TUHH

Technische Universität Hamburg-Harburg

Module Manual

Master of Science

Microelectronics and Microsystems

Winter Term 2014

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Program description

Content:

Core qualification

Module: Business & Management

Courses:

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Managment of Trust and Reputation	Seminar	2
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Public and Constitutional Law	Vorlesung	2

Module Responsibility:
Prof. Matthias Meyer

Admission Requirements:

Recommended Previous Knowledge:

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Capabilities:

Personal Competence:
Social Competence:
Autonomy:

ECTS-Credit points:
6 LP

Examination:

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
Civil Engineering: Kernqualifikation: Compulsory
Bioprocess Engineering: Kernqualifikation: Compulsory
Chemical and Bioprocess Engineering: Kernqualifikation: Compulsory
Computer Science: Kernqualifikation: Compulsory
Electrical Engineering: Kernqualifikation: Compulsory
Energy and Environmental Engineering: Kernqualifikation: Compulsory
Energy Systems: Kernqualifikation: Compulsory

Environmental Engineering: Kernqualifikation: Compulsory
Aircraft Systems Engineering: Kernqualifikation: Compulsory
Computational Science and Engineering: Kernqualifikation: Compulsory
Information and Communication Systems: Kernqualifikation: Compulsory
Mechatronics: Kernqualifikation: Compulsory
Microelectronics and Microsystems: Kernqualifikation: Compulsory
Product Development, Materials and Production: Kernqualifikation: Compulsory
Renewable Energies: Kernqualifikation: Compulsory
Naval Architecture and Ocean Engineering: Kernqualifikation: Compulsory
Theoretical Mechanical Engineering: Kernqualifikation: Compulsory
Process Engineering: Kernqualifikation: Compulsory
Water and Environmental Engineering: Kernqualifikation: Compulsory

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Course: Labour Law (Vorlesung)

Lecturer:
Dr. Walter Wellinghausen

Language:
DE

Cycle:
SS

Content:

- Contract of employment
- Conditions of work
- Employment protection
- Termination and cancellation of employment contracts
- Legal protection in disputes
- Rules governing compensation
- Accident and social security law
- Co-determination law
- Law governing disputes
- European employment law

Literature:
- Gesetzestexte zum Arbeitsrecht
- Rechtsprechung zum Arbeitsrecht
- Schaub: Arbeitsrechtshandbuch

Course: Business Model Generation & Green Technologies (Seminar)

Lecturer:
Dr. Michael Prange

Language:
EN

Cycle:
WS

Content:

- Overview about Green Technologies
- Introduction to Business Model Generation
- Business model patterns
- Design techniques for business ideas
- Strategy development
- Value proposition architecture
- Business plan and financing
- Component based foundations
- Lean Entrepreneurship

Based on examples and case studies primarily in the field of green technologies, students learn the basics of Business Model Generation and will be able to develop business models and to evaluate start up projects.

Literature:
Präsentationsfolien, Beispiele und Fallstudien aus der Vorlesung
Presentation slides, examples and case studies from the lecture

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Course: Corporate Entrepreneurship & Green Innovation (Seminar)

Lecturer:
Dr. Michael Prange

Language:
EN

Cycle:
SS

Content:

- Overview about Green Innovation
- Introduction to Corporate Entrepreneurship
- Entrepreneurial thinking in established companies
- Entrepreneurs and managers
- Strategic innovation processes
- Corporate Venturing
- Product Service Systems
- Open Innovation
- User Innovation

Based on examples and case studies primarily in the field of green innovation, students learn the basics of corporate entrepreneurship and will be able to implement entrepreneurial thinking in established companies and to describe strategic innovation processes.

Literature:
Präsentationsfolien, Beispiele und Fallstudien aus der Vorlesung
Presentation slides, examples and case studies from the lecture

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Course: E-Commerce (Vorlesung)

Lecturer:
Prof. Michael Ceyp

Language:
DE

Cycle:
SS

Content:
This lectures starts with an overview about the broad field of e-commerce. Then the relevant e-commerce systems, processes and management tasks are explained and discussed. Afterwards necessary online marketing instruments and their strength and weaknesses are defined to get traffic to an e-commerce shop. This lectures closes with a description of necessary steps for the e-commerce-implementation.

Literature:
Ceyp, M., Scupin, J-P. (2013), Erfolgreiches Social Media Marketing - Konzepte und Maßnahmen, Wiesbaden.
Fritz, W. (2004): Internet-Marketing und Electronic Commerce - Grundlagen-Rahmenbedingungen-Instrumente. 3. Aufl., Wiesbaden.
Heinemann, G. (2014), Der neue Online-Handel - Geschäftsmodell und Kanalexzellenz im E-Commerce, 5. Aufl, Wiesbaden.
Heinemann, G., (2012) Der neue Mobile-Commerce – Erfolgsfaktoren und Best Practices, Wiesbaden.
Kollmann, T. (2013): E-Business, 5. Aufl., Berlin.
Kreutzer, R. (2012), Praxisorientiertes Online-Marketing , Wiesbaden.
Meier, A./ Stormer, H.(2012): eBusiness &eCommerce - Management der digitalen Wertschöpfungskette, 3. Aufl., Berlin / Heidelberg.
Schwarze, J. (Hrsg) (2002): Electronic Commerce - Grundlagen und praktische Umsetzung, Herne /Berlin.
Wirtz, B.W.(2013): Electronic Business, 4. Aufl., Wiesbaden.

Course: Entrepreneurship & Green Technologies (Vorlesung)

Lecturer:
Dr. Michael Prange

Language:
DE/EN

Cycle:
WS/SS

Content:
The lecture "Entrepreneurship & Green Technologies" is offerend as an elective course for all master's programs at TUHH.
Based on examples and case studies primarily in the field of green technologies, students learn the basics of entrepreneurship and will be able to develop business models and to evaluate start-up projects.

Literature:
Präsentationsfolien, Beispiele und Fallstudien aus der Vorlesung
Presentation slides, examples and case studies from the lecture

Course: Intellectual Property (Vorlesung)

Lecturer:
Dr. Frederik Thiering

Language:
DE

Cycle:
WS

Content:

- Trademark law
- Copyright
- Patent law
- Know-how, supplementary performance protection, et al.
- Enforcement of intellectual property rights
- Licensing of intellectual property rights
- Hypothecation, security assignment and evaluation of intellectual property rights

Literature:
Quellen und Materialen wird im Internet zur Verfügung gestellt

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Course: Innovation Management (Vorlesung)

Lecturer:
Prof. Cornelius Herstatt

Language:
DE

Cycle:
SS

Content:
Innovation is key to corporate growth and sustainibility. In this lecture Prof. Herstatt presents a systematic way from generating ideas to the successful implementation of innovations. **The lecture is presented in German language only**

Literature:

- Goffin, K., Herstatt, C. and Mitchell, R. (2009): Innovationsmanagement: Strategie und effektive Umsetzung von Innovationsprozessen mit dem Pentathlon-Prinzip, München: Finanzbuch Verlag

Weiterführende Literatur

- Innovationsmanagement
  Juergen Hauschildt
- F + E Management
  Specht, G. / Beckmann, Chr.
- Management der frühen Innovationsphasen
  Cornelius Herstatt, Birgit Verworn
  (im TUHH-Intranet auch als E-Book verfügbar)
- Bringing Technology and Innovation Into the Boardroom
- weitere Literaturempfehlungen auf Anfrage

Course: International Law (Vorlesung)

Lecturer:
Dr. Frederik Thiering

Language:
EN

Cycle:
SS

Content:

- What is International Law?
- Bidding on International Tenders
- Drafting the International Project Contract
- International Dispute Resolution
- Mergers and Acquisitions
- Obtaining worldwide protection for Intellectual Property

- International product launch
- International taxation
- Import Restrictions and Antidumping

Literature:
Quellen und Materialen wird im Internet zur Verfügung gestellt

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Course: Internationalization Strategies (Vorlesung)

Lecturer:
Prof. Thomas Wrona

Language:
EN

Cycle:
SS

Content:
- Introduction
- Internationalization of markets
- Measuring internationalization of firms
- Target market strategies
- Market entry strategies
- Timing strategies
- Allocation strategies
- Case Studies

Literature:
Bartlett/Ghoshal (2002): Managing Across Borders, The Transnational Solution, 2nd edition, Boston

- Buckley, P.J./Ghauri, P.N. (1998), The Internationalization of the Firm, 2nd edition
- Czinkota, Ronkainen, Moffett, Marinova, Marinov (2009), International Business, Hoboken
- Dunning, J.H. (1993), The Globalization of Business: The Challenge of the 1990s, London
- Ghoshal, S. (1987), Global Strategy: An Organizing Framework, Strategic Management Journal, p. 425-440
- Praveen Parboteeah, K.,Cullen, J.B. (2011) , Strategic International Management, International 5th Edition
- Rugman, A.M./Collinson, S. (2012): International Business, 6th Edition, Essex 2012

Course: Management and Leadership (Vorlesung)

Lecturer:
Prof. Christian Ringle

Language:
DE

Cycle:
SS

Content:

- definitions and foundations of strategic management
- strategic planning
- strategic analysis and forecast
- development of strategic options
- strategy evaluaton, implementation and strategic control

Literature:
- Bea, F.X.; Haas, J.: Strategisches Management, 5. Auflage, Stuttgart 2009.
- Dess, G. G.; Lumpkin, G. T.; Eisner, A. B.: Strategic management: Creating competitive advantages, Boston 2010
- Hahn, D.; Taylor, B.: Strategische Unternehmensplanung: Strategische Unternehmensführung, 9. Auflage, Heidelberg 2006.
- Hinterhuber, H.H.: Strategische Unternehmensführung Bd. 1: Strategisches Denken, 7. Aufl., Berlin u. a. 2004
- Hinterhuber, H.H.: Strategische Unternehmensführung Bd. 2: Strategisches Handeln, 7. Aufl., Berlin u. a. 2004
- Hungenberg, H.: Strategisches Management in Unternehmen, 6. Auflage, Wiesbaden 2011
- Johnson, G.; Scholes, K.; Whittington, R.: Strategisches Management. Eine Einführung, 9. Auflage, München 2011
- Macharzina, K.: Unternehmensführung: Das internationale Managementwissen, 7. Auflage, Wiesbaden 2010.
- Porter, M.E.: Competitive strategy, New York 1980 (deutsche Ausgabe: Wettbewerbsstrategie, 10. Aufl., Frankfurt am Main 1999)
- Welge, M. K.; Al-Laham, A.: Strategisches Management, 5. Auflage, Wiesbaden 2008.

Course: Entrepreneurial Management (Vorlesung)

Lecturer:

Prof. Christoph Ihl

Language:
EN

Cycle:
WS

Content:
This course introduces the fundamentals of technology entrepreneurship including its economic and cultural underpinnings. It highlights the differences between mere business ideas and scalable and repeatable business opportunities. It is designed to familiarize students with the process and all relevant entrepreneurial tools and concepts that technology entrepreneurs use to create business opportunities and to start companies. It involves taking a technology idea and finding a high-potential commercial opportunity, gathering resources such as talent and capital, figuring out how to sell and market the idea, and managing rapid growth. The course also discusses relevant concepts and tools from entrepreneurial strategy, such as disruptive innovations, technology adoption cycles and intellectual property, as well as from entrepreneurial marketing, such as product positioning and differentiation, distribution, promotion and pricing. Particular emphasis will be put on business model design and customer development proposed in the lean startup approach. Participants will learn a systematic process that technology entrepreneurs use to identify, create and exploit business opportunities. The students will also achieve knowledge and skills in the activities related with the start and the growth of new companies. All in all, the course is supposed to create the entrepreneurial mindset of looking for technology opportunities and business solutions, where others see insurmountable problems. This mindset of turning problems into opportunities can well be generalized from startups to larger companies and other settings.

- Develop a working knowledge and understanding of the entrepreneurial perspective
- Understand the difference between a good idea and scalable business opportunity
- Understand the process of taking a technology idea and finding a high-potential commercial opportunity
- Develop understanding of major elements of business models and how they are interrelated
- Understand the components of business opportunity assessment and business plans
- Develop understanding of major elements of business models and how they are interrelated
- Knowledge about appropriate evaluation criteria for business ideas
- Understanding of the basic building blocks of promising business models
- Knowledge about the key aspects of business models and planning:
  value proposition and target customer analysis
  market and competitive analysis, IP protection
  production, sourcing and partners
  legal form, cooperation contracts, liability issues
  financial planning

Literature:
Byers, T.H.; Dorf, R.C.; Nelson, A.J. (2011). Technology Ventures: From Idea to Enterprise. 3rd ed. McGraw-Hill, 2011.
Hisrich, P.; Peters, M. P.; Shepherd, D. A. (2009). Entrepreneurship, 8th ed., McGraw-Hill, 2009.
Osterwalder, A.; Yves, P. (2010). Business model generation: a handbook for visionaries, game changers, and challengers. John Wiley & Sons, 2010.

Course: Marketing (Vorlesung)

Lecturer:
Prof. Christian Lüthje

Language:
EN

Cycle:
WS

Content:
Contents
Basics of Marketing
The philosophy and fundamental aims of marketing. Contrasting different marketing fields (e.g. business-to-consumer versus business-to-business marketing). The process of marketing planning, implementation and controlling
Strategic Marketing Planning
How to find profit opportunities? How to develop cooperation, internationalization, timing, differentiation and cost leadership strategies?
Market-oriented Design of products and services
How can companies get valuable customer input on product design and development? What is a service? How can companies design innovative services supporting the products?
Pricing
What are the underlying determinants of pricing decision? Which pricing strategies should companies choose over the life cycle of products? What are special forms of pricing on business-to-business markets (e.g. competitive bidding, auctions)?
Marketing Communication
What is the role of communication and advertising in business-to-business markets? Why advertise? How can companies manage communication over advertisement, exhibitions and public relations?
Sales and Distribution
How to build customer relationship? What are the major requirements of industrial selling? What is a distribution channel? How to design

and manage a channel strategy on business-to-business markets?

Knowledge
Students will gain an introduction and good overview of

- Specific challenges in the marketing of innovative goods and services
- Key strategic areas in strategic marketing planning (cooperation, internationalization, timing)
- Tools for information gathering about future customer needs and requirements
- Fundamental pricing theories and pricing methods
- Main communication instruments
- Marketing channels and main organizational issues in sales management
- Basic approaches for managing customer relationship

Skills
Based on the acquired knowledge students will be able to:

- Design market timing decisions
- Make decisions for marketing-related cooperation and internationalization activities
- Manage the challenges of market-oriented development of new products and services
- Translate customer needs into concepts, prototypes and marketable offers
- Determine the perceived quality of an existing product or service using advanced elicitation and measurement techniques that fit the given situation
- Analyze the pricing alternatives for products and services
- Make strategic sales decisions for products and services (i.e. selection of sales channels)
- Analyze the value of customers and apply customer relationship management tools

Social Competence
The students will be able to

- have fruitful discussions and exchange arguments
- present results in a clear and concise way
- carry out respectful team work

Self-reliance
The students will be able to

- Acquire knowledge independently in the specific context and to map this knowledge on other new complex problem fields.
- Consider proposed business actions in the field of marketing and reflect on them.

Literature:
Homburg, C., Kuester, S., Krohmer, H. (2009). Marketing Management, McGraw-Hill Education, Berkshire, extracts p. 31-32, p. 38-53, 406-414, 427-431
Bingham, F. G., Gomes, R., Knowles, P. A. (2005). Business Marketing, McGraw-Hill Higher Education, 3rd edition, 2004, p. 106-110
Besanke, D., Dranove, D., Shanley, M., Schaefer, S. (2007), Economics of strategy, Wiley, 3rd edition, 2007, p. 149-155
Hutt, M. D., Speh, T.W. (2010), Business Marketing Management, 10th edition, South Western, Lengage Learning, p. 112-116

Course: Project Management (Vorlesung)

Lecturer:
Prof. Carlos Jahn

Language:
EN

Cycle:
WS

Content:
The lecture “project management” aims at characterizing typical phases of projects. Important contents are: possible tasks, organization, techniques and tools for initiation, definition, planning, management and finalization of projects.

Literature:
Project Management Institute (2008): A guide to the project management body of knowledge (PMBOK® Guide). 4. Aufl. Newtown Square, Pa: Project Management Institute.

Course: Project Management in Industrial Practice (Vorlesung)

Lecturer:
Wilhelm Radomsky

Language:
DE

Cycle:
WS

Content:

- Project management in a company
- Project life cycle / Project environment
- Project structuring / Project planning
- Deployment of methods / Team development
- Contract / Risk / Change management
- Multi-project management / Quality management
- Project controlling / Reporting
- Project organization / Project conclusion

Literature:

• Brown (1998): Erfolgreiches Projektmanagement in 7 Tagen
• Burghardt (2002): Einführung in Projektmanagement
• Cleland / King (1997): Project Management Handbook
• Hemmrich, Harrant (2002): Projektmanagement, In 7 Schritten zum Erfolg
• Kerzner (2003): Projektmanagement
• Litke (2004): Projektmanagement
• Madauss (2005): Handbuch Projektmanagement
• Patzak / Rattay (2004): Projektmanagement
• PMI (2004): A Guide to the Project Management Body of Knowledge
• RKW / GPM: Projektmanagement Fachmann
• Schelle / Ottmann / Pfeiffer (2005): ProjektManager

Course: Risk Management (Vorlesung)

Lecturer:
Dr. Meike Schröder

Language:
DE

Cycle:
WS

Content:
Risks are inherent in every aspect of business, and the ability of managing risks is one important aspect that differentiates successful business leaders from others. There exist various categories of risk, such as credit, country, market, liquidity, operational, supply chain and reputational. Companies are vulnerable to risks. What makes such risks even more complex and challenging to manage is that the risks are often not within the direct control of the business executive. They can exist outside of the company boundary, and yet the impact to the company can be huge. The awareness and knowledge of how to manage risks in companies, will become increasingly important.
Some of the main topics covered in this lecture include:

- Targets and legal aspects of risk management
- Risks and their impact
- Risk types (classification)
- Risk management and human resource
- Steps of the risk management process and their instruments
- Methods of risk assessment
- Implementation of risk management
- Management of specific risks

This lecture is presented in German language only.

Literature:

Brühwiler, B., Romeike, F. (2010), Praxisleitfaden Risikomanagement. ISO 31000 und ONR 49000 sicher anwenden, Berlin: Erich Schmidt.
Cottin, C., Döhler, S. (2013), Risikoanalyse. Modellierung, Beurteilung und Management von Risiken mit Praxisbeispielen, 2. überarbeitete und erweiterte Aufl., Wiesbaden: Springer.
Eller, R., Heinrich, M., Perrot, R., Reif, M. (2010), Kompaktwissen Risikomanagement. Nachschlagen, verstehen und erfolgreich umsetzen, Wiesbaden: Gabler.
Fiege, S. (2006), Risikomanagement- und Überwachungssystem nach KonTraG. Prozess, Instrumente, Träger, Wiesbaden: Deutscher Universitäts-Verlag.
Frame, D. (2003), Managing Risk in organizations. A guide for managers, San Francisco: Wiley.
Götze, U., Henselmann, K., Mikus, B. (2001), Risikomanagement, Heidelberg: Physica-Verlag.
Müller, K. (2010), Handbuch Unternehmenssicherheit. Umfassendes Sicherheits-, Kontinuitäts- und Risikomanagement mit System, 2., neu bearbeitete Auflage, Wiesbaden: Springer.
Rosenkranz, F., Missler-Behr, M. (2005), Unternehmensrisiken erkennen und managen. Einführung in die quantitative Planung, Berlin u.a.: Springer.
Wengert, H., Schittenhelm F. A. (2013), Coporate Risk Mangement, Berlin: Springer.

Course: Key Aspects of Patent Law (Seminar)

Lecturer:
Prof. Christian Rohnke

Language:
DE

Cycle:
SS

Content:
Mayor Issues in Patent Law:
The seminar covers five mayor issues in german patent law, namely patentatbility, prosecution, ownership and employee inventions, infringement and licensing and other commercila uses.
The lecturer will give an introduction to each issue which will be followed by in-depth inquiry by the participants through group work, presentation of results and moderated discussion.

Literature:
wird noch bekannt gegeben

Course: Environmental Management and Corporate Responsibilty (Vorlesung)

Lecturer:
Prof. Heike Flämig

Language:
DE

Cycle:
SS

Content:

- Imparting knowledge on EMAS and ISO 14.001 as important methodological approaches for the integration of environmental and sustainability management in business companies
- Explaination of theoretical concepts of corporate sustainability management
- Imparting pracitical knowledge from different stakeholder views: consulting company, trading enterprise, NGO, financial market

Literature:
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Course: Management Consulting (Vorlesung)

Lecturer:
Gerald Schwetje

Language:
DE

Cycle:
SS

Content:
The Management Consulting lecture teaches students knowledge that is complementary to their technical and business administration studies. They learn the basics of consulting and agent-principal theory and are given an overview of the consulting market. They are also shown how management consulting works and which methodical building blocks (processes) are needed to deal with a client's concerns and to undertake a consulting process. By means of practical examples students gain an insight into the extensive range of management consultancy services and of functional consulting.

Literature:
Bamberger, Ingolf (Hrsg.): Strategische Unternehmensberatung: Konzeptionen – Prozesse – Methoden, Gabler Verlag, Wiesbaden 2008
Bansbach, Schübel, Brötzel & Partner (Hrsg.): Consulting: Analyse – Konzepte – Gestaltung, Stollfuß Verlag, Bonn 2008
Fink, Dietmar (Hrsg.): Strategische Unternehmensberatung, Vahlens Handbücher, München, Verlag Vahlen, 2009
Heuermann, R./Herrmann, F.: Unternehmensberatung: Anatomie und Perspektiven einer Dienstleistungselite, Fakten und Meinungen für Kunden, Berater und Beobachter der Branche, Verlag Vahlen, München 2003
Kubr, Milan: Management consulting: A guide to the profession, 3. Auflage, Geneva, International Labour Office, 1992
Küting, Karlheinz (Hrsg.): Saarbrücker Handbuch der Betriebswirtschaftlichen Beratung; 4. Aufl., NWB Verlag, Herne 2008
Nagel, Kurt: 200 Strategien, Prinzipien und Systeme für den persönlichen und unternehmerischen Erfolg, 4. Aufl., Landsberg/Lech, mi-Verlag, 1991
Niedereichholz, Christel: Unternehmensberatung: Beratungsmarketing und Auftragsakquisition, Band 1, 2. Aufl., Oldenburg Verlag, 1996
Niedereichholz; Christel: Unternehmensberatung: Auftragsdurchführung und Qualitätssicherung, Band 2, Oldenburg Verlag, 1997
Quiring, Andreas: Rechtshandbuch für Unternehmensberater: Eine praxisorientierte Darstellung der typischen Risiken und der zweckmäßigen Strategien zum Risikomanagement mit Checklisten und Musterverträgen, Vahlen Verlag, München 2005

Schwetje, Gerald: Ihr Weg zur effizienten Unternehmensberatung: Beratungserfolg durch eine qualifizierte Beratungsmethode, NWB Verlag, Herne 2013
Schwetje, Gerald: Wer seine Nachfolge nicht regelt, vermindert seinen Unternehmenswert, in: NWB, Betriebswirtschaftliche Beratung, 03/2011 und: Sparkassen Firmenberatung aktuell, 05/2011
Schwetje, Gerald: Strategie-Assessment mit Hilfe von Arbeitshilfen der NWB-Datenbank – Pragmatischer Beratungsansatz speziell für KMU: NWB, Betriebswirtschaftliche Beratung, 10/2011
Schwetje, Gerald: Strategie-Werkzeugkasten für kleine Unternehmen, Fachbeiträge, Excel-Berechnungsprogramme, Checklisten/Muster und Mandanten-Merkblatt: NWB, Downloadprodukte, 11/2011
Schwetje, Gerald: Die Unternehmensberatung als komplementäres Leistungsangebot der Steuerberatung - Zusätzliches Honorar bei bestehenden Klienten: NWB, Betriebswirtschaftliche Beratung, 02/2012
Schwetje, Gerald: Die Mandanten-Berater-Beziehung: Erfolgsfaktor Beziehungsmanagement, in: NWB Betriebswirtschaftliche Beratung, 08/2012
Schwetje, Gerald: Die Mandanten-Berater-Beziehung: Erfolgsfaktor Vertrauen, in: NWB Betriebswirtschaftliche Beratung, 09/2012
Wohlgemuth, Andre C.: Unternehmensberatung (Management Consulting): Dokumentation zur Vorlesung „Unternehmensberatung“, vdf Hochschulverlag, Zürich 2010

Course: Entrepreneurial Business Creation (Problemorientierte Lehrveranstaltung)

Lecturer:
Prof. Christoph Ihl

Language:
EN

Cycle:
WS

Content:
This course is supposed to provide intense hands-on experiences with the entrepreneurial process, tools and concepts discussed in the lecture “Entrepreneurship Management” and additional online material. At the beginning of the class, students form teams to search for and create a scalable and repeatable business opportunity. Rather than writing a comprehensive business plan or designing the perfect product, both of which are highly difficult and risky investments in the uncertain front end of any business idea, we follow a lean startup approach. Student teams will have to think about all the parts of building a business and apply the tools of business model design and customer & agile development in order optimize the search for and creation of a business opportunity. Students will start by mapping the assumptions regarding each of the part in their business model and then devote significant time on testing these hypotheses with customers and partners outside in the field (customer development). Based on the gathered information, students should realize which of their assumptions were wrong, and figure out ways how to fix it (learning events called “pivots”). The goal is to proceed in an iterative and incremental way (agile development) to build prototypes and (minimum viable) products. Throughout the course, student teams will present their lessons-learned (pivots) and how their business models have evolved based on their most important pivots. The course provides intense hands-on experience with the objective to develop the entrepreneurial mindset. This mindset of turning problems into opportunities can well be generalized from startups to innovative challenges in established companies and other innovative settings.

- assess and validate entrepreneurial opportunities, either for new venture creation or in the context of established corporations
- create and verify a business models to exploit entrepreneurial opportunities
- create and verify plans for gathering required resources such as talent and capital (startup) or employees and budgets (established firms)
- prepare comprehensive business plans
- identify and define business opportunities
- assess and validate entrepreneurial opportunities
- create and verify a business model of how to sell and market an entrepreneurial opportunity
- formulate and test business model assumptions and hypotheses
- conduct customer and expert interviews regarding business opportunities
- prepare business opportunity assessment
- create and verify a plan for gathering resources such as talent and capital
- pitch a business opportunity to your classmates and the teaching team
- team work
- communication and presentation
- give and take critical comments
- engaging in fruitful discussions
- autonomous work and time management
- project management
- analytical skills

Literature:
Blank, Steve (2013). Why the lean start-up changes everything. Harvard Business Review 91.5 (2013): 63-72.
Blank, Steven Gary, and Bob Dorf. The startup owner's manual: the step-by-step guide for building a great company. K&S Ranch, Incorporated, 2012.
Ries, Eric (2011). The lean startup: How today's entrepreneurs use continuous innovation to create radically successful businesses. Random House LLC, 2011.

Course: Managment of Trust and Reputation (Seminar)

Lecturer:
Dr. Michael Florian

Language:
DE

Cycle:
SS

Content:
The seminar offers a comparison and analysis of relevant theoretical concepts and practical issues in the corporate management of trust and reputation. Selected case studies will be used to discuss opportunities, problems, and limitations using trust and reputation to coordinate and control economic behavior.

Literature:
Allgäuer, Jörg E. (2009): Vertrauensmanagement: Kontrolle ist gut, Vertrauen ist besser. Ein Plädoyer für Vertrauensmanagement als zentrale Aufgabe integrierter Unternehmenskommunikation von Dienstleistungsunternehmen. München: brain script Behr.
Beckert, Jens; Metzner, André; Roehl, Heiko (1998): Vertrauenserosion als organisatorische Gefahr und wie ihr zu begegnen ist. In: Organisationsentwicklung 17 (4), S. 57-66.
Eberl, Peter (2003): Vertrauen und Management. Studien zu einer theoretischen Fundierung des Vertrauenskonstruktes in der Managementlehre. Stuttgart: Schäffer-Poeschel.
Eberl, Peter (2012): Vertrauen und Kontrolle in Organisationen. Das problematische Verhältnis der Betriebswirtschaftslehre zum Vertrauen. In: Möller, Heidi (Hg.): Vertrauen in Organisationen. Riskante Vorleistung oder hoffnungsvolle Erwartung? Wiesbaden: Springer VS, S. 93-110.
Eisenegger, Mark (2005): Reputation in der Mediengesellschaft. Konstitution Issues Monitoring Issues Management. Wiesbaden: VS Verlag für Sozialwissenschaften.
Florian, Michael (2013): Paradoxien des Vertrauensmanagements. Risiken und Chancen einer widerspenstigen immateriellen Ressource. In: Personalführung 46, Heft 2/2013, S. 40-47.
Grüninger, Stephan (2001): Vertrauensmanagement - Kooperation, Moral und Governance. Marburg: Metropolis.
Grüninger, Stephan; John, Dieter (2004): Corporate Governance und Vertrauensmanagement. In: Josef Wieland (Hg.): Handbuch Wertemanagement. Erfolgsstrategien einer modernen Corporate Governance. Hamburg: Murmann, S. 149-177.
Meifert, Matthias (2008): Ist Vertrauenskultur machbar? Vorbedingungen und Überforderungen betrieblicher Personalpolitik. In: Rainer Benthin und Ulrich Brinkmann (Hg.): Unternehmenskultur und Mitbestimmung. Betriebliche Integration zwischen Konsens und Konflikt. Frankfurt/Main, New York: Campus, S. 309-327.
Neujahr, Elke; Merten, Klaus (2012): Reputationsmanagement. Zur Kommunikation von Wertschätzung. In: PR-Magazin 06/2012, S. 60-67.
Osterloh, Margit; Weibel, Antoinette (2006): Investition Vertrauen. Prozesse der Vertrauensentwicklung in Organisationen. Wiesbaden: Gabler.
Osterloh, Margit; Weibel, Antoinette (2006): Vertrauen und Kontrolle. In: Robert J. Zaugg und Norbert Thom (Hg.): Handbuch Kompetenzmanagement. Durch Kompetenz nachhaltig Werte schaffen. Festschrift für Prof. Dr. Dr. h.c. mult. Norbert Thom zum 60. Geburtstag. Bern [u.a.]: Haupt, S. 53-63.
Osterloh, Margit; Weibel, Antoinette (2007): Vertrauensmanagement in Unternehmen: Grundlagen und Fallbeispiele. In: Manfred Piwinger und Ansgar Zerfaß (Hg.): Handbuch Unternehmenskommunikation. Wiesbaden: Gabler, S. 189-203.
Schmidt, Matthias; Beschorner, Thomas (2005): Werte- und Reputationsmanagement. München und Mering: Hampp.
Seifert, Matthias (2003): Vertrauensmanagement in Unternehmen. Eine empirische Studie über Vertrauen zwischen Angestellten und ihren Führungskräften. 2. Aufl. München und Mering: Hampp.
Sprenger, Reinhard K. (2002): Vertrauen führt. Worauf es im Unternehmen wirklich ankommt, Frankfurt/Main, New York.
Thiessen, Ansgar (2011): Organisationskommunikation in Krisen. Reputationsmanagement durch strategische, integrierte und situative Krisenkommunikation. Wiesbaden: VS Verlag für Sozialwissenschaften.
Walgenbach, Peter (2000): Das Konzept der Vertrauensorganisation. Eine theoriegeleitete Betrachtung. In: Die Betriebswirtschaft 60 (6), S. 707-720.
Walgenbach, Peter (2006): Wieso ist Vertrauen in ökonomischen Transaktionsbeziehungen so wichtig, und wie lässt es sich generieren? In: Hans H. Bauer, Marcus M. Neumann und Anja Schüle (Hg.): Konsumentenvertrauen. Konzepte und Anwendungen für ein nachhaltiges Kundenbindungsmanagement. München: Vahlen, S. 17-26.
Weibel, Antoinette (2004): Kooperation in strategischen Wissensnetzwerken. Vertrauen und Kontrolle zur Lösung des sozialen Dilemmas. Wiesbaden: Dt. Univ.-Verl.
Weinreich. Uwe (2003): Vertrauensmanagement. In: Deutscher Manager-Verband e.V. (Hg.): Die Zukunft des Managements. Perspektiven für die Unternehmensführung. Zürich: Vdf, Hochsch.-Verl. an der ETH, S. 193-201.

Course: Methods of Systematic Product Development (Seminar)

Lecturer:
Solveigh Hieber

Language:
DE/EN

Cycle:
SS

Content:
This seminar is about the basics of TRIZ and some additional creativity techniques.
Content:

- Introduction in Methods of Systematic Product Development
- Framework for the use of TRIZ and creativity techniques

- Historical background and origin of TRIZ
- TRIZ basic methods:
  - Innovation Check List
  - Ideal Final Result
  - Functional Analysis and Object Analysis
  - Contradiction Matrix and Inventive Principles
  - Physical Contradictions and Separation Principles
  - Method of Smart Little People
  - Trends of Technical Evolution
- Basics for Moderators
- The TRIZ Community today
- Additional, common Creativity Techniques

Literature:

Altschuller, S. (1984): Erfinden – Wege zur Lösung technischer Probleme. Limitierter Nachdruck 1998. VEB Verlag Technik
Koltze, K. & Souchkov, V. (2010): Systematische Innovation: TRIZ-Anwendung in der Produkt- und Prozessentwicklung. Carl Hanser Verlag
Orloff, M. A. (2006): Grundlagen der klassischen TRIZ. 3. Auflage. Springer Verlag

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Course: Public and Constitutional Law (Vorlesung)

Lecturer:
Klaus Tempke

Language:
DE

Cycle:
SS

Content:
Different areas of public law; proceedings, jurisdiction of administrative courts with stages of appeal, members of the courts;
Court levels, organization and legal capacity;
Introduction to and structure of fundamental rights;
Human dignity: the guiding principle of the constitution;
General right of privacy and freedom of action.

Literature:

Module: Microsystem Engineering

Courses:

Title	Typ	Hrs/wk
Microsystem Engineering	Vorlesung	2
Microsystem Engineering	Problemorientierte Lehrveranstaltung	1
Microsystem Engineering	Gruppenübung	1

Module Responsibility:
Prof. Manfred Kasper

Admission Requirements:

Recommended Previous Knowledge:
Electrical Engineering Fundamentals

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students know about the most important technologies and materials of MEMS as well as their applications in sensors and actuators.
Capabilities:
Students are able to analyze and describe the functional behaviour of MEMS components and to evaluate the potential of microsystems.

Personal Competence:
Social Competence:
Students are able to solve specific problems alone or in a group and to present the results accordingly.
Autonomy:
Students are able to acquire particular knowledge using specialized literature and to integrate and associate this knowledge with other fields.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
Electrical Engineering: Kernqualifikation: Compulsory
Computational Science and Engineering: Vertiefung Safe Embedded and Cyber-Physical Systems: Compulsory suffrage
International Management and Engineering: Vertiefung II. Electrical Engineering: Compulsory suffrage
Mechatronics: Vertiefung System Design: Compulsory suffrage
Microelectronics and Microsystems: Kernqualifikation: Compulsory suffrage

Course: Microsystem Engineering (Vorlesung)

Lecturer:
Prof. Manfred Kasper

Language:
EN

Cycle:
WS

Content:
Object and goal of MEMS
Scaling Rules
Lithography
Film deposition
Structuring and etching
Energy conversion and force generation
Electromagnetic Actuators
Reluctance motors
Piezoelectric actuators, bi-metal-actuator
Transducer principles
Signal detection and signal processing
Mechanical and physical sensors
Acceleration sensor, pressure sensor
Sensor arrays
System integration

Yield, test and reliability

Literature:

M. Kasper: Mikrosystementwurf, Springer (2000)
M. Madou: Fundamentals of Microfabrication, CRC Press (1997)

Course: Microsystem Engineering (Problemorientierte Lehrveranstaltung)

Lecturer:

Prof. Manfred Kasper

Language:

EN

Cycle:

WS

Content:

Examples of MEMS components
Layout consideration
Electric, thermal and mechanical behaviour
Design aspects

Literature:

Course: Microsystem Engineering (Übung)

Lecturer:

Prof. Manfred Kasper

Language:

EN

Cycle:

WS

Content:

Object and goal of MEMS
Scaling Rules
Lithography
Film deposition
Structuring and etching
Energy conversion and force generation
Electromagnetic Actuators
Reluctance motors
Piezoelectric actuators, bi-metal-actuator
Transducer principles
Signal detection and signal processing
Mechanical and physical sensors
Acceleration sensor, pressure sensor
Sensor arrays
System integration
Yield, test and reliability

Literature:

M. Kasper: Mikrosystementwurf, Springer (2000)
M. Madou: Fundamentals of Microfabrication, CRC Press (1997)

Module: Microsystems Technology in Theory and Practice

Courses:

Title	Typ	Hrs/wk
Microsystems Technology	Vorlesung	2
Microsystems Technology	Problemorientierte Lehrveranstaltung	2

Module Responsibility:
Prof. Hoc Khiem Trieu

Admission Requirements:
Bachelor's degree with profound basic knowledge in physics and chemistry

Recommended Previous Knowledge:
Basics in physics, chemistry, mechanics and semiconductor technology

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students are able
- to present and to explain current fabrication techniques for microstructures and especially methods for the fabrication of microsensors and microactuators, as well as the integration thereof in more complex systems
- to explain in details operation principles of microsensors and microactuators and
- to discuss the potential and limitation of microsystems in application.

Capabilities:
Students are capable
- to analyze the feasibility of microsystems,
- to develop process flows for the fabrication of microstructures and
- to apply them.

Personal Competence:
Social Competence:

Students are able to prepare and perform their lab experiments in team work as well as to present and discuss the results in front of audience.

Autonomy:
None

ECTS-Credit points:
6 LP

Examination:
Mündliche Prüfung

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
Electrical Engineering: Vertiefung Nanoelectronics and Microsystems Technology: Compulsory suffrage
Electrical Engineering: Vertiefung Medical Technology: Compulsory suffrage
International Management and Engineering: Vertiefung II. Mechatronics: Compulsory suffrage
Microelectronics and Microsystems: Kernqualifikation: Compulsory suffrage

Course: Microsystems Technology (Vorlesung)

Lecturer:
Prof. Hoc Khiem Trieu

Language:
EN

Cycle:
WS

Content:

- Introduction (historical view, scientific and economic relevance, scaling laws)
- Semiconductor Technology Basics, Lithography (wafer fabrication, photolithography, improving resolution, next-generation lithography, nano-imprinting, molecular imprinting)

- Deposition Techniques (thermal oxidation, epitaxy, electroplating, PVD techniques: evaporation and sputtering; CVD techniques: APCVD, LPCVD, PECVD and LECVD; screen printing)
- Etching and Bulk Micromachining (definitions, wet chemical etching, isotropic etch with HNA, electrochemical etching, anisotropic etching with KOH/TMAH: theory, corner undercutting, measures for compensation and etch-stop techniques; plasma processes, dry etching: back sputtering, plasma etching, RIE, Bosch process, cryo process, XeF2 etching)
- Surface Micromachining and alternative Techniques (sacrificial etching, film stress, stiction: theory and counter measures; Origami microstructures, Epi-Poly, porous silicon, SOI, SCREAM process, LIGA, SU8, rapid prototyping)
- Thermal and Radiation Sensors (temperature measurement, self-generating sensors: Seebeck effect and thermopile; modulating sensors: thermo resistor, Pt-100, spreading resistance sensor, pn junction, NTC and PTC; thermal anemometer, mass flow sensor, photometry, radiometry, IR sensor: thermopile and bolometer)
- Mechanical Sensors (strain based and stress based principle, capacitive readout, piezoresistivity, pressure sensor: piezoresistive, capacitive and fabrication process; accelerometer: piezoresistive, piezoelectric and capacitive; angular rate sensor: operating principle and fabrication process)
- Magnetic Sensors (galvanomagnetic sensors: spinning current Hall sensor and magneto-transistor; magnetoresistive sensors: magneto resistance, AMR and GMR, fluxgate magnetometer)
- Chemical and Bio Sensors (thermal gas sensors: pellistor and thermal conductivity sensor; metal oxide semiconductor gas sensor, organic semiconductor gas sensor, Lambda probe, MOSFET gas sensor, pH-FET, SAW sensor, principle of biosensor, Clark electrode, enzyme electrode, DNA chip)
- Micro Actuators, Microfluidics and TAS (drives: thermal, electrostatic, piezo electric and electromagnetic; light modulators, DMD, adaptive optics, microscanner, microvalves: passive and active, micropumps, valveless micropump, electrokinetic micropumps, micromixer, filter, inkjet printhead, microdispenser, microfluidic switching elements, microreactor, lab-on-a-chip, microanalytics)
- MEMS in medical Engineering (wireless energy and data transmission, smart pill, implantable drug delivery system, stimulators: microelectrodes, cochlear and retinal implant; implantable pressure sensors, intelligent osteosynthesis, implant for spinal cord regeneration)
- Design, Simulation, Test (development and design flows, bottom-up approach, top-down approach, testability, modelling: multiphysics, FEM and equivalent circuit simulation; reliability test, physics-of-failure, Arrhenius equation, bath-tub relationship)
- System Integration (monolithic and hybrid integration, assembly and packaging, dicing, electrical contact: wire bonding, TAB and flip chip bonding; packages, chip-on-board, wafer-level-package, 3D integration, wafer bonding: anodic bonding and silicon fusion bonding; micro electroplating, 3D-MID)

Literature:

M. Madou: Fundamentals of Microfabrication, CRC Press, 2002
N. Schwesinger: Lehrbuch Mikrosystemtechnik, Oldenbourg Verlag, 2009
T. M. Adams, R. A. Layton: Introductory MEMS, Springer, 2010
G. Gerlach; W. Dötzel: Introduction to microsystem technology, Wiley, 2008

Course: Microsystems Technology (Problemorientierte Lehrveranstaltung)

Lecturer:
Prof. Hoc Khiem Trieu

Language:
EN

Cycle:
WS

Content:

- Introduction (historical view, scientific and economic relevance, scaling laws)
- Semiconductor Technology Basics, Lithography (wafer fabrication, photolithography, improving resolution, next-generation lithography, nano-imprinting, molecular imprinting)
- Deposition Techniques (thermal oxidation, epitaxy, electroplating, PVD techniques: evaporation and sputtering; CVD techniques: APCVD, LPCVD, PECVD and LECVD; screen printing)
- Etching and Bulk Micromachining (definitions, wet chemical etching, isotropic etch with HNA, electrochemical etching, anisotropic etching with KOH/TMAH: theory, corner undercutting, measures for compensation and etch-stop techniques; plasma processes, dry etching: back sputtering, plasma etching, RIE, Bosch process, cryo process, XeF2 etching)
- Surface Micromachining and alternative Techniques (sacrificial etching, film stress, stiction: theory and counter measures; Origami microstructures, Epi-Poly, porous silicon, SOI, SCREAM process, LIGA, SU8, rapid prototyping)
- Thermal and Radiation Sensors (temperature measurement, self-generating sensors: Seebeck effect and thermopile; modulating sensors: thermo resistor, Pt-100, spreading resistance sensor, pn junction, NTC and PTC; thermal anemometer, mass flow sensor, photometry, radiometry, IR sensor: thermopile and bolometer)
- Mechanical Sensors (strain based and stress based principle, capacitive readout, piezoresistivity, pressure sensor: piezoresistive, capacitive and fabrication process; accelerometer: piezoresistive, piezoelectric and capacitive; angular rate sensor: operating principle and fabrication process)
- Magnetic Sensors (galvanomagnetic sensors: spinning current Hall sensor and magneto-transistor; magnetoresistive sensors: magneto resistance, AMR and GMR, fluxgate magnetometer)
- Chemical and Bio Sensors (thermal gas sensors: pellistor and thermal conductivity sensor; metal oxide semiconductor gas sensor, organic semiconductor gas sensor, Lambda probe, MOSFET gas sensor, pH-FET, SAW sensor, principle of biosensor, Clark electrode, enzyme electrode, DNA chip)
- Micro Actuators, Microfluidics and TAS (drives: thermal, electrostatic, piezo electric and electromagnetic; light modulators, DMD, adaptive optics, microscanner, microvalves: passive and active, micropumps, valveless micropump, electrokinetic micropumps,

micromixer, filter, inkjet printhead, microdispenser, microfluidic switching elements, microreactor, lab-on-a-chip, microanalytics)
- MEMS in medical Engineering (wireless energy and data transmission, smart pill, implantable drug delivery system, stimulators: microelectrodes, cochlear and retinal implant; implantable pressure sensors, intelligent osteosynthesis, implant for spinal cord regeneration)
- Design, Simulation, Test (development and design flows, bottom-up approach, top-down approach, testability, modelling: multiphysics, FEM and equivalent circuit simulation; reliability test, physics-of-failure, Arrhenius equation, bath-tub relationship)
- System Integration (monolithic and hybrid integration, assembly and packaging, dicing, electrical contact: wire bonding, TAB and flip chip bonding; packages, chip-on-board, wafer-level-package, 3D integration, wafer bonding: anodic bonding and silicon fusion bonding; micro electroplating, 3D-MID)

Literature:

M. Madou: Fundamentals of Microfabrication, CRC Press, 2002
N. Schwesinger: Lehrbuch Mikrosystemtechnik, Oldenbourg Verlag, 2009
T. M. Adams, R. A. Layton: Introductory MEMS, Springer, 2010
G. Gerlach; W. Dötzel: Introduction to microsystem technology, Wiley, 2008

Module: CMOS Nanoelectronics with Practice

Courses:

Title	Typ	Hrs/wk
CMOS Nanoelectronics	Vorlesung	2
CMOS Nanoelectronics	Gruppenübung	1
CMOS Nanoelectronics	Laborpraktikum	2

Module Responsibility:
Prof. Wolfgang Krautschneider

Admission Requirements:
BS in electrical engineering or related subjects

Recommended Previous Knowledge:
Fundamentals of MOS devices and electronic circuits

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:

- Students can explain the functionality of very small MOS transistors and explain the problems occurring due to scaling-down the minimum feature size.
- Students are able to explain the basic steps of processing of very small MOS devices.
- Students can exemplify the functionality of volatile and non-volatile memories und give their specifications.
- Students can describe the limitations of advanced MOS technologies.
- Students can explain measurement methods for MOS quality control.

Capabilities:

- Students can quantify the current-voltage-behavior of very small MOS transistors and list possible applications.
- Students can describe larger electronic systems by their functional blocks.
- Students can name the existing options for the specific applications and select the most appropriate ones.

Personal Competence:
Social Competence:

- Students can team up with one or several partners who may have different professional backgrounds
- Students are able to work by their own or in small groups for solving problems and answer scientific questions.

Autonomy:

- Students are able to assess their knowledge in a realistic manner.
- The students are able to draw scenarios for estimation of the impact of advanced mobile electronics on the future lifestyle of the society.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 110, Study Time in Lecture: 70

Assignment for the Following Curricula:
Electrical Engineering: Kernqualifikation: Compulsory
Computational Science and Engineering: Vertiefung Safe Embedded and Cyber-Physical Systems: Compulsory suffrage
International Management and Engineering: Vertiefung II. Electrical Engineering: Compulsory suffrage
Mechatronics: Vertiefung System Design: Compulsory suffrage
Microelectronics and Microsystems: Kernqualifikation: Compulsory suffrage

Course: CMOS Nanoelectronics (Vorlesung)

Lecturer:
Prof. Wolfgang Krautschneider

Language:

EN

Cycle:
WS

Content:

- Ideal and non-ideal MOS devices
- Threshold voltage, Parasitic charges, Work function difference
- I-V behavior
- Scaling-down rules
- Details of very small MOS transistors
- Basic CMOS process flow
- Memory Technology, SRAM, DRAM, embedded DRAM
- Gain memory cells
- Non-volatile memories, Flash memory circuits
- Methods for Quality Control, C(V)-technique, Charge pumping, Uniform injection
- Systems with extremely small CMOS transistors

Literature:

- S. Deleonibus, Electronic Device Architectures for the Nano-CMOS Era, Pan Stanford Publishing, 2009.
- Y. Taur and T.H. Ning, Fundamentals of Modern VLSI Devices, Cambridge University Press, 2nd edition.
- R.F. Pierret, Advanced Semiconductor Fundamentals, Prentice Hall, 2003.
- F. Schwierz, H. Wong, J. J. Liou, Nanometer CMOS, Pan Stanford Publishing, 2010.
- H.-G. Wagemann und T. Schönauer, Silizium-Planartechnologie, Grundprozesse, Physik und Bauelemente Teubner-Verlag, 2003, ISBN 3519004674

Course: CMOS Nanoelectronics (Übung)

Lecturer:
Prof. Wolfgang Krautschneider

Language:
EN

Cycle:
WS

Content:

- Ideal and non-ideal MOS devices
- Threshold voltage, Parasitic charges, Work function difference
- I-V behavior
- Scaling-down rules
- Details of very small MOS transistors
- Basic CMOS process flow
- Memory Technology, SRAM, DRAM, embedded DRAM
- Gain memory cells
- Non-volatile memories, Flash memory circuits
- Methods for Quality Control, C(V)-technique, Charge pumping, Uniform injection
- Systems with extremely small CMOS transistors

Literature:

- S. Deleonibus, Electronic Device Architectures for the Nano-CMOS Era, Pan Stanford Publishing, 2009.
- Y. Taur and T.H. Ning, Fundamentals of Modern VLSI Devices, Cambridge University Press, 2nd edition.
- R.F. Pierret, Advanced Semiconductor Fundamentals, Prentice Hall, 2003.
- F. Schwierz, H. Wong, J. J. Liou, Nanometer CMOS, Pan Stanford Publishing, 2010.
- H.-G. Wagemann und T. Schönauer, Silizium-Planartechnologie, Grundprozesse, Physik und Bauelemente Teubner-Verlag, 2003, ISBN 3519004674

Course: CMOS Nanoelectronics (Laborpraktikum)

Lecturer:
Prof. Wolfgang Krautschneider

Language:
EN

Cycle:
WS

Content:

- Ideal and non-ideal MOS devices
- Threshold voltage, Parasitic charges, Work function difference
- I-V behavior
- Scaling-down rules
- Details of very small MOS transistors
- Basic CMOS process flow
- Memory Technology, SRAM, DRAM, embedded DRAM
- Gain memory cells
- Non-volatile memories, Flash memory circuits
- Methods for Quality Control, C(V)-technique, Charge pumping, Uniform injection
- Systems with extremely small CMOS transistors

Literature:

- S. Deleonibus, Electronic Device Architectures for the Nano-CMOS Era, Pan Stanford Publishing, 2009.
- Y. Taur and T.H. Ning, Fundamentals of Modern VLSI Devices, Cambridge University Press, 2nd edition.
- R.F. Pierret, Advanced Semiconductor Fundamentals, Prentice Hall, 2003.
- F. Schwierz, H. Wong, J. J. Liou, Nanometer CMOS, Pan Stanford Publishing, 2010.
- H.-G. Wagemann und T. Schönauer, Silizium-Planartechnologie, Grundprozesse, Physik und Bauelemente Teubner-Verlag, 2003, ISBN 3519004674

Module: Electronic Devices and Circuits

Courses:

Title	Typ	Hrs/wk
Electronic Devices	Vorlesung	2
Circuit Design	Vorlesung	2

Module Responsibility:
Prof. Wolfgang Krautschneider

Admission Requirements:
BS in elelctrical engineering

Recommended Previous Knowledge:
Basic knowledge of (solid-state) physics and mathematics.
Knowledge in fundamentals of electrical engineering and electrical networks.

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:

- Students can explain basic concepts of electron transport in semiconductor devices (energy bands, generation/recombination, carrier concentrations, drift and diffusion current densities, semiconductor device equations).
- Students are able to explain functional principles of pn-diodes, MOS capacitors, and MOSFETs using energy band diagrams.
- Students can present and discuss current-voltage relationships and small-signal equivalent circuits of these devices.
- Students can explain the physics and current-voltage behavior transistors based on charged carrier flow.
- Students are able to explain the basic concepts for static and dynamic logic gates for integrated circuits
- Students can exemplify approaches for low power consumption on the device and circuit level
- Students can describe the potential and limitations of analytical expression for device and circuit analysis.
- Students can explain characterization techniques for MOS devices.

Capabilities:

- Students can qualitatively construct energy band diagrams of the devices for varying applied voltages.
- Students are able to qualitatively determine electric field, carrier concentrations, and charge flow from energy band diagrams.
- Students can understand scientific publications from the field of semiconductor devices.
- Students can calculate the dimensions of MOS devices in dependence of the circuits properties
- Students can design complex electronic circuits and anticipate possible problems.
- Students know procedure for optimization regarding high performance and low power consumption

Personal Competence:
Social Competence:

- Students can team up with other experts in the field to work out innovative solutions.
- Students are able to work by their own or in small groups for solving problems and answer scientific questions.
- Students have the ability to critically question the value of their contributions to working groups.

Autonomy:

- Students are able to assess their knowledge in a realistic manner.
- Students are able to define their personal approaches to solve challenging problems

ECTS-Credit points:
6 LP

Examination:
Mündliche Prüfung

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
Microelectronics and Microsystems: Kernqualifikation: Compulsory suffrage

Course: Electronic Devices (Vorlesung)

Lecturer:
Dr. Dietmar Schröder

Language:
EN

Cycle:
WS

Content:
The basic description of electron transport in semiconductors is introduced. Electronic operating principles of diodes, MOS capacitors, and MOS field-effect transistors are presented. The way to derive mathematical device models from physical principles is described in much detail. These models allow the understanding and simulation of electronic circuits built from the devices.

Literature:
Yuan Taur, Tak H. Ning
Fundamentals of Modern VLSI Devices
Cambridge University Press 1998
ISBN 0-521-55959-6
TU-Library: EKH-738 (Lehrbuchsammlung)

Course: Circuit Design (Vorlesung)

Lecturer:
Prof. Wolfgang Krautschneider

Language:
EN

Cycle:
WS

Content:

- MOS transistor as four terminal device
- Performace degradation due to short channel effects
- Scaling-down of MOS technology
- Digital logic circuits
- Basic analog circuits
- Operational amplifiers
- Bipolar and BiCMOS circuits

Literature:

- R. Jacob Baker: CMOS, Circuit Design, Layout and Simulation, IEEE Press, Wiley Interscience, 3rd Edition, 2010
- Neil H.E. Weste and David Money Harris, Integrated Circuit Design, Pearson, 4th International Edition, 2013
- John E. Ayers, Digital Integrated Circuits: Analysis and Design, CRC Press, 2009
- Richard C. Jaeger and Travis N. Blalock: Microelectronic Circuit Design, Mc Graw-Hill, 4rd. Edition, 2010

Module: Microsystem Design

Courses:

Title	Typ	Hrs/wk
Microsystem Design	Vorlesung	2
Microsystem Design	Laborpraktikum	3

Module Responsibility:
Prof. Manfred Kasper

Admission Requirements:

Recommended Previous Knowledge:
Mathematical Calculus, Linear Algebra, Microsystem Engineering

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students know about the most important and most common simulation and design methods used in microsystem design. The scientific background of finite element methods and the basic theory of these methods are known.
Capabilities:
Students are able to apply simulation methods and commercial simulators in a goal oriented approach to complex design tasks. Students know to apply the theory in order achieve estimates of expected accuracy and can judge and verify the correctness of results. Students are able to develop a design approach even if only incomplete information about material data or constraints are available. Student can make use of approximate and reduced order models in a preliminary design stage or a system simulation.

Personal Competence:
Social Competence:
Students are able to solve specific problems alone or in a group and to present the results accordingly. Students can develop and explain their solution approach and subdivide the design task to subproblems which are solved separately by group members.
Autonomy:
Students are able to acquire particular knowledge using specialized literature and to integrate and associate this knowledge with other fields.

ECTS-Credit points:
6 LP

Examination:
Mündliche Prüfung

Workload in Hours:
Indipendent Study Time: 110, Study Time in Lecture: 70

Assignment for the Following Curricula:
Electrical Engineering: Vertiefung Nanoelectronics and Microsystems Technology: Compulsory suffrage
Microelectronics and Microsystems: Kernqualifikation: Compulsory suffrage

Course: Microsystem Design (Vorlesung)

Lecturer:
Prof. Manfred Kasper

Language:
EN

Cycle:
SS

Content:
Finite difference methods
Approximation error
Finite element method
Order of convergence
Error estimation, mesh refinement
Makromodeling
Reduced order modeling
Black-box models
System identification
Multi-physics systems
System simulation
Levels of simulation, network simulation
Transient problems
Non-linear problems

Introduction to Comsol
Application to thermal, electric, electromagnetic, mechanical and fluidic problems

Literature:
M. Kasper: Mikrosystementwurf, Springer (2000)
S. Senturia: Microsystem Design, Kluwer (2001)

Course: Microsystem Design (Laborpraktikum)

Lecturer:
Prof. Manfred Kasper

Language:
EN

Cycle:
SS

Content:
Finite difference methods
Approximation error
Finite element method
Order of convergence
Error estimation, mesh refinement
Makromodeling
Reduced order modeling
Black-box models
System identification
Multi-physics systems
System simulation
Levels of simulation, network simulation
Transient problems
Non-linear problems
Introduction to Comsol
Application to thermal, electric, electromagnetic, mechanical and fluidic problems

Literature:
M. Kasper: Mikrosystementwurf, Springer (2000)
S. Senturia: Microsystem Design, Kluwer (2001)

Module: Fundamentals of IC Design

Courses:

Title	Typ	Hrs/wk
Fundamentals of IC Design	Vorlesung	2
Fundamentals of IC Design	Laborpraktikum	2

Module Responsibility:
Prof. Wolfgang Krautschneider

Admission Requirements:
BS in electrical engineering or related program

Recommended Previous Knowledge:
Fundamentals of electrical engineering, electronic devices and circuits

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:

- Students can explain the basic structure of the circuit simulator SPICE.
- Students are able to describe the differences between the MOS transistor models of the circuit simulator SPICE.
- Students can discuss the different concept for realization the hardware of electronic circuits.
- Students can exemplify the approaches for “Design for Testability”.
- Students can specify models for calculation of the reliability of electronic circuits.

Capabilities:

- Students can determine the input parameters for the circuit simulation program SPICE.
- Students can select the most appropriate MOS modelling approaches for circuit simulations.
- Students can quantify the trade-off of different design styles.
- Students can determine the lot sizes and costs for reliability analysis.

Personal Competence:
Social Competence:

- Students can compile design studies by themselves or together with partners.
- Students are able to select the most efficient design methodology for a given task.
- Students are able to define the work packages for design teams.

Autonomy:

- Students are able to assess the strengths and weaknesses of their design work in a self-contained manner.
- Students can name and bring together all the tools required for total design flow.

ECTS-Credit points:
6 LP

Examination:
Mündliche Prüfung

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
Electrical Engineering: Vertiefung Nanoelectronics and Microsystems Technology: Compulsory suffrage
Microelectronics and Microsystems: Kernqualifikation: Compulsory suffrage

Course: Fundamentals of IC Design (Vorlesung)

Lecturer:
Prof. Wolfgang Krautschneider

Language:
DE/EN

Cycle:
SS

Content:

- Circuit-Simulator SPICE
- SPICE-Models for MOS transistors
- IC design
- Technology of MOS circuits
- Standard cell design
- Design of gate arrays
- Examples for realization of ASICs in the institute of nanoelectronics
- Reliability of integrated circuits
- Testing of integrated circuits

Literature:

R. J. Baker, „CMOS-Circuit Design, Layout, and Simulation“, Wiley & Sons, IEEE Press, 2010
X. Liu, VLSI-Design Methodology Demystified; IEEE, 2009
N. Van Helleputte, J. M. Tomasik, W. Galjan, A. Mora-Sanchez, D. Schroeder, W. H. Krautschneider, R. Puers, A flexible system-on-chip (SoC) for biomedical signal acquisition and processing, Sensors and Actuators A: Physical, vol. 142, p. 361-368, 2008.

Course: Fundamentals of IC Design (Laborpraktikum)

Lecturer:

Prof. Wolfgang Krautschneider

Language:

DE/EN

Cycle:

SS

Content:

- Circuit-Simulator SPICE
- SPICE-Models for MOS transistors
- IC design
- Technology of MOS circuits
- Standard cell design
- Design of gate arrays
- Examples for realization of ASICs in the institute of nanoelectronics
- Reliability of integrated circuits
- Testing of integrated circuits

Literature:

R. J. Baker, „CMOS-Circuit Design, Layout, and Simulation“, Wiley & Sons, IEEE Press, 2010
X. Liu, VLSI-Design Methodology Demystified; IEEE, 2009
N. Van Helleputte, J. M. Tomasik, W. Galjan, A. Mora-Sanchez, D. Schroeder, W. H. Krautschneider, R. Puers, A flexible system-on-chip (SoC) for biomedical signal acquisition and processing, Sensors and Actuators A: Physical, vol. 142, p. 361-368, 2008.

Module: Laboratory: Analog and Digital Circuit Design

Courses:

Title	Typ	Hrs/wk
Laboratory: Analog Circuit Design	Laborpraktikum	2
Laboratory: Digital Circuit Design	Laborpraktikum	2

Module Responsibility:
Prof. Wolfgang Krautschneider

Admission Requirements:
BS in electrical engineering or a related subject

Recommended Previous Knowledge:
Basic knowledge of semiconductor devices and circuit design

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:

- Students can explain the structure and philosophy of the software framework for circuit design.
- Students can determine all necessary input parameters for circuit simulation.
- Students know the basics physics of the analog behavior.
- Students are able to explain the functions of the logic gates of their digital design.
- Students can explain the algorithms of checking routines.
- Students are able to select the appropriate transistor models for fast and accurate simulations.

Capabilities:

- Students can activate and execute all necessary checking routines for verification of proper circuit functionality.
- Students are able to run the input desks for definition of their electronic circuits.
- Students can define the specifications of the electronic circuits to be designed.
- Students can optimize the electronic circuits for low-noise and low-power.
- Students can develop analog circuits for mobile medical applications.
- Students can define the building blocks of digital systems.

Personal Competence:
Social Competence:

- Students are trained to work through complex circuits in teams.
- Students are able to share their knowledge for efficient design work.
- Students can help each other to understand all the details and options of the design software.
- Students are aware of their limitations regarding circuit design, so they do not go ahead, but they involve experts when required.
- Students can present their design approaches for easy checking by more experienced experts.

Autonomy:

- Students are able to realistically judge the status of their knowledge and to define actions for improvements when necessary.
- Students can break down their design work in sub-tasks and can schedule the design work in a realistic way.
- Students can handle the complex data structures of their design task and document it in consice but understandable way.
- Students are able to judge the amount of work for a major design project.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
Electrical Engineering: Vertiefung Nanoelectronics and Microsystems Technology: Compulsory suffrage
Mechatronics: Vertiefung System Design: Compulsory suffrage
Microelectronics and Microsystems: Kernqualifikation: Compulsory suffrage

Course: Laboratory: Analog Circuit Design (Laborpraktikum)

Lecturer:
Prof. Wolfgang Krautschneider

Language:
DE

Cycle:
WS

Content:

- Input desk for circuits
- Algorithms for simulation
- MOS transistor model
- Simulation of analog circuits
- Placement and routing
- Generation of layouts
- Design checking routines
- Postlayout simulations

Literature:
Handouts to be distributed

Course: Laboratory: Digital Circuit Design (Laborpraktikum)

Lecturer:
Prof. Wolfgang Krautschneider

Language:
DE

Cycle:
SS

Content:

- Definition of specifications
- Architecture studies
- Digital simulation flow
- Philosophy of standard cells
- Placement and routing of standard cells
- Layout generation
- Design checking routines

Literature:
Handouts will be distributed

Module: Semiconductor Seminar

Courses:

Title	Typ	Hrs/wk
Semiconductor Seminar	Seminar	2

Module Responsibility:
Dr. Dietmar Schröder

Admission Requirements:

Recommended Previous Knowledge:
Bachelor of Science
Semiconductors

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students can explain the most important facts and relationships of a specific topic from the field of semiconductors.
Capabilities:
Students are able to compile a specified topic from the field of semiconductors and to give a clear, structured and comprehensible presentation of the subject. They can comply with a given duration of the presentation. They can write in English a summary including illustrations that contains the most important results, relationships and explanations of the subject.

Personal Competence:
Social Competence:
Students are able to adapt their presentation with respect to content, detailedness, and presentation style to the composition and previous knowledge of the audience. They can answer questions from the audience in a curt and precise manner.
Autonomy:
Students are able to autonomously carry out a literature research concerning a given topic. They can independently evaluate the material. They can self-reliantly decide which parts of the material should be included in the presentation.

ECTS-Credit points:
2 LP

Examination:
Referat

Workload in Hours:
Indipendent Study Time: 32, Study Time in Lecture: 28

Assignment for the Following Curricula:
Electrical Engineering: Vertiefung Nanoelectronics and Microsystems Technology: Compulsory suffrage
Microelectronics and Microsystems: Kernqualifikation: Compulsory suffrage

Course: Semiconductor Seminar (Seminar)

Lecturer:
Dr. Dietmar Schröder, Prof. Manfred Kasper, Prof. Wolfgang Krautschneider, Prof. Manfred Eich, Prof. Hoc Khiem Trieu

Language:
EN

Cycle:
SS

Content:
Prepare, present, and discuss talks about recent topics from the field of semiconductors. The presentations must be given in English.
Evaluation Criteria:

- understanding of subject, discussion, response to questions
- structure and logic of presentation (clarity, precision)
- coverage of the topic, selection of subjects presented
- linguistic presentation (clarity, comprehensibility)
- visual presentation (clarity, comprehensibility)
- handout (see below)
- compliance with timing requirement.

Handout:
Before your presentation, it is mandatory to distribute a printed handout (short abstract) of your presentation in English language. This must be no longer than two pages A4, and include the most important results, conclusions, explanations and diagrams.

Literature:

Aktuelle Veröffentlichungen zu dem gewählten Thema

Courses:

Title	Typ	Hrs/wk

Module Responsibility:
Prof. Wolfgang Krautschneider

Admission Requirements:

Recommended Previous Knowledge:

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Capabilities:

Personal Competence:
Social Competence:
Autonomy:

ECTS-Credit points:
6 LP

Examination:
lt. FSPO

Workload in Hours:
Indipendent Study Time: 180, Study Time in Lecture: 0

Assignment for the Following Curricula:
Microelectronics and Microsystems: Kernqualifikation: Compulsory suffrage

Courses:

Title	Typ	Hrs/wk
Sociology of Work	Seminar	2
Blue Engineering – Aspects of social and ecological responsibility II	Seminar	1
German as a Foreign Language for International Master Programs	Seminar	4
European Culture: Architectural and Cultural History Course A	Seminar	2
European Culture: Architectural and Cultural History Course B	Seminar	2
European Culture: History II.	Seminar	2
European Culture: Art	Seminar	2
Engineering Education Research and Applications	Seminar	2
Human Factors in Aviation and Maritime Systems	Vorlesung	2
Foreign Language Course	Seminar	2
Management and Communication	Seminar	2
Humanities and Engineering: Intercultural Communication	Seminar	2
Humanities and Engineering: Politics	Seminar	2
Theory of Communication	Seminar	2
Creative Processes in Technology, Music and the Arts	Seminar	2
Power plays in organizations: Micro-political competence and gender competence for professional practice	Seminar	2
Socio-economic and ecological Responsability in Engineering Profession	Seminar	2
Sociology and Social Critism	Seminar	2
World Literature: Meaning and Interpretation in the Interculture Dialogue	Seminar	2
Economic Sociology	Seminar	2
Academic Writing for Engineers	Seminar	2

Module Responsibility:
Dagmar Richter

Admission Requirements:

Recommended Previous Knowledge:

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Capabilities:

Personal Competence:
Social Competence:
Autonomy:

ECTS-Credit points:
6 LP

Examination:

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
Civil Engineering: Kernqualifikation: Compulsory
Bioprocess Engineering: Kernqualifikation: Compulsory
Chemical and Bioprocess Engineering: Kernqualifikation: Compulsory
Computer Science: Kernqualifikation: Compulsory
Electrical Engineering: Kernqualifikation: Compulsory
Energy and Environmental Engineering: Kernqualifikation: Compulsory
Energy Systems: Kernqualifikation: Compulsory
Environmental Engineering: Kernqualifikation: Compulsory
Aircraft Systems Engineering: Kernqualifikation: Compulsory
Global Innovation Management: Kernqualifikation: Compulsory suffrage
Computational Science and Engineering: Kernqualifikation: Compulsory
Information and Communication Systems: Kernqualifikation: Compulsory

International Management and Engineering: Kernqualifikation: Compulsory
Logistics, Infrastructure and Mobility: Kernqualifikation: Compulsory
Mechatronics: Kernqualifikation: Compulsory
Microelectronics and Microsystems: Kernqualifikation: Compulsory
Product Development, Materials and Production: Kernqualifikation: Compulsory
Renewable Energies: Kernqualifikation: Compulsory
Naval Architecture and Ocean Engineering: Kernqualifikation: Compulsory
Theoretical Mechanical Engineering: Kernqualifikation: Compulsory
Process Engineering: Kernqualifikation: Compulsory
Water and Environmental Engineering: Kernqualifikation: Compulsory

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Course: Sociology of Work (Seminar)

Lecturer:
Prof. Gabriele Winker

Language:
DE

Cycle:
WS

Content:
Work is a central sociological category that mediates between individual and society. Currently, it is subject to radical and diverse processes of change. In the seminar course, we will present and discuss recent findings in the field of work research. Topics include, among others, subjectivation and precarisation of labor as well as reproductive and care work.

Literature:
Fuchs, Tatjana (2006): Kurzfassung Was ist gute Arbeit? Anforderungen aus der Sicht von Erwerbstätigen In: INIFES (Hg.): Forschungsbericht an die Bundesanstalt für Arbeitsschutz und Arbeitsmedizin. Stadtbergen, 13-38
Hochschild, Arlie Russell, 2003. Love and Gold. In: femina politica, Zeitschrift für feministische Politik-Wissenschaft, 12.Jg. Heft 1/2003. S.77-9
Kratzer, Nick u.a. (2011): Leistungspolitik und Work-Life-Balance. Eine Trendanalyse des Projekts Lanceo. Institut für Sozialwissenschaftliche Forschung e. V. ISF München
Lehndorff, Steffen (2003): Marktsteuerung von Dienstleistungsarbeit. In: Dörre, Klaus; Röttger, Bernd (Hg.): Das neue Marktregime. Konturen eines nachfordistischen Produktionsmodells. Hamburg: VSAVerl., S. 153 171
Marrs, Kira (2010): Herrschaft und Kontrolle in der Arbeit. In: Böhle, Fritz/ Voß, Günter/ Wachtler, Günther (Hg.): Handbuch Arbeitssoziologie. Wiesbaden, 331-358
Bourdieu, Pierre (1998): Prekariat ist überall. In: Ders.: Gegenfeuer. Konstanz, 96-102

Course: Blue Engineering – Aspects of social and ecological responsibility II (Seminar)

Lecturer:
Robinson Peric

Language:
DE

Cycle:
WS

Content:
The seminar broaches the issue of both the connections and disparities between ecological and social responsibility in the context of engineering sciences. The underlying vision consists in a socially and ecologically sustainable development of technology, following a holistic approach in solving problems of mankind and nature. In this venue, the seminar provokes a creative immersion with questions regarding sustainable development and tries to evoke answers both on a small scale, as well as from a broader view.

Literature:
Literatur wird zu Beginn des Seminars bekanntgegeben.
References will be announced on the seminar's first appointment.

Course: German as a Foreign Language for International Master Programs (Seminar)

Lecturer:
Dagmar Richter

Language:
DE

Cycle:
WS/SS

Content:

Master's German course in cooperation with IBH e.V. – Master's German courses at different levels
In the international studies program these are obligatory for non-native speakers of German and for students without a DSH certificate or equivalent TEST-DAF result. Grading after an aptitude test. All other students must sign up for a total of 4 ECTS from the catalog of non-technical supplementary courses.

Literature:

- Will be announced in lectures -

Course: European Culture: Architectural and Cultural History Course A (Seminar)

Lecturer:

Dr. Marlis Bussacker

Language:

DE

Cycle:

WS

Content:

Literature:

- Wilfried Koch, Baustilkunde, Bertelsmann Lexikon Verlag, Gütersloh 1993
- Jacques Tullier, Geschichte der Kunst, Architektur, Skulptur, Malerei, Paris 2002
- Silvio Vietta, Europäische Kulturgeschichte – eine Einführung, München 2005

Course: European Culture: Architectural and Cultural History Course B (Seminar)

Lecturer:

Dr. Imke Hofmeister

Language:

DE

Cycle:

WS

Content:

Literature:

- Wilfried Koch, Baustilkunde, Bertelsmann Lexikon Verlag, Gütersloh 1993
- Jacques Tullier, Geschichte der Kunst, Architektur, Skulptur, Malerei, Paris 2002
- Silvio Vietta, Europäische Kulturgeschichte – eine Einführung, München 2005

Course: European Culture: History II. (Seminar)

Lecturer:

Prof. Margarete Jarchow, Dr. Martin Doerry

Language:

DE

Cycle:

WS

Content:

No event has left such deep traces on the political consciousness of the Federal Republic of Germany as the murder of millions of European Jews. With five autobiographical texts by survivors and victims of the holocaust the former historical events at that time are reconstructed. Their impact on current standards of political thought and action will be analyzed. The concentration of the individual stories facilitates the understanding of the historical context.
All titles are also available in English translation. Selected reviews as well as documentary footage are presented.

Literature:

Der Publizist Sebastian Haffner erzählt vom Entstehen des Nationalsozialismus und von seiner wachsenden Distanz zum NS-Regime („Geschichte eines Deutschen. Die Erinnerungen 1914 – 1933").
Der Historiker Saul Friedländer berichtet vom Überleben mit falscher Identität in einem französischen Internat („Wenn die Erinnerung kommt").
Der Kritiker Marcel Reich-Ranicki schreibt über seine Flucht aus dem Warschauer Ghetto und seine Liebe zur deutschen Kultur („Mein Leben").
Die Literaturwissenschaftlerin Ruth Klüger hat das KZ Auschwitz-Birkenau überlebt und wird bis heute von der eigenen Erinnerung an das Vernichtungslager verfolgt („weiter leben").
Die Ärztin Lilli Jahn schließlich wurde in Auschwitz von den Nazis umgebracht, ihr Schicksal ist in einem Briefwechsel mit ihren fünf Kindern dokumentiert (Martin Doerry: „Mein verwundetes Herz. Das Leben der Lilli Jahn. 1900 – 1944").

Course: European Culture: Art (Seminar)

Lecturer:
Dr. Gabriele Himmelmann

Language:
DE

Cycle:
WS/SS

Content:
The seminar focuses on works of painting, sculpture, arts and crafts, and design in a specific epoch of art and cultural history. By means of examples students acquire in-depth knowledge about works of art, their origins, their production conditions, their production techniques, and the societal framework conditions in their stylistic epoch. Ability to discuss and to communicate is trained by analyzing the works of art that are dealt with and eyes are opened for one's own and other cultures. The course includes excursions to museums and art museums to gain access to the customary ways in which museums present their exhibits.

Literature:
- Geschichte der Kunst in 12 Bänden, Beck'sche Reihe, München 2011
- Geschichte der bildenden Kunst in Deutschland, 8 Bände, München: Prestel 2006-
- Kunst-Epochen, Reclam-Universalbibliothek, Stuttgart 2002-
- Hans Belting / Heinrich Dilly / Wolfgang Kemp / Willibald Sauerländer / Martin Warnke, Kunstgeschichte – Eine Einführung, 7. Aufl. Berlin 2008
- Jutta Held / Norbert Schneider, Grundzüge der Kunstwissenschaft, Köln 2007
- Michael J. Gelb, How to think like Leonardo da Vinci, New York 1998
- E.H. Gombrich, The Story of Art, Phaidon Press Limited, London 1995
- Wilfried Koch, Baustilkunde, Bertelsmann Lexikon Verlag, Gütersloh 1993
- Jacques Tullier, Geschichte der Kunst, Architektur, Skulptur, Malerei, Paris 2002
- Silvio Vietta, Europäische Kulturgeschichte – eine Einführung, München 2005

Course: Engineering Education Research and Applications (Seminar)

Lecturer:
Prof. Christian Hans Gerhard Kautz

Language:
DE

Cycle:
WS/SS

Content:

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Learning scenarios, active learning methods
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Methods, results and implications of engineering education research
Conceptual understanding and misconceptions in introductory engineering courses
Research on learning behaviour, motivation, and beliefs
Preparation of Tutorials for selected lecture courses
Problem-Based Learning
Learning styles in engineering education
Assessment

Literature:
ausgewählte Artikel aus Fachzeitschriften werden an die Seminarteilnehmer verteilt, weiterführende Literatur wird zum jeweiligen Thema angegeben

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Course: Human Factors in Aviation and Maritime Systems (Vorlesung)

Lecturer:
Dr. Peter Maschke

Language:
DE

Cycle:
WS/SS

Content:
Title: Human Factor in Aviation and Maritime Systems
The human operator is both the strong and weak element within the aviation and maritime system. On the one hand, the operator increases the reliability of the technical system by a factor of ten. On the other hand, the operator him/herself induces a high error rate which is the

most critical risk in these man-machine systems: The main cause for more than 70% of accidents in aviation and maritime systems is due to human error. In this context the human operator (pilot, air traffic controller, astronaut or nautical officer) always interacts with machines or in a team of other operators.
To improve safety and efficiency, focus should be put both on designing a human oriented machine and on the operator: What are the important job requirements, how to find people who fulfil these requirements, and what can be reached by technical and non-technical training. For these options it has to be taken into account that human behavior is limited due to physiological and psychological aspects, e.g. human perception is biased due to subjectivity, and human decision making is not rational. The diversity of team situations is complicating these aspects.

Literature:

Badke-Schaub, Hofinger & Lauche (2008). Human Factors - Psychologie sicheren Handelns in Risikobranchen. Heidelberg: Springer.
Bauch, A. (2001). Ergonomie in der Flugzeugkabine - Passagierprozesse und manuelle Arbeitsablaufe. DGLR BERICHT (S. 49-56), ISSN 3932182154. Link: http://www.mp.haw-hamburg.de/pers/Scholz/dglr/bericht0101/Bauch.pdf
Goeters, K.-M. (Ed.) (2004). Aviation Psychology: Practice and Research. Aldershot: Ashgate.
Johnston,N., Fuller R., McDonald, N. (Eds.) (1994). Aviation Psychology: Training and Selection. Aldershot Hampshire: Avebury Aviation.
Sackett, P.R. & Lievens, F. (2008). Personnel Selection. Annual Review of Psychology, 59,
419-450.
Schuler, H. (2006). Lehrbuch der Personalpsychologie (2. Auflage). Göttingen: Hogrefe.
Schuler, H. (2007). Lehrbuch der Organisationpsychologie (4. Auflage). Huber: Bern.

Course: Foreign Language Course (Seminar)

Lecturer:
Dagmar Richter

Language:

Cycle:
WS/SS

Content:
In the Field of the Nontechnical Complementary Courses students are able to chose foreign language courses. Therefore the Hamburger Volkshochschule offers a special language programm on TUHH campus for TUHH Students. It includes courses in english, chinese, french, japanese, portuguese, russia, swedish, spanisch and german as a foreign language. All lectures impart common language knowledge, english courses although english for technical purposes.

Literature:
Kursspezifische Literatur / selected bibliography depending on special lecture programm.

Course: Management and Communication (Seminar)

Lecturer:
Prof. Gabriele Winker

Language:
DE

Cycle:
SS

Content:
The seminar will present basic elements of personality-promoting work organisation, motivation theories, different management concepts, communication theories and approaches to conflict and knowledge management. These subjects are applied to specific practical examples. Participants are given the opportunity to reflect on their own communicative and social behaviour.

Literature:

Große Boes, Stefanie; Kaseric, Tanja (2010): Trainer-Kit. Die wichtigsten Trainings-Theorien, ihre Anwendung im Seminar und Übungen für den Praxistransfer. 4. Aufl. Bonn: managerSeminare Verlags GmbH
Klutmann, Beate (2004): Führung: Theorie und Praxis. Hamburg: Windmühle
Laufer, Hartmut (2011): Grundlagen erfolgreicher Mitarbeiterführung. Führungspersönlichkeit, Führungsmethoden, Führungsinstrumente. 11. Auflage. Offenbach: GABAL
Neuberger, Oswald (2002): Führen und führen lassen. 6. überarb. und erw. Aufl. Stuttgart: Lucius und Lucius
Schulz von Thun, Friedemann; Ruppel, Johannes; Stratmann, Roswitha (2002): Miteinander reden: Kommunikationspsychologie für Führungskräfte. 4. Aufl. Reinbek bei Hamburg

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Course: Humanities and Engineering: Intercultural Communication (Seminar)

Lecturer:
Prof. Margarete Jarchow, Dr. Matthias Mayer

Language:

EN

Cycle:
WS/SS

Content:

As young professionals with technical background you may often tend to focus on communicating numbers and statistics in your presentations. However, facts are only one aspect of convincing others. Often, your personality, personal experience, cultural background and emotions are more important. You have to convince as a person in order to get your content across.
In this workshop you will learn how to increase and express your cultural competence. You will apply cultural knowledge and images in order to positively influence communicative situations. You will learn how to add character and interest to your talks, papers and publications by referring to your own and European Cultural background. You will find out the basics of communicating professionally and convincingly by showing personality and by referring to your own cultural knowledge. You will get hands-on experience both in preparing and in conducting such communicative situations. This course is not focussing on delivering new knowledge about European culture but helps you using existing knowledge or such that you can gain e.g. in other Humanities courses.
Content

- How to enrich the personal character of your presentations **by referring to European and your own culture**.
- How to properly arrange **content and structure.**
- How to use **PowerPoint for visualization** (you will use computers in an NIT room).
- How to be well-prepared and convincing **when delivering** your thoughts to your audience**.**

Literature:
Literaturhinweise werden zu Beginn des Seminars bekanntgegeben.
Literature will be announced at the beginning of the seminar.

Course: Humanities and Engineering: Politics (Seminar)

Lecturer:
Dr. Stephan Albrecht, Anne Katrin Finger, Gunnar Jeremias

Language:
EN

Cycle:
WS/SS

Content:
Scientists and engineers neither just strive for truths and scientific laws, nor are they working in a space far from politics. Science and engineering have contributed to what we now call the Anthropocene, the first time in the history of mankind when essential cycles of the earth system, e.g. carbon cycle, climate system, are heavily influenced or even shattered. Furthermore, Peak oil is indicating the end of cheap fossil energy thus triggering the search for alternatives such as biomass.
Systems of knowledge, science and technology in the OECD countries have since roughly 30 years increasingly become divided. On the one hand new technologies such as modern biotechnology, IT or nanotechnology are developing rapidly, bringing about many innovations for industry, agriculture, and consumers. On the other hand scientific studies from earth, environmental, climate change, agricultural and social sciences deliver increasingly robust evidence on more or less severe impacts on society, environment, global equity, and economy resulting from innovations during the last 50 years. Technological innovation thus is no longer an uncontested concept. And many protest movements demonstrate that the introduction of new or the enlargement of existing technologies (e.g. airports, railway stations, highways, high-voltage power lines surveillance) isn't at all a matter of course.
It is important to bear in mind the fact that all processes of technological innovation are made by humans, individually and collectively. Industrial, social, and political organizations as actors from the local to global level of communication, deliberation, and decision making interact in diverse arenas, struggling to promote their respective corporate and/or political agenda. So innovations are as well a problem of technology as a problem of politics. Innovation and technology policies aren't the same in all countries. We can observe conceptual and practical variations.
Since the 1992 Earth Summit in Rio de Janeiro Agenda 21 constitutes a normative umbrella, indicating Sustainable Development (SD) as core cluster of earth politics on all levels from local to global. Meanwhile other documents such as the Millennium Development Goals (MDG) have complemented the SD agenda. SD can be interpreted as operationalization of the Universal Declaration of Human Rights, adopted in 1948 by the General Assembly of the United Nations and since amended many times.
Engineers and scientists as professionals can't avoid to become confronted with many non-technical and non-disciplinary items, challenges, and dilemmas. So they have to choose between alternative options for action, as individuals and as members of organizations or employees. Therefore the seminar will address core elements of the complex interrelations between science, society and politics. Reflections on experiences of participants – e.g. from other countries as Germany – during the seminar are very welcome.
The goals of the seminar include:

- Raising awareness and increasing knowledge about the political implications of scientific work and institutions;
- Improving the understanding of different concepts and designs of innovation and technology policies;
- Increasing knowledge about the status and perspectives of sustainable development as framework concept for technological and scientific progress;
- Understanding core elements of recent arguments, conflicts, and crises on technological innovations, e.g. geo-engineering or bio-economy;

- Improving the understanding of scientists' responsibility for impacts of their professional activities;
- Embedding individual professional responsibility in social and political contexts.

The seminar will deal with current problems from areas such as innovation policy, energy, food systems, and raw materials. Issues will include the future of energy, food security and electronics. Historical issues will also be addressed.
The seminar will start with a profound overarching introduction. Issues will be introduced by a short presentation and a Q & A session, followed by group work on selected problems. All participants will have to prepare a presentation during the weekend seminar. The seminar will use inter alia interactive tools of teaching such as focus groups, simulations and presentations by students. Regular and active participation is required at all stages.

Literature:
Literatur wird zu Beginn des Seminars abgesprochen.

Course: Theory of Communication (Seminar)

Lecturer:
Dr. Michael Florian

Language:
DE

Cycle:
SS

Content:
The seminar focuses on sociological theories of communication and selected problems of practical application in the area of crisis communication. The issue of crisis communication will be analyzed on the basis of case studies.

Literature:
Habermas, Jürgen (1981): Theorie des kommunikativen Handelns. 2 Bände. Frankfurt/Main: Suhrkamp.
Luhmann, Niklas (1984): Soziale Systeme. Grundriß einer allgemeinen Theorie. Frankfurt/Main: Suhrkamp.
Malsch, Thomas (2005): Kommunikationsanschlüsse. Zur soziologischen Differenz von realer und künstlicher Sozialität. Wiesbaden: VS Verlag für Sozialwissenschaften.
Malsch, Thomas; Schmitt, Marco (Hg.) (2014): Neue Impulse für die soziologische Kommunikationstheorie. Empirische Widerstände und theoretische Verknüpfungen. Springer Fachmedien: Wiesbaden.
Meckel, Miriam; Schmid, Beat F. (Hg.) (2008): Unternehmenskommunikation. Kommunikationsmanagement aus Sicht der Unternehmensführung. 2., überarbeitete und erweiterte
Auflage. Gabler GWV Fachverlage: Wiesbaden.
Merten, Klaus (1999): Einführung in die Kommunikationswissenschaft. Bd 1/1: Grundlagen der Kommunikationswissenschaft. Münster: Lit Verlag.
Nolting, Tobias; Thießen, Ansgar (Hg.) (2008): Krisenmanagement in der Mediengesellschaft. Potenziale und Perspektiven der Krisenkommunikation. Wiesbaden: VS Verlag für Sozialwissenschaften.
Schützeichel, Rainer (2004): Soziologische Kommunikationstheorien. Konstanz: UVK Verlagsgesellschaft.
Thießen, Ansgar (2011): Organisationskommunikation in Krisen. Reputationsmanagement durch situative, integrierte und strategische Krisenkommunikation. VS Verlag für Sozialwissenschaften/Springer Fachmedien: Wiesbaden.
Thießen, Ansgar (Hg.) (2013): Handbuch Krisenmanagement. Springer Fachmedien: Wiesbaden.

Course: Creative Processes in Technology, Music and the Arts (Seminar)

Lecturer:
Prof. Hans-Joachim Braun

Language:
EN

Cycle:
WS

Content:
Creativity, which involves the generation of useful ideas and products, is an elusive term. "Inspirationalists" ,who point out spontaneous insights and "aha effects", have increasingly come under pressure from "structuralists", who emphasize hard work and expertise in creative processes, divesting creative people from supernatural gifts. In this light , a musical composition can be regarded as a piece of "cognitive engineering".In this seminar we will deal with the different concepts of creativity in their historical and cultural context. The main focus will be on investigating creative processes in invention, engineering design, architecture, the fine arts (for example Picasso`s Guernica), and in musical composition and improvisation. .Do creative processes follow a similar logic or are there vital domain-dependent differences? Two what extent have recent, particularly psychometric, studies been able to obtain empirically relevant and satisfying answers to the issue of creativity?

Literature:
H.-J. Braun, Engineering Design and Musical Composition: An Exploratory Inquiry; ICON vol.8, 2002, 1-24.
J. Kaufman &R.J. Steinberg; The Cambridge Handbook of Creativity, Cambridge U.P. 2010.
R.K. Sawyer, Explaining Creativity. The Science of Human Innovation, Oxford U.P. 2012,
R.W. Weisberg, Creativity: Understanding Innovation in Problem Solving, Science, Invention and the Arts, New York, John Wiley, 2006.

Course: Power plays in organizations: Micro-political competence and gender competence for professional practice (Seminar)

Lecturer:
Doris Cornils

Language:
DE

Cycle:
WS

Content:
folgt

Literature:
Cornils, D.; Mucha, A.; Rastetter, D. (2014): Mikropolitisches Kompetenzmodell: Erkennen, verstehen und bewerten mikropolitischer Kompetenz. In: OSC, Organisationberatung – Supervision – Coaching, 1/2014, S. 3-19
Cornils, Doris (2012): Mikropolitik und Aufstiegskompetenz von Frauen, in: CEWS-Journal, Center of Excellence Women and Science, 14.6.2012, Nr. 84, S. 23-34

Course: Socio-economic and ecological Responsability in Engineering Profession (Seminar)

Lecturer:
Dr. Wolfgang Neef

Language:
DE

Cycle:
WS

Content:

- technical science,economics and society
- sociologic and economic models of engineering in future
- engineering and technology without growth- and profit-compulsion

Literature:
Reader für die Lehrveranstaltung zu den Themen "Technik und Gesellschaft" und "Studium und Berufseinstieg"
Reader zu the topics "Technology and Society" and "Studying and Starting in Profession"

Course: Sociology and Social Critism (Seminar)

Lecturer:
Prof. Gabriele Winker

Language:
DE

Cycle:
WS

Content:
The seminar course focuses on the question of the significance and extent of social inequality. It will provide an overview of central sociological terms of analysis and findings of inequality studies.

Literature:
- Burzan, Nicole. Soziale Ungleichheit. Eine Einführung in die zentralen Theorien. 3. überarb. Aufl. Wiesbaden: VS Verlag für Sozialwissenschaften, 2007
- Hradil, Stefan: Soziale Ungleichheit in Deutschland. 8. Aufl., Nachdruck, Wiesbaden: VS Verlag für Sozialwissenschaften, 2005
- Kreckel, Reinhard: Politische Soziologie der sozialen Ungleichheit, 3., überarbeitete und erweiterte Auflage, Frankfurt/New York: Campus, 2004
- Winker, Gabriele; Nina Degele: Intersektionalität. Zur Analyse sozialer Ungleichheiten. Bielefeld: transcript Verlag, 2009

Course: World Literature: Meaning and Interpretation in the Interculture Dialogue (Seminar)

Lecturer:
Bertrand Schütz

Language:
DE

Cycle:
WS/SS

Content:
The seminar 'literature and culture' investigates the scope and possible meaning of what is commonly called European and especially German culture.
The practice of hermeneutics as basic discipline of the humanities comprises the approach to literary texts and their broader cultural context as well.
Subject matters are chosen according to their relevance for contemporary issues, particularly with regard to an intercultural dialogue.
Culture is thereby to be understood as the creative response to a given situation and the capacity to integrate inputs and influences, therefore as an ongoing process of permanent readjustment and learning, and by no means as a fixed identity in terms of an “essence”.

Literature:
Außer den unten angegebenen Referenzwerken wird je nach Thematik des Semesters eine spezifische Bibliographie erstellt.
Ernst Cassirer
Philosophie der symbolischen Formen
Hamburg 2010
Hans-Jörg Rheinberg
Experiment - Differenz - Schrift
Zur Geschichte epistemischer Dinge
Marburg 1992
Werner Heisenberg
Ordnung der Wirklichkeit
München 1989
Thomas S. Kuhn
The structure of scientific revolutions
The University of Chicago Press 1962

Course: Economic Sociology (Seminar)

Lecturer:
Dr. Michael Florian

Language:
DE

Cycle:
WS

Content:
Economic sociology means the application of sociological theories, methods, and perspectives in the analysis of economic issues. The seminar is concerned with new developments in economic sociology. Using case studies, the course will offer insights into the strengths and weaknesses of different sociological approaches.

Literature:
Baecker, Dirk: Wirtschaftssoziologie. Transcript: Bielefeld, 2006.
Bourdieu, Pierre et al.: Der Einzige und sein Eigenheim. Erweiterte Neuausgabe. Hamburg: VSA, 2002.
Beckert, Jens: Was ist soziologisch an der Wirtschaftssoziologie? Ungewißheit und die Einbettung wirtschaftlichen Handelns. In: Zeitschrift für Soziologie 25, 1996, S. 125–146.
Beckert, Jens: Grenzen des Marktes. Die sozialen Grundlagen wirtschaftlicher Effizienz. Campus: Frankfurt/New York, 1997
Beckert, Jens; Diaz-Bone, Rainer; Ganßmann, Heiner (Hg.) (2007): Märkte als soziale Strukturen. Frankfurt am Main/New York: Campus-Verlag.
Beckert, Jens; Deutschmann, Christoph (Hg.) (2010): Wirtschaftssoziologie. Sonderheft 49 der Kölner Zeitschrift für Soziologie und Sozialpsychologie: Wiesbaden: VS Verlag für Sozialwissenschaften.
Fligstein, Neil (2011): Die Architektur der Märkte. Wiesbaden: VS Verlag für Sozialwissenschaften.
Florian, Michael; Hillebrandt, Frank (Hg.): Pierre Bourdieu: Neue Perspektiven für die Soziologie der Wirtschaft. VS Verlag für Sozialwissenschaften: Wiesbaden, 2006.
Granovetter, Mark: Ökonomisches Handeln und soziale Struktur: Das Problem der Einbettung. In: Hans-Peter Müller und Steffen Sigmund (Hrsg.): Zeitgenössische amerikanische Soziologie. Leske + Budrich, Opladen 2000, S. 175-207.
Heinemann, Klaus (Hg.): Soziologie wirtschaftlichen Handelns. Sonderheft 28 der Kölner Zeitschrift für Soziologie und Sozialpsychologie. Opladen: Westdeutscher Verlag, 1987
Hirsch-Kreinsen, Hartmut: Wirtschafts- und Industriesoziologie. Grundlagen, Fragestellungen, Themenbereiche. Weinheim/München: Juventa, 2005.
Smelser, Neil J.; Swedberg, Richard (HG.): The Handbook of Economic Sociology. 2nd edition. Princeton/Oxford: Princeton University Press and New York: Russell Sage Foundation: New York, 2005.

Course: Academic Writing for Engineers (Seminar)

Lecturer:
Dr. Janina Lenger

Language:

DE

Cycle:

WS/SS

Content:

Writing is not a talent but a craft. It can only be improved if it is explicitly practiced. Students will acquire the necessary tools and knowledge to successfully write scientific texts in this seminar. Main components are brief inputs, practical exercises and knowledge sharing.
Contents are:
- the basics of writing theory
- components of scientific writing
- methods and exercises for problem solving within the writing process
- dealing with supervisors
- time management

Literature:

M. Cargill, P. O'Connor, Writing Scientific Research Articles, Wiley-Blackwell, Chichester, UK, 2009.
O. Kruse, Keine Angst vor dem leeren Blatt, Campus Verlag, Frankfurt/New York, 2000.
J. Wolfsberger, Frei Geschrieben, Mut Freiheit und Strategie für wissenschaftliche Abschlussarbeiten, UTB, Stuttgart, 2010.
W. Schneider, Deutsch für junge Profis, Rowohlt Taschenbuch Verlag, Reinbek bei Hamburg, 2011.
H.-J. Ortheil, Schreiben dicht am Leben, Dudenverlag, Mannheim – Zürich, 2012.

Module: Seminar Communications Engineering

Courses:

Title	Typ	Hrs/wk
Seminar Communications Engineering	Seminar	2

Module Responsibility:
Prof. Gerhard Bauch

Admission Requirements:
Desirable: One or more of the following moduls:
- Digital Communications
- Mobile Communications
- Information theory and coding
- Modern Wireless Systems

Recommended Previous Knowledge:

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students prepare on their own a special topic from communications engineering or digital signal processing.
Capabilities:
The students are able to prepare on their own a special topic from communications engineering or digital signal processing and present it in a seminar talk. They are able to discuss about the topic in a wider context. Furthermore, they are able to contribute to the discussion of other presentations during the seminar.

Personal Competence:
Social Competence:
The students are able to discuss within the semnar group.
Autonomy:

ECTS-Credit points:
2 LP

Examination:
Referat

Workload in Hours:
Indipendent Study Time: 32, Study Time in Lecture: 28

Assignment for the Following Curricula:
Electrical Engineering: Vertiefung Information and Communication Systems: Compulsory suffrage
Microelectronics and Microsystems: Kernqualifikation: Compulsory suffrage

Course: Seminar Communications Engineering (Seminar)

Lecturer:
Prof. Gerhard Bauch

Language:
DE/EN

Cycle:
WS/SS

Content:
changing topics

Literature:
je nach Thema

Module: Project Work IMPMM

Courses:

Title	Typ	Hrs/wk
Project Work IMPMM	Projektseminar	1

Module Responsibility:
Prof. Wolfgang Krautschneider

Admission Requirements:

Recommended Previous Knowledge:

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Capabilities:

Personal Competence:
Social Competence:
Autonomy:

ECTS-Credit points:
16 LP

Examination:
Projektarbeit

Workload in Hours:
Indipendent Study Time: 466, Study Time in Lecture: 14

Assignment for the Following Curricula:
Microelectronics and Microsystems: Kernqualifikation: Compulsory

Course: Project Work IMPMM (Projektseminar)

Lecturer:
Prof. Wolfgang Krautschneider

Language:
EN

Cycle:
WS/SS

Content:

Literature:

Courses:

Title	Typ	Hrs/wk

Module Responsibility:
Prof. Wolfgang Krautschneider

Admission Requirements:

Recommended Previous Knowledge:

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Capabilities:

Personal Competence:
Social Competence:
Autonomy:

ECTS-Credit points:
6 LP

Examination:
lt. FSPO

Workload in Hours:
Indipendent Study Time: 180, Study Time in Lecture: 0

Assignment for the Following Curricula:
Microelectronics and Microsystems: Kernqualifikation: Compulsory suffrage

Specialisation Communication and Signal Processing

Module: The Computational Web

Courses:

Title	Typ	Hrs/wk
The Computational Web	Vorlesung	2
The Computational Web	Projektseminar	2

Module Responsibility:
Prof. Helmut Weberpals

Admission Requirements:

Recommended Previous Knowledge:
Students are expected to have

- Solid knowledge of software engineering in general
- Solid knowledge of relational databases
- Solid experience in object-oriented programming
- Practical experience with web technologies and concepts
- Experience with an integrated development environment (IDE)

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students have acquired a thorough knowledge of Web services in general and of cloud services in particular. They have grasped a glimpse of emerging standards and have a clear understanding of the potential of the Computational Web.

Capabilities:
Students have acquired

- solid skills in setting up Web services,
- solid skills in setting up cloud services
- a thorough command of Amazon Web Services, the number one in cloud computing.

Personal Competence:
Social Competence:
Students are trained in communicating abstract ideas and are familiar with planning and conducting projects within a small team.

Autonomy:
Students are able to direct a Computational Web project: estimating the potential, devising the appropriate set-up, and adapting the business workflow.

ECTS-Credit points:
6 LP

Examination:
Projektarbeit

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
Computer Science: Vertiefung Computer and Software Engineering: Compulsory suffrage
Computational Science and Engineering: Vertiefung Systems Engineering and Robotics: Compulsory suffrage

Information and Communication Systems: Vertiefung Communication Systems, Schwerpunkt Software: Compulsory suffrage
Information and Communication Systems: Vertiefung Secure and Dependable IT Systems, Schwerpunkt Software and Signal Processing: Compulsory suffrage
Microelectronics and Microsystems: Vertiefung Communication and Signal Processing: Compulsory suffrage

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Course: The Computational Web (Vorlesung)

Lecturer:
Prof. Helmut Weberpals

Language:
EN

Cycle:
WS

Content:
The ubiquity of web technologies is revolutionising not only information services but also computing services. The Computational Web grants pervasive access to high-performance computer resources and will form the heart of modern information technology infrastructure. The course deals with the following topics:

- Introduction to the Computational Web
- Web Services Architecture
- Cloud Services Architecture
- Massively Parallel Cloud Computing
- Future Trends

Students will be be working on a series of mini-projects which will eventually evolve into a final project. Therefore, doing your projects well and in time is essential for performing well on this course.

Literature:
Björn Böttcher and Helmut Weberpals:
The Hitchhiker's Guide to the Computational Web.
To appear 2014.

Course: The Computational Web (Projektseminar)

Lecturer:
Prof. Helmut Weberpals

Language:
EN

Cycle:
WS

Content:
The ubiquity of web technologies is revolutionising not only information services but also computing services. The Computational Web grants pervasive access to high-performance computer resources and will form the heart of modern information technology infrastructure. The course deals with the following topics:

- Introduction to the Computational Web
- Web Services Architecture
- Cloud Services Architecture
- Massively Parallel Cloud Computing
- Future Trends

Students will be be working on a series of mini-projects which will eventually evolve into a final project. Therefore, doing your projects well and in time is essential for performing well on this course.

Literature:
Björn Böttcher and Helmut Weberpals:
The Hitchhiker's Guide to the Computational Web.
To appear 2014.

Module: Microwave Engineering

Courses:

Title	Typ	Hrs/wk
Microwave Engineering	Vorlesung	2
Microwave Engineering	Hörsaalübung	2
Microwave Engineering	Laborpraktikum	1

Module Responsibility:
Prof. Arne Jacob

Admission Requirements:

Recommended Previous Knowledge:
Fundamentals of communication engineering, semiconductor devices and circuits. Basics of Wave propagation from transmission line theory and theoretical electrical engineering.

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students can explain the propagation of electromagnetic waves and related phenomena. They can describe transmission systems and components. They can name different types of antennas and describe the main characteristics of antennas. They can explain noise in linear circuits, compare different circuits using characteristic numbers and select the best one for specific scenarios.

Capabilities:
Students are able to calculate the propagation of electromagnetic waves. They can analyze complete transmission systems und configure simple receiver circuits. They can calculate the characteristic of simple antennas and arrays based on the geometry. They can calculate the noise of receivers and the signal-to-noise-ratio of transmission systems. They can apply their theoretical knowledge to the practical courses.

Personal Competence:
Social Competence:
Students work together in small groups during the practical courses. Together they document, evaluate and discuss their results.

Autonomy:
Students are able to relate the knowledge gained in the course to contents of previous lectures. With given instructions they can extract data needed to solve specific problems from external sources. They are able to apply their knowledge to the laboratory courses using the given instructions.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 110, Study Time in Lecture: 70

Assignment for the Following Curricula:
Electrical Engineering: Kernqualifikation: Compulsory
Information and Communication Systems: Vertiefung Communication Systems: Compulsory suffrage
International Management and Engineering: Vertiefung II. Electrical Engineering: Compulsory suffrage
Microelectronics and Microsystems: Vertiefung Communication and Signal Processing: Compulsory suffrage

Course: Microwave Engineering (Vorlesung)

Lecturer:
Prof. Arne Jacob

Language:
DE/EN

Cycle:
WS

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

Literature:

H.-G. Unger, „Elektromagnetische Theorie für die Hochfrequenztechnik, Teil I“, Hüthig, Heidelberg, 1988
H.-G. Unger, „Hochfrequenztechnik in Funk und Radar“, Teubner, Stuttgart, 1994
E. Voges, „Hochfrequenztechnik - Teil II: Leistungsröhren, Antennen und Funkübertragung, Funk- und Radartechnik“, Hüthig, Heidelberg, 1991
E. Voges, „Hochfrequenztechnik“, Hüthig, Bonn, 2004

C.A. Balanis, “Antenna Theory”, John Wiley and Sons, 1982
R. E. Collin, “Foundations for Microwave Engineering”, McGraw-Hill, 1992
D. M. Pozar, “Microwave and RF Design of Wireless Systems”, John Wiley and Sons, 2001
D. M. Pozar, “Microwave Engineerin”, John Wiley and Sons, 2005

Course: Microwave Engineering (Übung)

Lecturer:
Prof. Arne Jacob

Language:
DE/EN

Cycle:
WS

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

Literature:

H.-G. Unger, „Elektromagnetische Theorie für die Hochfrequenztechnik, Teil I“, Hüthig, Heidelberg, 1988
H.-G. Unger, „Hochfrequenztechnik in Funk und Radar“, Teubner, Stuttgart, 1994
E. Voges, „Hochfrequenztechnik - Teil II: Leistungsröhren, Antennen und Funkübertragung, Funk- und Radartechnik“, Hüthig, Heidelberg, 1991
E. Voges, „Hochfrequenztechnik“, Hüthig, Bonn, 2004

C.A. Balanis, “Antenna Theory”, John Wiley and Sons, 1982
R. E. Collin, “Foundations for Microwave Engineering”, McGraw-Hill, 1992
D. M. Pozar, “Microwave and RF Design of Wireless Systems”, John Wiley and Sons, 2001
D. M. Pozar, “Microwave Engineerin”, John Wiley and Sons, 2005

Course: Microwave Engineering (Laborpraktikum)

Lecturer:
Prof. Arne Jacob

Language:
DE/EN

Cycle:
WS

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

Literature:

H.-G. Unger, „Elektromagnetische Theorie für die Hochfrequenztechnik, Teil I“, Hüthig, Heidelberg, 1988
H.-G. Unger, „Hochfrequenztechnik in Funk und Radar“, Teubner, Stuttgart, 1994
E. Voges, „Hochfrequenztechnik - Teil II: Leistungsröhren, Antennen und Funkübertragung, Funk- und Radartechnik“, Hüthig, Heidelberg, 1991
E. Voges, „Hochfrequenztechnik“, Hüthig, Bonn, 2004

C.A. Balanis, “Antenna Theory”, John Wiley and Sons, 1982
R. E. Collin, “Foundations for Microwave Engineering”, McGraw-Hill, 1992
D. M. Pozar, “Microwave and RF Design of Wireless Systems”, John Wiley and Sons, 2001
D. M. Pozar, “Microwave Engineerin”, John Wiley and Sons, 2005

Module: Communication Networks I - Analysis and Structure

Courses:

Title	Typ	Hrs/wk
Analysis and Structure of Communication Networks	Vorlesung	2
Selected Topics of Communication Networks	Problemorientierte Lehrveranstaltung	2
Communication Networks Excercise	Problemorientierte Lehrveranstaltung	1

Module Responsibility:
Prof. Andreas Timm-Giel

Admission Requirements:

Recommended Previous Knowledge:

- Fundamental stochastics
- Basic understanding of computer networks and/or communication technologies is beneficial

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students are able to describe the principles and structures of communication networks in detail. They can explain the formal description methods of communication networks and their protocols. They are able to explain how current and complex communication networks work and describe the current research in these examples.
Capabilities:
Students are able to evaluate the performance of communication networks using the learned methods. They are able to work out problems themselves and apply the learned methods. They can apply what they have learned autonomously on further and new communication networks.

Personal Competence:
Social Competence:
Students are able to define tasks themselves in small teams and solve these problems together using the learned methods. They can present the obtained results. They are able to discuss and critically analyse the solutions.
Autonomy:
Students are able to obtain the necessary expert knowledge for understanding the functionality and performance capabilities of new communication networks independently.

ECTS-Credit points:
6 LP

Examination:
Kolloquium

Workload in Hours:
Indipendent Study Time: 110, Study Time in Lecture: 70

Assignment for the Following Curricula:
Computer Science: Vertiefung Computer and Software Engineering: Compulsory suffrage
Electrical Engineering: Vertiefung Information and Communication Systems: Compulsory suffrage
Electrical Engineering: Vertiefung Control and Power Systems: Compulsory suffrage
Computational Science and Engineering: Vertiefung Safe Embedded and Cyber-Physical Systems: Compulsory suffrage
Information and Communication Systems: Vertiefung Communication Systems: Compulsory suffrage
Information and Communication Systems: Vertiefung Secure and Dependable IT Systems, Schwerpunkt Networks: Compulsory suffrage
Mechatronics: Vertiefung WhiteList: Compulsory suffrage
Microelectronics and Microsystems: Vertiefung Communication and Signal Processing: Compulsory suffrage

Course: Analysis and Structure of Communication Networks (Vorlesung)

Lecturer:
Prof. Andreas Timm-Giel

Language:
EN

Cycle:
WS

Content:

Literature:

- Skript des Instituts für Kommunikationsnetze
- Tannenbaum, Computernetzwerke, Pearson-Studium

Further literature is announced at the beginning of the lecture.

Course: Selected Topics of Communication Networks (Problemorientierte Lehrveranstaltung)

Lecturer:
Prof. Andreas Timm-Giel

Language:
EN

Cycle:
WS

Content:
Example networks selected by the students will be researched on in a PBL course by the students in groups and will be presented in a poster session at the end of the term.

Literature:

- see lecture

Course: Communication Networks Excercise (Problemorientierte Lehrveranstaltung)

Lecturer:
Prof. Andreas Timm-Giel

Language:
EN

Cycle:
WS

Content:
Part of the content of the lecture Communication Networks are reflected in computing tasks in groups, others are motivated and addressed in the form of a PBL exercise.

Literature:

- announced during lecture

Module: Mobile Communications

Courses:

Title	Typ	Hrs/wk
Mobile Communications	Vorlesung	2
Mobile Communications	Hörsaalübung	1

Module Responsibility:
Dr. Rainer Grünheid

Admission Requirements:

Recommended Previous Knowledge:

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Capabilities:

Personal Competence:
Social Competence:
Autonomy:

ECTS-Credit points:
4 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 78, Study Time in Lecture: 42

Assignment for the Following Curricula:
Electrical Engineering: Vertiefung Information and Communication Systems: Compulsory suffrage
Microelectronics and Microsystems: Vertiefung Communication and Signal Processing: Compulsory suffrage

Course: Mobile Communications (Vorlesung)

Lecturer:
Dr. Rainer Grünheid

Language:
EN

Cycle:
SS

Content:
The lecture deals with technical principles and related concepts of mobile communications. In this context, the main focus is put on the physical and data link layer of the ISO-OSI stack.
In the lecture, the transmission medium, i.e., the mobile radio channel, serves as the starting point of all considerations. The characteristics and the mathematical descriptions of the radio channel are discussed in detail. Subsequently, various physical layer aspects of wireless transmission are covered, such as channel coding, modulation/demodulation, channel estimation, synchronization, and equalization. Moreover, the different uses of multiple antennas at the transmitter and receiver, known as MIMO techniques, are described. Besides these physical layer topics, concepts of multiple access schemes in a cellular network are outlined.
In order to illustrate the above-mentioned technical solutions, the lecture will also provide a system view, highlighting the basics of some contemporary wireless systems, including UMTS/HSPA, LTE, LTE Advanced, and WiMAX.

Literature:
John G. Proakis, Masoud Salehi: Digital Communications. 5th Edition, Irwin/McGraw Hill, 2007
David Tse, Pramod Viswanath: Fundamentals of Wireless Communication. Cambridge, 2005
Bernard Sklar: Digital Communications: Fundamentals and Applications. 2nd Edition, Pearson, 2013
Stefani Sesia, Issam Toufik, Matthew Baker: LTE - The UMTS Long Term Evolution. Second Edition, Wiley, 2011

Course: Mobile Communications (Übung)

Lecturer:
Dr. Rainer Grünheid

Language:
EN

Cycle:
SS

Content:

The lecture deals with technical principles and related concepts of mobile communications. In this context, the main focus is put on the physical and data link layer of the ISO-OSI stack.
In the lecture, the transmission medium, i.e., the mobile radio channel, serves as the starting point of all considerations. The characteristics and the mathematical descriptions of the radio channel are discussed in detail. Subsequently, various physical layer aspects of wireless transmission are covered, such as channel coding, modulation/demodulation, channel estimation, synchronization, and equalization. Moreover, the different uses of multiple antennas at the transmitter and receiver, known as MIMO techniques, are described. Besides these physical layer topics, concepts of multiple access schemes in a cellular network are outlined.
In order to illustrate the above-mentioned technical solutions, the lecture will also provide a system view, highlighting the basics of some contemporary wireless systems, including UMTS/HSPA, LTE, LTE Advanced, and WiMAX.

Literature:

John G. Proakis, Masoud Salehi: Digital Communications. 5th Edition, Irwin/McGraw Hill, 2007
David Tse, Pramod Viswanath: Fundamentals of Wireless Communication. Cambridge, 2005
Bernard Sklar: Digital Communications: Fundamentals and Applications. 2nd Edition, Pearson, 2013
Stefani Sesia, Issam Toufik, Matthew Baker: LTE - The UMTS Long Term Evolution. Second Edition, Wiley, 2011

Module: Fibre and Integrated Optics

Courses:

Title	Typ	Hrs/wk
Fibre and Integrated Optics	Vorlesung	2
Fibre and Integrated Optics (Problem Solving Course)	Gruppenübung	1

Module Responsibility:
Prof. Manfred Eich

Admission Requirements:
Bachelor in physics, electrical engineering or general engineering science

Recommended Previous Knowledge:
Basic principles of electrodynamics and optics

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students can explain the fundamental mathematical and physical relations and technological basics of guided optical waves. They can describe integrated optical as well as fibre optical structures. They can give an overview on the applications of integrated optical components in optical signal processing.
Capabilities:
Students can generate models and derive mathematical descriptions in relation to fibre optical and integrated optical wave propagation. They can derive approximative solutions and judge factors influential on the components' performance.

Personal Competence:
Social Competence:
Students can jointly solve subject related problems in groups. They can present their results effectively within the framework of the problem solving course.
Autonomy:
Students are capable to extract relevant information from the provided references and to relate this information to the content of the lecture. They can reflect their acquired level of expertise with the help of lecture accompanying measures such as exam typical exam questions. Students are able to connect their knowledge with that acquired from other lectures.

ECTS-Credit points:
4 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 78, Study Time in Lecture: 42

Assignment for the Following Curricula:
Electrical Engineering: Vertiefung Microwave Engineering, Optics, and Electromagnetic Compatibility: Compulsory suffrage
Microelectronics and Microsystems: Vertiefung Communication and Signal Processing: Compulsory suffrage

Course: Fibre and Integrated Optics (Vorlesung)

Lecturer:
Prof. Manfred Eich

Language:
EN

Cycle:
SS

Content:

- Theory of optical waveguides
- Coupling to and from waveguides
- Losses
- Linear and nonlinear dspersion
- Components and technical applications

Literature:
Bahaa E. A. Saleh, Malvin Carl Teich, Fundamentals of Photonics, Wiley 2007
Hunsperger, R.G., Integrated Optics: Theory and Technology, Springer, 2002
Agrawal, G.P.,Fiber-Optic Communication Systems, Wiley, 2002, ISBN 0471215716
Marcuse, D., Theory of Dielectric Optical Waveguides, Academic Press,1991, ISBN 0124709516

Tamir, T. (ed), Guided-Wave Optoelectronics, Springer, 1990

Course: Fibre and Integrated Optics (Problem Solving Course) (Übung)

Lecturer:
Prof. Manfred Eich

Language:
EN

Cycle:
SS

Content:
See lecture Fibre and Integrated Optics

Literature:
See lecture Fibre and Integrated Optics

Module: Digital Image Analysis

Courses:

Title	Typ	Hrs/wk
Digital Image Analysis	Vorlesung	4

Module Responsibility:
Prof. Rolf-Rainer Grigat

Admission Requirements:

Recommended Previous Knowledge:
System theory of one-dimensional signals (convolution and correlation, sampling theory, interpolation and decimation, Fourier transform, linear time-invariant systems), linear algebra (Eigenvalue decomposition, SVD), basic stochastics and statistics (expectation values, influence of sample size, correlation and covariance, normal distribution and its parameters), basics of Matlab, basics in optics

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students can

- Describe imaging processes
- Depict the physics of sensorics
- Explain linear and non-linear filtering of signals
- Establish interdisciplinary connections in the subject area and arrange them in their context
- Interpret effects of the most important classes of imaging sensors and displays using mathematical methods and physical models.

Capabilities:
Students are able to

- Use highly sophisticated methods and procedures of the subject area
- Identify problems and develop and implement creative solutions.

Students can solve simple arithmetical problems relating to the specification and design of image processing and image analysis systems.
Students are able to assess different solution approaches in multidimensional decision-making areas.
Students can undertake a prototypical analysis of processes in Matlab.

Personal Competence:
Social Competence:

Autonomy:
Students can solve image analysis tasks independently using the relevant literature.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
Computer Science: Vertiefung Intelligence Engineering: Compulsory suffrage
Electrical Engineering: Vertiefung Information and Communication Systems: Compulsory suffrage
Electrical Engineering: Vertiefung Medical Technology: Compulsory suffrage
Computational Science and Engineering: Vertiefung Systems Engineering and Robotics: Compulsory suffrage
Information and Communication Systems: Vertiefung Communication Systems, Schwerpunkt Signal Processing: Compulsory suffrage
Information and Communication Systems: Vertiefung Secure and Dependable IT Systems, Schwerpunkt Software and Signal Processing: Compulsory suffrage
International Management and Engineering: Vertiefung II. Information Technology: Compulsory suffrage
Mechatronics: Vertiefung Intelligent Systems and Robotics: Compulsory suffrage
Microelectronics and Microsystems: Vertiefung Communication and Signal Processing: Compulsory suffrage
Theoretical Mechanical Engineering: Vertiefung Computer Science: Compulsory suffrage

Course: Digital Image Analysis (Vorlesung)

Lecturer:
Prof. Rolf-Rainer Grigat

Language:

EN

Cycle:
WS

Content:

- Image representation, definition of images and volume data sets, illumination, radiometry, multispectral imaging, reflectivities, shape from shading
- Perception of luminance and color, color spaces and transforms, color matching functions, human visual system, color appearance models
- imaging sensors (CMOS, CCD, HDR, X-ray, IR), sensor characterization(EMVA1288), lenses and optics
- spatio-temporal sampling (interpolation, decimation, aliasing, leakage, moiré, flicker, apertures)
- features (filters, edge detection, morphology, invariance, statistical features, texture)
- optical flow (variational methods, quadratic optimization, Euler-Lagrange equations)
- segmentation (distance, region growing, cluster analysis, active contours, level sets, energy minimization and graph cuts)
- registration (distance and similarity, variational calculus, iterative closest points)

Literature:

Bredies/Lorenz, Mathematische Bildverarbeitung, Vieweg, 2011
Wedel/Cremers, Stereo Scene Flow for 3D Motion Analysis, Springer 2011
Handels, Medizinische Bildverarbeitung, Vieweg, 2000
Pratt, Digital Image Processing, Wiley, 2001
Jain, Fundamentals of Digital Image Processing, Prentice Hall, 1989

Module: 3D Computer Vision

Courses:

Title	Typ	Hrs/wk
3D Computer Vision	Vorlesung	2
3D Computer Vision	Gruppenübung	2

Module Responsibility:
Prof. Rolf-Rainer Grigat

Admission Requirements:

Recommended Previous Knowledge:

- Knowlege of the modules Digital Image Analysis and Pattern Recognition and Data Compression are used in the practical task
- Linear Algebra (including PCA, SVD), nonlinear optimization (Levenberg-Marquardt), basics of stochastics and basics of Matlab are required and cannot be explained in detail during the lecture.

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students can explain and describe the field of projective geometry.

Capabilities:
Students are capable of

- Implementing an exemplary 3D or volumetric analysis task
- Using highly sophisticated methods and procedures of the subject area
- Identifying problems and
- Developing and implementing creative solution suggestions.

With assistance from the teacher students are able to link the contents of the three subject areas (modules)

- Digital Image Analysis
- Pattern Recognition and Data Compression
  and
- 3D Computer Vision

in practical assignments.

Personal Competence:
Social Competence:
Students can collaborate in a small team on the practical realization and testing of a system to reconstruct a three-dimensional scene or to evaluate volume data sets.

Autonomy:
Students are able to solve simple tasks independently with reference to the contents of the lectures and the exercise sets.
Students are able to solve detailed problems independently with the aid of the tutorial's programming task.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
Computer Science: Vertiefung Intelligence Engineering: Compulsory suffrage
Computational Science and Engineering: Vertiefung Systems Engineering and Robotics: Compulsory suffrage
Information and Communication Systems: Vertiefung Communication Systems, Schwerpunkt Signal Processing: Compulsory suffrage
Information and Communication Systems: Vertiefung Secure and Dependable IT Systems, Schwerpunkt Software and Signal Processing: Compulsory suffrage
Mechatronics: Vertiefung Intelligent Systems and Robotics: Compulsory suffrage
Microelectronics and Microsystems: Vertiefung Communication and Signal Processing: Compulsory suffrage

Course: 3D Computer Vision (Vorlesung)

Lecturer:
Prof. Rolf-Rainer Grigat

Language:
EN

Cycle:
WS

Content:

- Projective Geometry and Transformations in 2D und 3D in homogeneous coordinates
- Projection matrix, calibration
- Epipolar Geometry, fundamental and essential matrices, weak calibration, 5 point algorithm
- Homographies 2D and 3D
- Trifocal Tensor
- Correspondence search

Literature:

- **Skriptum Grigat/Wenzel**
- Hartley, Zisserman: Multiple View Geometry in Computer Vision. Cambridge 2003.

Course: 3D Computer Vision (Übung)

Lecturer:
Prof. Rolf-Rainer Grigat

Language:
EN

Cycle:
WS

Content:

- Projective Geometry and Transformations in 2D und 3D in homogeneous coordinates
- Projection matrix, calibration
- Epipolar Geometry, fundamental and essential matrices, weak calibration, 5 point algorithm
- Homographies 2D and 3D
- Trifocal Tensor
- Correspondence search

Literature:

- **Skriptum Grigat/Wenzel**
- Hartley, Zisserman: Multiple View Geometry in Computer Vision. Cambridge 2003.

Module: Digital Audio Signal Processing

Courses:

Title	Typ	Hrs/wk
Digital Audio Signal Processing	Vorlesung	2
Digital Audio Signal Processing	Hörsaalübung	1

Module Responsibility:
Prof. Udo Zölzer

Admission Requirements:
Bachelor in electrical engineering, mechatronics, computer science, or general engineering

Recommended Previous Knowledge:

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Die Studierenden können die grundlegenden Verfahren und Methoden der digitalen Audiosignalverarbeitung erklären. Sie können die wesentlichen physikalischen Effekte bei der Sprach- und Audiosignalverarbeitung erläutern und in Kategorien einordnen. Sie können einen Überblick der numerischen Methoden und messtechnischen Charakterisierung von Algorithmen zur Audiosignalverarbeitung geben. Sie können die erarbeiteten Algorithmen auf weitere Anwendungen im Bereich der Informationstechnik und Informatik abstrahieren.
Capabilities:
The students will be able to apply methods and techniques from audio signal processing in the fields of mobile and internet communication. They can rely on elementary algorithms of audio signal processing in form of Matlab code and interactive JAVA applets. They can study parameter modifications and evaluate the influence on human perception and technical applications in a variety of applications beyond audio signal processing. Students can perform measurements in time and frequency domain in order to give objective and subjective quality measures with respect to the methods and applications.

Personal Competence:
Social Competence:
The students can work in small groups to study special tasks and problems and will be enforced to present their results with adequate methods during the exercise.
Autonomy:
The students will be able to retrieve information out of the relevant literature in the field and putt hem into the context of the lecture. They can relate their gathered knowledge and relate them to other lectures (signals and systems, digital communication systems, image and video processing, and pattern recognition). They will be prepared to understand and communicate problems and effects in the field audio signal processing.

ECTS-Credit points:
4 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 78, Study Time in Lecture: 42

Assignment for the Following Curricula:
Electrical Engineering: Vertiefung Information and Communication Systems: Compulsory suffrage
Microelectronics and Microsystems: Vertiefung Communication and Signal Processing: Compulsory suffrage

Course: Digital Audio Signal Processing (Vorlesung)

Lecturer:
Prof. Udo Zölzer

Language:
EN

Cycle:
WS

Content:

- 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)

Literature:

- U. Zölzer, Digitale Audiosignalverarbeitung, 3. Aufl., B.G. Teubner, 2005.
- U. Zölzer, Digitale Audio Signal Processing, 2nd Edition, J. Wiley & Sons, 2005.

- U. Zölzer (Ed), Digital Audio Effects, 2nd Edition, J. Wiley & Sons, 2011.

Course: Digital Audio Signal Processing (Übung)

Lecturer:
Prof. Udo Zölzer

Language:
EN

Cycle:
WS

Content:

Literature:

Specialisation Microelectronics Complements

Module: Electronic Circuits for Medical Applications

Courses:

Title	Typ	Hrs/wk
Electronic Circuits for Medical Applications	Vorlesung	2
Electronic Circuits for Medical Applications	Gruppenübung	1
Electronic Circuits for Medical Applications	Laborpraktikum	1

Module Responsibility:
Prof. Wolfgang Krautschneider

Admission Requirements:

BS in electrical engineering, medical engineering or related subjects

Recommended Previous Knowledge:
Fundamentals of electrical engineering

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:

- Students can explain the basic functionality of the information transfer by the central nervous system
- Students are able to explain the build-up of an action potential and its propagation along an axon
- Students can exemplify the communication between neurons and electronic devices
- Students can describe the special features of low-noise amplifiers for medical applications
- Students can explain the functions of prostheses, e. g. an artificial hand
- Students are able to discuss the potential and limitations of cochlea implants and artificial eyes

Capabilities:

- Students can calculate the time dependent voltage behavior of an action potential
- Students can give scenarios for further improvement of low-noise and low-power signal acquisition.
- Students can develop the block diagrams of prosthetic systems
- Students can define the building blocks of electronic systems for an articifial eye.

Personal Competence:
Social Competence:

- Students are trained to solve problems in the field of medical electronics in teams together with experts with different professional background.
- Students are able to recognize their specific limitations, so that they can ask for assistance to the right time.
- Students can document their work in a clear manner and communicate their results in a way that others can be involved whenever it is necessary

Autonomy:

- Students are able to realistically judge the status of their knowledge and to define actions for improvements when necessary.
- Students can break down their work in appropriate work packages and schedule their work in a realistic way.
- Students can handle the complex data structures of bioelectrical experiments without needing support.
- Students are able to act in a responsible manner in all cases and situations of experimental work.

ECTS-Credit points:
6 LP

Examination:
Mündliche Prüfung

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
Electrical Engineering: Vertiefung Nanoelectronics and Microsystems Technology: Compulsory suffrage
Electrical Engineering: Vertiefung Medical Technology: Compulsory suffrage

Course: Electronic Circuits for Medical Applications (Vorlesung)

Lecturer:
Prof. Wolfgang Krautschneider

Language:
EN

Cycle:
WS

Content:

- Market for medical instruments
- Membrane potential, action potential, sodium-potassium pump
- Information transfer by the central nervous system
- Interface tissue - electrode
- Amplifiers for medical applications, analog-digital converters
- Examples for electronic implants
- Artificial eye, cochlea implant

Literature:
Kim E. Barret, Susan M. Barman, Scott Boitano and Heddwen L. Brooks
Ganong‘s Review of Medical Physiology, 24nd Edition, McGraw Hill Lange, 2010
Tier- und Humanphysiologie: Eine Einführung von Werner A. Müller (Author), Stephan Frings (Author), 657 p., 4. editions, Springer, 2009
Robert F. Schmidt (Editor), Hans-Georg Schaible (Editor)
Neuro- und Sinnesphysiologie (Springer-Lehrbuch) (Paper back), 488 p., Springer, 2006, 5. Edition, currently online only
Russell K. Hobbie, Bradley J. Roth, Intermediate Physics for Medicine and Biology, Springer, 4th ed., 616 p., 2007
Vorlesungen der Universität Heidelberg zur Tier- und Humanphysiologie: http://www.sinnesphysiologie.de/gruvo03/gruvoin.htm
Internet: http://butler.cc.tut.fi/~malmivuo/bem/bembook/

Course: Electronic Circuits for Medical Applications (Übung)

Lecturer:
Prof. Wolfgang Krautschneider

Language:
EN

Cycle:
WS

Content:

- Market for medical instruments
- Membrane potential, action potential, sodium-potassium pump
- Information transfer by the central nervous system
- Interface tissue - electrode
- Amplifiers for medical applications, analog-digital converters
- Examples for electronic implants
- Artificial eye, cochlea implant

Literature:
Kim E. Barret, Susan M. Barman, Scott Boitano and Heddwen L. Brooks
Ganong‘s Review of Medical Physiology, 24nd Edition, McGraw Hill Lange, 2010
Tier- und Humanphysiologie: Eine Einführung von Werner A. Müller (Author), Stephan Frings (Author), 657 p., 4. editions, Springer, 2009
Robert F. Schmidt (Editor), Hans-Georg Schaible (Editor)
Neuro- und Sinnesphysiologie (Springer-Lehrbuch) (Paper back), 488 p., Springer, 2006, 5. Edition, currently online only
Russell K. Hobbie, Bradley J. Roth, Intermediate Physics for Medicine and Biology, Springer, 4th ed., 616 p., 2007
Vorlesungen der Universität Heidelberg zur Tier- und Humanphysiologie: http://www.sinnesphysiologie.de/gruvo03/gruvoin.htm
Internet: http://butler.cc.tut.fi/~malmivuo/bem/bembook/

Course: Electronic Circuits for Medical Applications (Laborpraktikum)

Lecturer:
Prof. Wolfgang Krautschneider

Language:
EN

Cycle:
WS

Content:

Literature:

Module: Optoelectronics I - Wave Optics

Courses:

Title	Typ	Hrs/wk
Optoelectronics I: Wave Optics	Vorlesung	2
Optoelectronics I: Wave Optics (Problem Solving Course)	Gruppenübung	1

Module Responsibility:
Prof. Manfred Eich

Admission Requirements:
Bachelor in physics, electrical engineering or general engineering science

Recommended Previous Knowledge:
Basics in electrodynamics, calculus

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students can explain the fundamental mathematical and physical relations of freely propagating optical waves.
They can give an overview on wave optical phenomena such as diffraction, reflection and refraction, etc.
Students can describe waveoptics based components such as electrooptical modulators in an application oriented way.

Capabilities:
Students can generate models and derive mathematical descriptions in relation to free optical wave propagation.
They can derive approximative solutions and judge factors influential on the components' performance.

Personal Competence:
Social Competence:
Students can jointly solve subject related problems in groups. They can present their results effectively within the framework of the problem solving course.

Autonomy:
Students are capable to extract relevant information from the provided references and to relate this information to the content of the lecture.
They can reflect their acquired level of expertise with the help of lecture accompanying measures such as exam typical exam questions.
Students are able to connect their knowledge with that acquired from other lectures.

ECTS-Credit points:
4 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 78, Study Time in Lecture: 42

Assignment for the Following Curricula:
Electrical Engineering: Vertiefung Nanoelectronics and Microsystems Technology: Compulsory suffrage
Electrical Engineering: Vertiefung Microwave Engineering, Optics, and Electromagnetic Compatibility: Compulsory suffrage
Microelectronics and Microsystems: Vertiefung Microelectronics Complements : Compulsory suffrage

Course: Optoelectronics I: Wave Optics (Vorlesung)

Lecturer:
Prof. Manfred Eich

Language:
EN

Cycle:
SS

Content:

- Introduction to optics
- Electromagnetic theory of light
- Interference
- Coherence

- Diffraction
- Fourier optics
- Polarisation and Crystal optics
- Matrix formalism
- Reflection and transmission
- Complex refractive index
- Dispersion
- Modulation and switching of light

Literature:

Bahaa E. A. Saleh, Malvin Carl Teich, Fundamentals of Photonics, Wiley 2007
Hecht, E., Optics, Benjamin Cummings, 2001
Goodman, J.W. Statistical Optics, Wiley, 2000
Lauterborn, W., Kurz, T., Coherent Optics: Fundamentals and Applications, Springer, 2002

Course: Optoelectronics I: Wave Optics (Problem Solving Course) (Übung)

Lecturer:

Prof. Manfred Eich

Language:

EN

Cycle:

SS

Content:

see lecture Optoelectronics 1 - Wave Optics

Literature:

see lecture Optoelectronics 1 - Wave Optics

Module: Optoelectronics II - Quantum Optics

Courses:

Title	Typ	Hrs/wk
Optoelectronics II: Quantum Optics	Vorlesung	2
Optoelectronics II: Quantum Optics (Problem Solving Course)	Gruppenübung	1

Module Responsibility:
Prof. Manfred Eich

Admission Requirements:
Bachelor in physics, electrical engineering or general engineering science

Recommended Previous Knowledge:
Basic principles of electrodynamics, optics and quantum mechanics

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students can explain the fundamental mathematical and physical relations of quantum optical phenomena such as absorption, stimulated and spontanous emission. They can describe material properties as well as technical solutions. They can give an overview on quantum optical components in technical applications.
Capabilities:
Students can generate models and derive mathematical descriptions in relation to quantum optical phenomena and processes. They can derive approximative solutions and judge factors influential on the components' performance.

Personal Competence:
Social Competence:
Students can jointly solve subject related problems in groups. They can present their results effectively within the framework of the problem solving course.

Autonomy:
Students are capable to extract relevant information from the provided references and to relate this information to the content of the lecture. They can reflect their acquired level of expertise with the help of lecture accompanying measures such as exam typical exam questions. Students are able to connect their knowledge with that acquired from other lectures.

ECTS-Credit points:
4 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 78, Study Time in Lecture: 42

Assignment for the Following Curricula:
Electrical Engineering: Vertiefung Nanoelectronics and Microsystems Technology: Compulsory suffrage
Electrical Engineering: Vertiefung Microwave Engineering, Optics, and Electromagnetic Compatibility: Compulsory suffrage
Microelectronics and Microsystems: Vertiefung Microelectronics Complements : Compulsory suffrage

Course: Optoelectronics II: Quantum Optics (Vorlesung)

Lecturer:
Prof. Manfred Eich

Language:
EN

Cycle:
WS

Content:

- Generation of light
- Photons
- Thermal and nonthermal light
- Laser amplifier
- Noise
- Optical resonators
- Spectral properties of laser light
- CW-lasers (gas, solid state, semiconductor)

- Pulsed lasers

Literature:

Bahaa E. A. Saleh, Malvin Carl Teich, Fundamentals of Photonics, Wiley 2007
Demtröder, W., Laser Spectroscopy: Basic Concepts and Instrumentation, Springer, 2002
Kasap, S.O., Optoelectronics and Photonics: Principles and Practices, Prentice Hall, 2001
Yariv, A., Quantum Electronics, Wiley, 1988
Wilson, J., Hawkes, J., Optoelectronics: An Introduction, Prentice Hall, 1997, ISBN: 013103961X
Siegman, A.E., Lasers, University Science Books, 1986

Course: Optoelectronics II: Quantum Optics (Problem Solving Course) (Übung)

Lecturer:
Prof. Manfred Eich

Language:
EN

Cycle:
WS

Content:
see lecture Optoelectronics 1 - Wave Optics

Literature:
see lecture Optoelectronics 1 - Wave Optics

Module: Digital Signal Processing and Digital Filters

Courses:

Title	Typ	Hrs/wk
Digital Signal Processing and Digital Filters	Vorlesung	3
Digital Signal Processing and Digital Filters	Hörsaalübung	1

Module Responsibility:
Prof. Gerhard Bauch

Admission Requirements:
Mathematics 1-3
Signals and Systems (desireable)

Recommended Previous Knowledge:
Fundamentals of signal and system theory as well as random processes.
Fundamentals of spectral transforms (Fourier series, Fourier transform, Laplace transform)

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students know and understand basic algorithms of digital signal processing. They are familiar with the spectral transforms of discrete-time signals and are able to describe and analyse signals and systems in time and image domain. They know basic structures of digital filters and can identify and assess important properties including stability. They are aware of the effects caused by quantization of filter coefficients and signals. They are familiar with the basics of adaptive filters. They can perform traditional and parametric methods of spectrum estimation, also taking a limited observation window into account.
Capabilities:
The students are able to apply methods of digital signal processing to new problems. They can choose and parameterize suitable filter striuctures. In particular, the can design adaptive filters according to the minimum mean squared error (MMSE) criterion and develop an efficient implementation, e.g. based on the LMS or RLS algorithm. Furthermore, the students are able to apply methods of spectrum estimation and to take the effects of a limited observation window into account.

Personal Competence:
Social Competence:
The students can jointly solve specific problems.
Autonomy:
The students are able to acquire relevant information from appropriate literature sources. They can control their level of knowledge during the lecture period by solving tutorial problems, software tools, clicker system.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
Electrical Engineering: Vertiefung Information and Communication Systems: Compulsory suffrage
Electrical Engineering: Vertiefung Control and Power Systems: Compulsory suffrage
Computational Science and Engineering: Vertiefung Systems Engineering and Robotics: Compulsory suffrage
Information and Communication Systems: Vertiefung Communication Systems, Schwerpunkt Signal Processing: Compulsory suffrage
Mechatronics: Vertiefung Intelligent Systems and Robotics: Compulsory suffrage
Microelectronics and Microsystems: Vertiefung Microelectronics Complements : Compulsory suffrage

Course: Digital Signal Processing and Digital Filters (Vorlesung)

Lecturer:
Prof. Gerhard Bauch

Language:
EN

Cycle:
WS

Content:

- Transforms of discrete-time signals:
  - Discrete-time Fourier Transform (DTFT)
  - Discrete Fourier-Transform (DFT), Fast Fourier Transform (FFT)
  - Z-Transform

- Correspondence of continuous-time and discrete-time signals, sampling, sampling theorem
- Fast convolution, Overlap-Add-Method, Overlap-Save-Method
- Fundamental structures and basic types of digital filters
- Characterization of digital filters using pole-zero plots, important properties of digital filters
- Quantization effects
- Design of linear-phase filters
- Fundamentals of stochastic signal processing and adaptive filters
  - MMSE criterion
  - Wiener Filter
  - LMS- and RLS-algorithm
- Traditional and parametric methods of spectrum estimation

Literature:

K.-D. Kammeyer, K. Kroschel: Digitale Signalverarbeitung. Vieweg Teubner.
V. Oppenheim, R. W. Schafer, J. R. Buck: Zeitdiskrete Signalverarbeitung. Pearson StudiumA. V.
W. Hess: Digitale Filter. Teubner.
Oppenheim, R. W. Schafer: Digital signal processing. Prentice Hall.
S. Haykin: Adaptive flter theory.
L. B. Jackson: Digital filters and signal processing. Kluwer.
T.W. Parks, C.S. Burrus: Digital filter design. Wiley.

Course: Digital Signal Processing and Digital Filters (Übung)

Lecturer:

Prof. Gerhard Bauch

Language:

EN

Cycle:

WS

Content:

- Transforms of discrete-time signals:
  - Discrete-time Fourier Transform (DTFT)
  - Discrete Fourier-Transform (DFT), Fast Fourier Transform (FFT)
  - Z-Transform
- Correspondence of continuous-time and discrete-time signals, sampling, sampling theorem
- Fast convolution, Overlap-Add-Method, Overlap-Save-Method
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- Characterization of digital filters using pole-zero plots, important properties of digital filters
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Literature:

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Module: Design of Highly Complex Integrated Systems and CAD Tools

Courses:

Title	Typ	Hrs/wk
CAD Tools	Vorlesung	2
Design of Highly Complex Integrated Systems	Vorlesung	2

Module Responsibility:
Prof. Volkhard Klinger

Admission Requirements:

Recommended Previous Knowledge:

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Capabilities:

Personal Competence:
Social Competence:
Autonomy:

ECTS-Credit points:
6 LP

Examination:
Mündliche Prüfung

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
Electrical Engineering: Vertiefung Nanoelectronics and Microsystems Technology: Compulsory suffrage
Microelectronics and Microsystems: Vertiefung Microelectronics Complements : Compulsory suffrage

Course: CAD Tools (Vorlesung)

Lecturer:
Prof. Volkhard Klinger

Language:
EN

Cycle:
WS

Content:

Literature:

Course: Design of Highly Complex Integrated Systems (Vorlesung)

Lecturer:
Prof. Volkhard Klinger

Language:
EN

Cycle:
SS

Content:

Literature:

Thesis

Module: Master Thesis

Courses:

Title	Typ	Hrs/wk

Module Responsibility:
Professoren der TUHH

Admission Requirements:

Recommended Previous Knowledge:

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:

- The students can use specialized knowledge (facts, theories, and methods) of their subject competently on specialized issues.
- The students can explain in depth the relevant approaches and terminologies in one or more areas of their subject, describing current developments and taking up a critical position on them.
- The students can place a research task in their subject area in its context and describe and critically assess the state of research.

Capabilities:
The students are able:

- To select, apply and, if necessary, develop further methods that are suitable for solving the specialized problem in question.
- To apply knowledge they have acquired and methods they have learnt in the course of their studies to complex and/or incompletely defined problems in a solution-oriented way.
- To develop new scientific findings in their subject area and subject them to a critical assessment.

Personal Competence:
Social Competence:
Students can

- Both in writing and orally outline a scientific issue for an expert audience accurately, understandably and in a structured way.
- Deal with issues competently in an expert discussion and answer them in a manner that is appropriate to the addressees while upholding their own assessments and viewpoints convincingly.

Autonomy:
Students are able:

- To structure a project of their own in work packages and to work them off accordingly.
- To work their way in depth into a largely unknown subject and to access the information required for them to do so.
- To apply the techniques of scientific work comprehensively in research of their own.

ECTS-Credit points:
30 LP

Examination:
lt. FSPO

Workload in Hours:
Indipendent Study Time: 900, Study Time in Lecture: 0

Assignment for the Following Curricula:
Civil Engineering: Abschlussarbeit: Compulsory
Bioprocess Engineering: Abschlussarbeit: Compulsory
Chemical and Bioprocess Engineering: Abschlussarbeit: Compulsory
Computer Science: Abschlussarbeit: Compulsory
Electrical Engineering: Abschlussarbeit: Compulsory
Energy and Environmental Engineering: Abschlussarbeit: Compulsory
Energy Systems: Abschlussarbeit: Compulsory
Environmental Engineering: Abschlussarbeit: Compulsory
Aircraft Systems Engineering: Abschlussarbeit: Compulsory
Global Innovation Management: Abschlussarbeit: Compulsory
Computational Science and Engineering: Abschlussarbeit: Compulsory
Information and Communication Systems: Abschlussarbeit: Compulsory
International Management and Engineering: Abschlussarbeit: Compulsory
Joint European Master in Environmental Studies - Cities and Sustainability: Abschlussarbeit: Compulsory

Logistics, Infrastructure and Mobility: Abschlussarbeit: Compulsory
Mechatronics: Abschlussarbeit: Compulsory
Biomedical Engineering: Abschlussarbeit: Compulsory
Microelectronics and Microsystems: Abschlussarbeit: Compulsory
Product Development, Materials and Production: Abschlussarbeit: Compulsory
Renewable Energies: Abschlussarbeit: Compulsory
Naval Architecture and Ocean Engineering: Abschlussarbeit: Compulsory
Ship and Offshore Technology: Abschlussarbeit: Compulsory
Theoretical Mechanical Engineering: Abschlussarbeit: Compulsory
Process Engineering: Abschlussarbeit: Compulsory
Water and Environmental Engineering: Abschlussarbeit: Compulsory