prof. Gollmann

Prerequisites:

None

Recommended Previous Knowledge:

Familiarity with C or C++; object-oriented progra

Learning Outcomes:

- Knowledge: Major causes for software vulnerabilities; current practices for identifying and avoiding software vulnerabilities; fundamentals of code-based access control.
- Competencies: Vulnerability analysis of code and software systems; secure programming.

ECTS Credit Points:

4

Mode of Examination:

Integral Examination

Performance Record:

Written Examination

Workload in hours:

Contact Time: 42, Self-study: 78

Course Unit: Software Security

Lecturer:

Prof. Gollmann

Language:

English

Period:

Winter Semester

Contents:

- Reliability & software security
- Unicode attacks
- Integer overflows
- Buffer overflows
- Race conditions
- Security testing
- Type-safe languages
- SQL attacks
- Scripting languages
- Identity-based access control
- Code-based access control
- Java security model
- .NET CLR security model

- Stack walks and history-based access control

Reading Resources:

Viega & McGraw: Building Secure Software, Addison Wesley (2001)
Howard & LeBlanc: Writing Secure Code, 2nd Edition, Microsoft Press (2002)
LaMacchia, Lange, Lyons, Martin, Price: .NET Framework Security, Addison-Wesley Professional (2002)
Li Gong: Inside Java 2 Platform Security, Addison-Wesley (1999)

Module: Project Seminar

Course Units:

Title	*Type*	*Duration*
Seminar: Realization of an I&K Application System	Seminar	1
Exercise: Realization of an I&K Application System	Project	3

Module Responsible:

Prof. Schupp

Prerequisites:

None

Recommended Previous Knowledge:

- Bachelor in computer science
- Basic knowledge of a (preferably object-oriented) programming language
- Familiarity with basic concepts of the Internet

Learning Outcomes:

Knowledge: Concepts, techniques and tools of today's innovative information and communication systems. In addition, deepened knowledge required for conduction the project depending on the topic
Methodical skills: Learning and applying object-oriented analysis, design and implementation
System skills: Practically experiencing the difficulties of developing a non-trivial system

ECTS Credit Points:

6

Mode of Examination:

Integral Examination

Performance Record:

Presentations, oral participation, submitted programs

Workload in hours:

Contact Time: 52, Self-study: 108

Course Unit: Project Seminar

Lecturer:

Prof. Schupp; Prof. Turau

Language:

English

Period:

Winter Semester

Contents:

- Object-oriented analysis, design and implementation
- An object-oriented programming language (typically: Java)
- Communication protocols
- Further software technologies as required for the project
- Conducting software development projects

Reading Resources:

Ian Sommerville: Software-Engineering. Addison-Wesley. (Grundlagen: Analyse, Design, Realisierung)
J. Rumbaugh et al.: Objektorientiertes Modellieren und Entwerfen. Hanser, 1991. (Objektorientiertes OMT-Modell und Entwurfsprozeß)

Martin Fowler: UML Distilled, Applying the Standard Object Modeling Language. Addison Wesley, 1997.
(Kompakte Einführung in die UML-Notation)
E. Gamma, R. Helm, R. Johnson, J. Vlissides: Design Patterns, Elements of Reusable Object-Oriented Software. Addison-Wesley, 1995.

Speciality Module II: Digital Signal Processing

Elective Modules

Module: Adaptive Compute Systems

Course Units:

Title	*Type*	*Duration*
Adaptive Compute Systems	Lecture	2

Module Responsible:
Prof. Mayer-Lindenberg

Prerequisites:

None

Recommended Previous Knowledge:

Basic Knowledge on algorithms, digital systems
Helpful but not mandatory lectures: "Languages and Algorithms", "Digital Filter", "Signal Processors", "Pattern Recognition"

Learning Outcomes:

Knowledge: This lecture brings together various techniques and algorithms parametrically or in their structure to achieve a better performance in some sense. They cover neural networks, related adaptive filters, genetic optimization and machine learning.

ECTS Credit Points:

3

Mode of Examination:

Integral Examination

Performance Record:

Written Examination

Workload in hours:

Contact Time: 28, Self-study: 62

Course Unit: Adaptive Compute Systems

Lecturer:

Prof. Mayer-Lindenberg

Language:

English

Period:

Winter Semester

Contents:

- natural neural systems
- perceptron and multilayer feed-forward networks
- Hopfield and Kohonen networks. Boltzmann machine, ART
- adaptive FIR and IIR filters and applications
- genetics and evolution in biology
- genetic algorithms
- applications to resource allocation, programming, artificial life and neural structures
- knowledge acqusition and representation

- fuzzy logic and fuzzy data bases
- adaptive data bases
- hardware architectures for neural networks, and adaptive hardware.

Reading Resources:

Goos, Vorlesungen über Informatik Band IV, Springer-Verlag
H.Ritter, T.Martinez, K.Schulten, Neuronale Netze
K. Weicker, Evolutionäre Algorithmen, Teubner 2002

Module: Digital Video Signal Coding

Course Units:

Title	*Type*	*Duration*
Digital Video Signal Goding	Lecture	2

Module Responsible:

Prof. Grigat

Prerequisites:

None

Recommended Previous Knowledge:

Linear algebra, basic stochastics, binary arithmetics

Learning Outcomes:

- Knowledge: Broad theoretical and methodological foundations of data compression, advanced training on the example of MPEG-4 AVC
- Competece of Systems and Problem Solving: Understanding of problems, creative usage of scientific problem analysis and mathematical formalization (comparison of lossy and lossless coding schemes based on source models)

ECTS Credit Points:

2

Mode of Examination:

Integral Examination

Performance Record:

Written Examination

Workload in hours:

Contact Time: 28, Self-study: 62

Course Unit: International Logistics

Lecturer:

Prof. Grigat

Language:

English

Period:

Winter Semester

Contents:

- Information and entropy
- entropy coding (Huffman, arithmetic)
- lossless coding (DPCM, RLC, Ziv-Lempel, CALIC, JPEG-LS)
- quantisation (scalar, vector quantisation)
- transform coding (DCT, hybrid DCT)
- motion estimation
- subband coding

Reading Resources:

Salomon, Data Compression, the Complete Reference, Springer, 2000
Solari, Digital video and audio compression, McGraw-Hill, 1997
Tekalp, Digital Video Processing, Prentice Hall, 1995

Module: Digital Filters

Course Units:

Title	*Type*	*Duration*
Digital Filters	Lecture	2

Module Responsible:

Prof. Rohling

Prerequisites:

None

Recommended Previous Knowledge:

Fundamentals in linear time-invariant (LTI) system theory

Learning Outcomes:

Knowledge: Overview of analysis and synthesis of digital filters, knowledge of technical details and general design criteria
Competence in methodology: Modelling and assessment of complex systems
Competence in systems: System-oriented thinking
Soft skills: Ability of learning autonomously and efficiently, communication in English

ECTS Credit Points:

3

Mode of Examination:

Integral Examination

Performance Record:

Written Examination

Workload in hours:

Contact Time: 28, Self-study: 62

Course Unit: Digital Filters

Lecturer:

Prof. Rohling

Language:

English

Period:

Winter Semester

Contents:

- Introduction
    - Discrete-time Systems
    - Transfer Function and Frequency Response
    - Causality and Stability
    - FIR and IIR Systems
    - Signal Flow Graphs
- Finite Impulse Response Digital Filters
    - Transversal Structures
    - Lattice Structures
    - Frequency Sampling Structures
    - Symmetry Properties and Linear Phase
    - Complementary Filters
    - Half-Band Filter

- FIR Filter Design
    - Least Squared Error Design
    - Windows for FIR Filter Design
    - Frequency-Sampling Design
    - Chebyshev Approximation
    - Design of Half-Band Filters
- Infinite Impulse Response Digital Filters
    - Direct-Form Structures
    - Cascade Form Strutures
    - Parallel Form Structures
    - Allpass Structures
    - Recursive Lattice Structures
- IIR Filter Design
    - Bilinear Transformation Method
    - Impulse Invariant Method
    - Matched-Z Transformation Method
    - Frequency Transformations

Reading Resources:

Alan V. Oppenheim, Ronald W. Schafer, Discrete-Time Signal Processing, Prentice Hall, 1989,
ISBN 0-13-216771-1
John G. Proakis, Dimitris G. Manolakis, Introduction to Digital Signal Processing, Macmillan Publishing, 1988,
ISBN 0-02-396810-9

Module: Digital Signal Processors

Course Units:

Title	*Type*	*Duration*
Digital Signal Processors	Lecture	2

Modue Responsible:

Prof. Mayer-Lindenberg

Prerequisites:

None

Recommended Previous Knowledge:

Knowledge on linear systems, digital filters, digital systems and microprocessors.

Learning Outcomes:

Knowledge about state-of-the-art DSP hardware
Conpetence to design cost-effective DSP systems for given requirements

ECTS Credit Points:

3

Mode of Examination:

Integral Examination

Performance Record:

Written Examination

Workload in hours:

Contact Time: 28, Self-study: 68

Course Unit: Digital Signal Processors

Lecturer:

Prof. Mayer-Lindenberg

Language:

Englisch

Period:

Summer Semester

Contents:

- of digital signal processing
- FIR filter processor design using a multiplier accumulator
- Integrated signalprocessors
- DSP system design, host ports, converters
- fast Fourier transform and filtering in the frequency domain
- Floating point DSP, FFT and fast FIR applications
- parallel DSP systems
- comparison to fast general purpose processors
- FPGA computing and DSP on FPGA
- special purpose processors for graphics and multimedia

Reading Resources:

F. Mayer-Lindenberg, Dedicated Digital Processors, Wiley 2004
J. G. Proakis, Digital Signal Processing, Prentice Hall 1996

Module: Digital Audio Signal Processing

Course Units:

Title	*Type*	*Duration*
Digital Audio Signal Processing	Lecture	2

Module Responsible:

Prof. Zölzer

Prerequisites:

None

Recommended Previous Knowledge:

Signals and systems, Fourier, Laplace and Z transforms

Learning Outcomes:

Knowledge: Principles of digital audio signal processing with broad theoretical fundamentals.
Competence of Methods: Theory driven applications of methods for advanced signal processing.
Competence of Problem Solving: Identification of problems and creative application of scientific methods and strategies for solving problems.

ECTS Credit Points:
3

Mode of Examination:

Integral Examination

Performance Record:

Written Examination

Workload in hours:

Contact Time: 28, Self-study: 62

Course Unit: Digital Audio Signal Processing

Lecturer:

Prof. Zölzer

Language:

English

Period:

Winter Semester

Contents:

- Introduction (Studio Technology, Digital Transmission Systems, Storage Media, Audio Components at Home)
- Quantization (Signal Quantization, Dither, Noise Shaping, Number Representation)
- AD/DA Conversion (Methods, AD Converters, DA Converters, Audio Processing Systems, Digital Signal Processors, Digital Audio Interfaces, Single-Processor Systems, Multiprocessor Systems)
- Equalizers (Recursive Audio Filters, Nonrecursive Audio Filters, Multi-Complementary Filter Bank)
- Room Simulation (Early Reflections, Subsequent Reverberation, Approximation of Room Impulse Responses)
- Dynamic Range Control (Static Curve, Dynamic Behavior, Implementation, Realization Aspects)
- Sampling Rate Conversion (Synchronous Conversion, Asynchronous Conversion, Interpolation Methods)
- Data Compression (Lossless Data Compression, Lossy Data Compression, Psychoacoustics, ISO-MPEG1 Audio Coding)

Reading Resources:

U. Zölzer, Digitale Audiosignalverarbeitung, 3. Aufl., B.G. Teubner, 2005.
U. Zölzer (Ed), Digital Audio Effects, J. Wiley & Sons, 2002.

Module: Digital Image Processing

Course Units:

Title	*Type*	*Duration*
Digital Image Processing	Lecture	2
Exercise: Digital Image Processing	Exercise	1

Module Responsible:

Prof. Grigat

Prerequisites:

None

Recommended Previous Knowledge:

LTI system theory of one-dimensional signals (sampling theory, interpolation, Fourier transform, linear time-invariant systems), linear algebra (Eigenvalue decomposition), basic stochastics (expectation values and samples)

Learning Outcomes:

Knowledge: Broad theoretical and methodological foundations of imaging capture and processing algorithms, in depth knowledge of digital filtering of image signals. In-depth knowledge of interdisciplinary relations and embedding the field into the scientific and social environment (system theory, filter, physiology, perception psychology)
Competence of Methods: Theory-driven application of very demanding methods and procedures (multidimensional sampling theory, untary transforms, characterization of sensor and display)
Competence of Problem Solving: Understanding of problems, creative usage of scientific problem analysis and mathematical formalization (applications to mobile phone cameras)
Competence of Systems: Quantitative Comparison of competing methodology in multidimensional decision spaces (spatio-temporal signal processing, image deficiencies as an interrelation of perception and signal theory)

ECTS Credit Points:

4

Mode of Examination:

Integral Examination

Performance Record:

Written examination

Workload in hours:

Contact Time: 42, Self-study: 78

Course Unit: Digital Image Processing

Lecturer:

Prof. Grigat

Language:

English

Period:

Winter Semester

Contents:

- Perception of luminosity and color
- color spaces
- multidimensional sampling in space and time
- decimation, de-interlacing

- large area and edge flicker
- apertures of image sensors and displays in space and time
- image transforms
- image filtering
- edge operators
- histogram equalisation
- morphological operators
- homomorphic filtering
- hough transform
- geometric moments

Reading Resources:

Pratt, Digital Image Processing, Wiley, 2001
Jain, Fundamentals of Digital Image Processing, Prentice Hall, 1989
Jähne, Haußecker, Computer Vision and Applications, Academic Press, 2000

Speciality Module III: Networking

Elective Modules

Module: Optical Communications

Course Units:

Title	*Type*	*Duration*
Optical Communications	Lecture	2
Exercise: Optical Communications	Exercise	1

Module Responsible:

Prof. Brinkmeyer

Prerequisites:

None

Recommended Previous Knowledge:

Fundamentals of electromagnetic theory, communications, waveguide theory, and electronic devices

Learning Outcomes:

Knowledge: Understanding basic principles of optical communications
Competencies: Abilities of designing and evaluating optical transmission systems

ECTS Credit Points:

4

Mode of Examination:

Integral Examination

Performance Record:

Oral Examination

Workload in hours:

Contact Time: 42, Self-study: 78

Course Unit: Optical Communications

Lecturer:

Prof. Brinkmeyer

Language:

English

Period:

Winter Semester

Contents:

- Review of optical waveguide fundamentals
- Properties of silica optical fiber relevant in communications
- Passive components in fiber optics
- Review of photodiode and LED fundamentals
- Noise in photodetectors
- Laserdiodes
- Optical fiber amplifiers
- Nonlinearities in optical fibers
- Optical fiber systems

Reading Resources:

G.P. Agrawal: Fiber-optic communication system. John Wiley&Sons, 2002
J. Gowar: Optical communication systems, Prentice-Hall, 1997
I.P. Kaminov, L. Koch (ed.): Optical Fiber Telecommunications, vol. IIIa, IIIb, Academic Press 1997
E. Voges, K. Petermann (ed.): Optische Kommunikationstechnik, Springer, 2002

Module: Microwave Engineering

Course Units:

Title	*Type*	*Duration*
Microwave Engineering	Lecture	2
Exercise: Microwave Engineering	Exercise	1

Module Responsible:

Prof. Jacob

Prerequisites:

None

Recommended Previous Knowledge:

The lecture is based on fundamentals of communication engineering, semiconductor devices and circuits, and wave propagation.

Learning Outcomes:

Knowledge: In-depth Introduction to the Foundations of Microwave Engineering
Competence of Methods: Dedicated Application of the Theoretical Foundations to the Analysis of Selected Practical Problems

ECTS Credit Points:

4

Mode of Examination:

Integral Examination

Performance Record:

Written Examination

Workload in hours:

Contact Time: 42, Self-study: 78

Course Unit: Microwave Engineering

Lecturer:

Prof. Jacob

Language:

English

Period:

Winter Semester

Contents:

- Antennas: Analysis - Characteristics - Realizations;
- Radio Wave Propagation
- Transmitter: Power Generation with Vacuum Tubes and Transistors;
- Receiver: Preamplifier - Heterodyning - Noise;
- Selected System Applications

Reading Resources:

Voges, E.: Hochfrequenztechnik, Hüthig, 2004
Jacob, A.: Vorlesungsskript (deutsch)

Module: Communication Networks I: Principles

Course Units:

Title	*Type*	*Duration*
Communication Networks I	Lecture	2
Exercise: Communication Networks I	Exercise	1

Module Responsible:

Prof. Timm-Giel

Prerequisites:

None

Recommended Previous Knowledge:

Probability theory fundamentals, Poisson process

Learning Outcomes:

- After successful completion of this course students should be able to
- to identify and to explain principles and generic problems of communication networks and protocols
- to explain solution methods of the different problem classes
- to develop solutions for problem statements similar to the generic paradigms
- to participate in English based communication during the lesson

ECTS Credit Points:

4

Mode of Examination:

Integral Examination

Performance Record:

Written Examination

Workload in hours:

Contact Time: 42, Self-study: 78

Course Unit: Communication Networks I

Lecturer:

Prof. Timm-Giel

Language:

English

Period:

Winter Semester

Contents:

- Introduction to Communication Networks
- OSI – Model
- Basic Principles:
    - Error handling (detection, correction, repeat request)
    - Flow control (window technique, channel utilization)
    - Routing (shortest path routing, bifurcated routing, broadcast routing)
    - Multiple access protocols (TDMA, reservation, token, ALOHA, CSMA, CSMA/CD)
- Sample Networks
    - TCP/IP and the Internet
    - WLAN
    - Mobile Communication Networks

Reading Resources:

A.S. Tanenbaum: Computer Networks, 4th ed., Pearson Education International (2003)
A.S. Tanenbaum: Computernetzwerke, 4.Aufl.,Pearson Studium (2003)
J. Schiller, Mobile Communication Networks
M. Bossert, M. Breitbach, Digitale Netze, Teubner Leipzig (1999)
Larry L. Peterson & Bruce S.Davie: Computer Networks, Morgan Kaufmann Publisher (2000)
James F. Kurose & Keith W. Ross: Computer Networking, Pearson/Addison Wesley (2005)

Module: Queuing Theory for Communication Networks

Course Units:

Title	*Type*	*Duration*
Queuing Theory for Communication Networks	Lecture	2
Exercise: Queuing Theory for Communication Networks	Exercise	1

Module Responsible:

Prof. Timm-Giel

Prerequisites:

None

Recommended Previous Knowledge:

Probability Theory

Learning Outcomes:

After successful completion of this course students should be able to

- to identify and to explain generic problems and solution approaches for queueing problems in communication networks
- to explain solution methods of the different problem classes
- to develop solutions for problem statements similar to the generic paradigms
- to do queueing systems based modelling and problem solving
- to understand the implications of abstraction steps and trade-offs
- to participate in English based communication during the lesson

ECTS Credit Points:

4

Mode of Examination:

Integral Examination

Performance Record:

Written Examination

Workload in hours:

Contact Time: 42, Self-study: 78

Course Unit: Queuing Theory for Communication Networks

Lecturer:

Prof. Timm-Giel

Language:

English

Period:

Winter Semester

Contents:

- Random variables, stochastic processes, Markow chains
- Poisson process
- Deterministic queueing model
- Birth-death process
- Theorem of Little
- Systems with multiple servers
- M/GI/1 system
- Static and dynamic priorities

- Token method
- Networks of queues

Reading Resources:

P.G. Harrison, N.M. Patel: Performance Modelling of Communication Networks and Computer Architectures, Addison Wesley (1993)

Module: Analysis and Structure of Communication Networks

Course Units:

Title	*Type*	*Duration*
Communication Networks II	Lecture	2
Modern Methods for Modelling of Communicaton Networks	Labor	2
Exercise: Communication Networks II	Exercise	1

Module Responsible:

Prof. Timm-Giel

Prerequisites:

None

Recommended Previous Knowledge:

Understanding of basic principles of communication networks and their protocols as presented in "Communication Networks I"

Learning Outcomes:

- After successful completion of this course students should be able to
- to explain principles of discrete event simulations for communication networks
- to explain principles of network planning
- to evaluate network performance using event discrete simulation and network planning tools
- to evaluate the reliability of the simulation results, e.g. using confidence intervals
- to develop solutions for problem statements similar to the generic paradigms
- to participate in English based communication during the lesson

ECTS Credit Points:

6

Mode of Examination:

Integral Examination

Performance Record:

Written Examination

Workload in hours:

Contact Time: 56, Self-study: 124

Course Unit: Communication Networks II: Topical Networking Technologies

Lecturer:

Prof. Timm-Giel

Language:

Englisch

Period:

Summer Semester

Contents:

Discrete Event Simulations

- Random Number Generators
- Statistical Evaluation
- Simulation Systems

Network Planning

- Principles of Network Planning and Optimization

- Exact Methods, e.g. Simplex algorithm, Branch and Bound
- Heuristics, e.g. genetic algorithms, simulated annealing
- Examples

Reading Resources:

P. Bratley, B.L. Fox, L.E. Schrage: A Guide to Simulation. Springer 1983, 1987

B.P. Zeigler, H. Praehofer, T.G. Kim: Theory of Modeling and Simulation, Academic Press, 2000

R.Y. Rubinstein, B. Melamed: Modern Simulation and Modeling. Wiley Series in Probability and Statistics 1998

Labor Unit: Modern Methods for Modelling of Communication Networks

Lecturer:

Dr. Kreft

Language:

Englisch

Period:

Summer Semester

Contents:

- Learning the capabilities and the programming of an event-driven simulator
- Definition and modeling of specific problems in the area of communication networks
- Solving the problems by using discrete event simulators and MATLAB
- Understanding of network planning as an optimization problem
- Solving of discrete or mixed integer linear optimization problems

Reading Resources:

Linear Programming FAQs http://www-unix.mcs.anl.gov/otc/Guide/faq/linear-programming-faq.html

Module: Introduction to Antenna Theory

Course Units:

Title	*Type*	*Duration*
Introduction to Antenna Theory	Lecture	2
Exercise: Introduction to Antenna Theory	Exercise	1

Module Responsible:

Dr. Kreft

Prerequisites:

None

Recommended Previous Knowledge:

Fundamentals of Maxwell´s theory, transmission line theory

Learning Outcomes:

Knowledge: Detailed Knowledge on Antenna Theory and Applications
Competence of Methods: Analysis of Antennas

ECTS Credit Points:

4

Mode of Examination:

Integral Examination

Performance Record:

Oral Examination

Workload in hours:

Contact Time: 48, Self-study: 78

Course Unit: Introduction to Antenna Theory

Lecturer:

Dr. Höft

Language:

Englisch

Period:

Summer Semester

Contents:

- Method of analysis: vector potential, duality, equivalent sources, image theory, Huygens principle
- Analysis of basic structures: linear antennas, aperture antennas, array antennas
- Characterising quantities: radiation pattern, gain, radiation resistance, reciprocity, noise
- Transmission of radio and microwaves: bounded and free-space transmission
- Examples of antennas: transmit and receive anteannas for EMC, mobile services, strongly focussing antennas, ground station antennas, satellite antennas

Reading Resources:

R.E. Collin, Antennas and Radiowave Propagation, McGraw-Hill, New York 1985

Module: Mobile Communications

Course Units:

Title	*Type*	*Duration*
Mobile Communications	Lecture	2
Exercise: Mobile Communications	Exercise	1

Module Responsible:

Prof. Rohling

Prerequisites:

None

Recommended Previous Knowledge:

Fundamentals in linear time-invariant (LTI) system theory

Learning Outcomes:

Knowledge: Overview of existing and new mobile communication systems,knowledge of technical details and general design criteria
Competence in methodology: Modelling and assessment of complex systems
Competence in systems: System-oriented thinking
Soft skills: Ability of learning autonomously and efficiently, communication in English

ECTS Credit Points:

4

Mode of Examination:

Integral Examination

Performance Record:

Written Examination

Workload in hours:

Contact Time: 42, Self-study: 78

Course Unit: Mobile Communications

Lecturer:

Prof. Rohling

Language:

Englisch

Period:

Summer Semester

Contents:

- Mobile radio channels: Properties, deterministic and stochastic channel models
- Digital transmission techniques: single and multicarrier transmission, modulation schemes
- Channel estimation and equalization techniques
- Channel coding methods which are suitable for radio channels
- Diversity reception and combining techniques
- Multiple access schemes for single and multicarrier transmission
- Transmission protocols and aspects of cellular networks
- A comprehensive comparison of the transmission technique used in current systems like GSM, HIPERLAN, and DAB

Reading Resources:

John G. Proakis, Digital Communications (3rd Edition), McGraw-Hill, 1995 ISBN 0-07-051726-6

Module: Network Security

Course Units:

Title	*Type*	*Duration*
Network Security	Lecture	2
Exercise: Network Security	Exercise	1

Module Responsible:

Prof. Gollmann

Prerequisites:

None

Recommended Previous Knowledge:

Discrete mathematics, computer networks (TCP/IP)

Learning Outcomes:

Knowledge: Fundametal methods of modern cryptography; currently deployed standard network security protocols and mechanisms
Competencies: Analysis of network security problems; identification of appropriate security solutions

ECTS Credit Points:

4

Mode of Examination:

Integral Examination

Performance Record:

Written Examination

Workload in hours:

Contact Time: 42, Self-study: 78

Course Unit: Network Security

Lecturer:

Prof. Gollmann

Language:

English

Period:

Summer Semester

Contents:

- Security objectives
- Cryptographic services and mechanisms
- Hash functions
- Digital signatures: RSA and DSA
- Encryption algorithms: DES, AES, block cipher modes, stream ciphers
- Cryptanalysis, differential power analysis
- Diffie-Hellman key exchange, Kerberos
- IPsec protocols, mobile IPv6·
- SSL/TLS
- GSM/UMTS security protocols
- Firewalls and Intrusion Detection Systems
- Testing network security

Reading Resources:

A. Menezes, P. van Oorschot, S. Vanstone: Handbook of Applied Cryptography, CRC Press (1997)
D. Gollmann: Computer Security (2. Auflage), Wiley (2006)
V. Niemi, K. Nyberg: UMTS Security, Wiley (2003)

Assignment and Thesis

Compulsory Modules

Module: Project Work

Module Responsible:

A professor of the TUHH

Prerequisites:

none

Recommended Previous Knowledge:

All knowledge, skills and competencies that are taught and developed in the first year.

Learning Outcomes:

The students are able to work scientifically correct. They have the ability to complete and document research on a subject matter assignment with scientific methods independently and within a given timeframe. The students are able to develop solutions for technical problems on the basis of pure science with regards to safety, environmental, ethical and economic aspects.

ECTS Credit Points:

15

Mode of Examination:

Integral Examination

Performance Record:

Project work and oral exam

Workload:

Self-study: 450

Module: Master Thesis

Module Responsible:

A professor of the TUHH

Prerequisites:

Achievements of at least 80 ECTS from the the curriculum

Recommended Previous Knowledge:

All knowledge, skills and competencies that are taught and developed in semesters 1-3.

Learning Outcomes:

The graduates have the necessary competencies for correct scientific work and are able to write profound research papers. They have the ability to complete research on a pure science subject matter with sophisticated scientific methods independently and within a given timeframe. The students are able to analyze and evaluate possible solutions for the given problem and can put their work into the context of current research.

ECTS Credit Points:

30

Mode of Examination:

Integral Examination

Performance Record:

Thesis and Presentation

Workload:

Self-study: 900