COBURG UNIVERSITY
of applied sciences and arts

Module guide: Overview for study program AIMS

No.	Module	Person in charge of module	Lecturer
1.	Computer Based Measurement Technology (HC)	Wolf	Wolf
2.	Sensor Technology (HC)	Springer	Springer / Lindner
3.	Mathematical Data Analysis	Springer	Springer
4.	Photoelectric Detection (USST)	Yang	Yang / Lindner
5.	Nanometrology (USST)	Hou Zheng?	Hou
6.	Digital Signal Processing (USST)	Li	Li
7.	Summer School on Novel Technologies	Lindner	NN (Lecturers from industry)
8.	Practical Project (extern)	Springer	All Professors, Supervisors in internship companies
9.	Master Thesis	Springer	All Professors, supervisors from companies and institutes
10.	Elective (HC) Flow Measurement in Waste Water Systems	Sitzmann	Sitzmann
11.	Elective (HC) Risk of Investment in Emerging Technology	Lindner	Lindner
12.	Elective (HC) Microoptical Sensors	Kufner	Kufner
13.	Elective (HC) Microacoustic Sensors	Lindner	Lindner
14.	Elective (HC) Methods of Instrumental Analysis	Müller-Friedrich	Müller-Friedrich
15.	Elective (HC) Chemical Sensors	Müller-Friedrich	Müller-Friedrich
16.	Elective (HC) Computer Simulation	Wolf	Wolf
17.	Elective (HC) Scientific Documentation and Reporting	Emmerling	Emmerling
18.	Elective (HC) Design of Experiments	Lindner	Lindner
19.	Elective (USST) Medical Imaging Technology	Wolf/Lindner	Wolf/ Lindner
20.	Elective (USST) Automotive Electronics	Huang	Huang
21.	Elective (USST) Interferometric Testing	Sen	Sen
22.	German (HC)	Zimmer	Ruthenberg-Burchert
23.	Chinese (HC)	Zimmer	Scheidmantel

Program:	***AIMS: Analytical Instruments, Measurement and Sensor Technology***
Module designation:	***Computer Based Measurement Technology***
Abbreviation, if any:	*CBMT*
Subtitle, if any:	--
Instruction events, if any:	--
Semesters:	*1 or 2*
Person responsible for the module:	*Prof. Dr. Conrad Wolf*
Lecturer:	*Prof. Dr. Conrad Wolf*
Language:	*English*
Assignment to the curriculum:	*obligatory*
Form of instruction/lecture hours per week:	*Seminar-based tuition (2 lecture hours per week)* *Computer exercises and lab experiments (2 lecture hours per week)*
Level of work:	*Tuition time: 60 hours* *Self-study: 120 hours*
Credit points:	*6*
Prerequisites:	*Introduction to electrical measurement technology, basic knowledge of a higher programming language*
Course objectives/skills:	*Knowledge and profound understanding of the fundamentals in computer-based data acquisition, networking, measurement data processing and evaluation (with emphasis on industrial measurement technology).* *Skill to implement measurement software with the graphical programming language LabVIEW.* *Skill to analyze measurement tasks and to design and implement solution concepts (selection of suitable equipment, programming, data analysis) in an industrial environment.*
Content:	Lecture: *Introduction* *Measurement basics, Electronic measurement, Computer-based measurement, Measurement chain* *Data sampling* *Computer numbers, Sample and hold, DAC, ADC, Measurement equipment, Sampling theory, Windowing* *Interfaces & protocols* *Classification* *Serial point-to-point connection (RS-232)* *Industrial fieldbus systems (Communication basics and layer model, PROFIBUS, CAN)* *Ethernet-based interfaces (Ethernet, TCP/IP, PROFINET, EtherCAT)* *Measurement data processing* *DFT, Digital filters, Cross-correlation, Digital feedback control* LabVIEW class: *Introduction* *LabVIEW development environment* *Control flow* *CASE, FOR, WHILE, Sequence, Scripting and formula nodes, Global and local variables* *Data types and structures*

	Arrays, Cluster, Waveform data, Graphs and charts, Strings *Structuring* *Sub-VIs* *File and Hardware I/O* *Basic file handling, Measurement instrumentation access* *Design Patterns* *State machine, Functional global variable, Producer and consumer Loops, Error handling, Timing* *Data Sockets* Experiments: *Remote control of a measurement instrument with LabVIEW via RS-232* *RS-232 interface parameters, MAX, virtual instrument* *Remote control of a DSO with LabVIEW* *SCPI commands, virtual instrument* *Recording of a Bode diagram with function generator and DMM* *GPIB, automated LabVIEW measurement routine* *Measurement of time signal and spectrum with DAQ board* *NI DAQmx, sampling theorem, aliasing, windowing*
Program examination requirements:	*Written examination*
Media forms:	*Beamer and board/whiteboard,* *Electronic scripts and working documents,* *PCs with programming environment*
Literature:	• *B. Buckman: Computer-based Electronic Measurement* • *Prentice Hall (2001) G. D'Antona, A. Ferrero: Digital Signal Processing for Measurement Systems* • *Springer (2005) R. Bishop: LabVIEW 2009 Student Edition* • *Prentice Hall (2009) S. Sumathi, P. Serekha: LabVIEW Based Advanced Instrumentation Systems Springer (2007)*

Program:	*AIMS: Analytical Instruments, Measurement and Sensor Technology*
Module designation:	***Sensor Technology***
Abbreviation, if any:	*ST*
Subtitle, if any:	--
Instruction events, if any:	--
Semesters:	*1 or 2*
Person responsible for the module:	*Prof. Dr. Gerhard Lindner*
Lecturer:	*Prof. Dr. Gerhard Lindner, Prof. Dr. Martin Springer, Prof. Dr. Maria Kufner*
Language:	*English*
Assignment to the curriculum:	*obligatory*
Form of instruct./lecture hours per week:	*Lecture, seminar, laboratory experiments / 4 hours per week*
Level of work:	*Tuition time: 60 hours* *Self-study: 120 hours*
Credit points:	*6*
Prerequisites:	*Strong undergraduate background in physics and mathematics;* *Basic knowledge of electronics (AC circuits, amplifiers, measurement techniques)*
Course objectives/skills:	*Detailed knowledge about different sensor principles, their applications and limitations;* *Ability to select a suitable type of sensor for a specific application;* *Knowledge of current trends in sensor technology;* *Ability to integrate different sensors into a measurement system.* *Ability to solve measurement tasks with suitable sensors.*
Content:	*Lecture:* *Basic sensor principles:* • *Passive sensors (Resistive, capacitive, inductive sensors* • *Active sensors (Voltage, current and charge sources)* • *Transmission line sensors (Oscillators and sender/receiver configurations)* *Construction, function and applications of sensors.* *Typical applications of different sensor types.* *Laboratory experiments (10 per student), e.g.:* • *Position measurement (capacitive, GMR-, Hall, inductive, ultrasound, optical sensors)* • *Acceleration measurements (MEMS acceleration sensors, piezoelectric sensors)* • *Temperature and flow sensors (Coriolis flow meter, thermistors, thermocouples)*
Program examination requirements:	*Written examination (closed book), laboratory experiment reports*
Media forms:	*Multi-media equipment, PC, visualizer, laboratory*
Literature:	• *J. Fraden: Handbook of modern sensors. Springer, New York 2004* • *W. Göpel, J. Hesse, J.N. Zemel (eds) : Sensors, A Comprehensive Survey. Vol. 1 – 8, Wiley-VCH, since 1989 :*

Program:	*AIMS: Analytical Instruments, Measurement and Sensor Technology*
Module designation:	***Mathematical Data Analysis***
Abbreviation, if any:	*MDA*
Subtitle, if any:	--
Instruction events, if any:	--
Semesters:	*1 or 2*
Person responsible for the module:	*Prof. Dr. Martin Springer*
Lecturer:	*Prof. Dr. Martin Springer*
Language:	*English*
Assignment to the curriculum:	*obligatory*
Form of instruction/lecture hours per week:	*Lecture, exercises /4 hours per week*
Level of work:	*Tuition time: 60 hours* *Self-study: 120 hours*
Credit points:	*6*
Prerequisites:	*Strong undergraduate background in mathematics*
Course objectives/skills:	• *Detailed knowledge of mathematical approaches to the analysis of data from time series measurements* • *Understanding of mathematical foundations of systems modelling*
Content:	*Probabilities* • *Distributions, density* • *Expectation value, variance* • *Joint distributions* • *Stationarity, ergodicity* • *Confidence intervals* *Time-series modelling* • *Introduction to random signals* • *Random processes* • *Box-Jenkins method* • *Auto-regressive moving-average (ARMA) models* • *Estimation of order and parameters of ARMA models* • *Seasonal time series models* *Correlation analysis* • *Linear regression* • *Auto-correlation function (ACF)* • *Partial auto-correlation function (PACF)* • *Cross-correlation function (CCF)* *Spectral analysis* • *Fourier transforms* • *Discrete Fourier transform* • *Power spectrum* • *Spectral theory of stationary processes* • *Estimation of spectrum for random and deterministic signals*
Program examination requirements:	*Written examination*
Media forms:	*Blackboard, handout (PDF)*
Literature:	• *Bendat, J.S., Piersol, A.G.: Random Data. Wiley, Hoboken 2010 (4. ed.)* • *Derryberry, D.R.: Basic Data Analysis for Time Series with R. Wiley, Hoboken 2014* • *Rice, J.A.: Mathematical Statistics and Data Analysis. Brooks/Cole, Andover 2007 (3. ed.)* • *Woyczynski, W.A.: A First Course in Statistics for Signal Analysis. Birkhäuser, Boston 2006*

Program:	*AIMS: Analytical Instruments, Measurement and Sensor Technology*

Module designation:	***Photoelectric Detection***
Abbreviation, if any:	*PD*
Subtitle, if any:	--
Instruction events, if any:	--
Semesters:	*1 or 2*
Person responsible for the module:	*Prof. Yang Yongcai*
Lecturer:	*Prof. Yang Yongcai* *Prof. Dr. Gerhard Lindner*
Language:	*English*
Assignment to the curriculum:	*Obligatory*
Form of instruction/lecture hours per week:	*Seminar-based tuition with several instrumental instructions / 4 lecture hours per week*
Level of work:	*Tuition time: 60 hours* *Self-study: 120 hours*
Credit points:	*6*
Prerequisites:	*Basic courses in electronics and optics*
Course objectives/skills:	*Photoelectric Detection is a kind of modern measurement technology. The purpose of this course is to make students know the basic theory how to convert electric signal into optic signal and how to convert optic signal into electric signal again. It is also very important to know the principle, characteristic and structure of photoelectric devices and elements and how to use them into the field of the detection.*
Content:	***General introduction:*** *Modern information technology, Photoelectric information technology, Photoelectric measurement, the basics of optics, the basics of circuits* ***Introduction to electric light conversion:*** *Including light–emitting diodes (LEDs), Laser diodes (LDs), superluminescent diodes (SLDs), Liquid crystal displays (LCDs), organic light-emitting diodes (OLEDs), polymer light-emitting diodes (PLEDs)* *Introduction to photoelectric conversion: Including MPT, photodiode, phototransistor, pyroelectric detector, Mercury Cadmium Telluride detectors, opto-isolators, CCD, PSD and so on.* *Introduction to technical applications of photoelectric detection*
Program examination requirements:	*Written examination*
Media forms:	*Beamer and board/whiteboard, LCD projection machine, PCs with ppt environment*
Literature:	• *Semiconductor Optoelectronics (MIT graduate level open course ware)*

Program:	*AIMS: Analytical Instruments, Measurement and Sensor Technology*
Module designation:	***Nanometrology***
Abbreviation, if any:	*NM*
Subtitle, if any:	--
Instruction events, if any:	--
Semesters:	*1 or 2*
Person responsible for the module:	*Prof. Dr. Hou Wenmei*
Lecturer:	*Prof. Dr. Hou Wenmei* *Prof. Dr. Zheng Jihong*
Language:	*English*
Assignment to the curriculum:	*obligatory*
Form of instruction/lecture hours per week:	*Seminar based tuition with several instrumental instructions / 4 lecture hours per week*
Level of work:	*Tuition time: 60 hours* *Self-study: 120 hours*
Credit points:	*6*
Prerequisites:	*Basic courses of physics, electronic and optics*
Course objectives/skills:	*Students should learn basic knowledge of various nano-measurement methods with understanding of the underlying interaction mechanisms, because these methods have been developed for special applications, some of them allow investigation and manipulation of nanostructures down to the atomic scale, targeted far beyond microscopy. They will learn how to analyse and design measurement process for different tasks. To achieve this purpose the students should also learn the knowledge about nanotechnology, a broad, highly interdisciplinary and still evolving field, one of most promising technology in the new century.*
Content:	***General introduction:*** *Principle of operation, instrumentation and probes of Scanning Tunneling Microscopy and Atomic Force Microscope and their instrumentation and analyses.* ***Introduction of Nanotechnology:*** *Include micro- and nanofabrication and stamping techniques for micro- and nanofabrication, MEMS/NEMS devices and applications. It will also introduce the basic knowledge of Carbon nanotubes and nanowires. An important area is the fabrications and applications of MEMS/NEMS devices.*
Program examination requirements:	*Written examination*
Media forms:	*Beamer and board/whiteboard, electronic scripts and working documents*
Literature:	• *Handbook of Nanotechnology Editor-in-Chief Bharat Bhushan, Springer 2004*

Program:	*AIMS: Analytical Instruments, Measurement and Sensor Technology*
Module designation:	***Digital Signal Processing***
Abbreviation, if any:	*SP*
Subtitle, if any:	--
Instruction events, if any:	--
Semesters:	*1 or 2*
Person responsible for the module:	*Prof. Li Jun*
Lecturer:	*Prof. Li Jun*
Language:	*English*
Assignment to the curriculum:	*obligatory*
Form of instruction/lecture hours per week:	*Lecture/ 4 hours per week*
Level of work:	*Tuition time: 60 hours* *Self-study: 120 hours*
Credit points:	*6*
Prerequisites:	*Basic mathematic knowledge, mathematic for engineers*
Course objectives/skills:	*Signal Processing, in particular Digital Signal Processing (DSP) is the discipline that studies the rules governing the behavior of discrete signals, as well as the systems used to process them. It also deals with the issues involved in processing continuous signals using digital techniques. The main advantage of digital systems in relevance to analog systems are high reliability for modifying the system`s characteristics, and low cost. For the reason explained above, the field of digital signal processing has developed so fast in the last decades that it has been incorporated into the graduate and undergraduate programs of virtually all universities.* *This course is aimed at equipping readers with tools that will enable them to design and analyze most digital signal processing systems.* *The building blocks for digital signal processing systems considered here are used to process signals which are discrete in time and in amplitude.*
Content:	*Discrete-time signal and system* • *Introduction* • *Discrete-time signal* • *Discrete-time system* • *Difference equations and time-domain response* • *Sampling of Continuous-time signals* *The z and Fourier transforms* • *Introduction* • *Definition of the z transform* • *Inverse z transform* • *Properties of the z transform* • *Transfer functions* • *Stability in the z domain* • *Frequency response* • *Fourier transform* • *Properties of the Fourier transform*

	Discrete transforms • *Introduction* • *Discrete Fourier transform* • *Properties of DFT* • *Digital filtering using the DFT* • *Fast Fourier transform* • *Other discrete transforms* • *Signal representations* *Digital filters* • *Introduction* • *Basic structures of nonrecursive digital filters* • *Basic structures of recursive digital filters* • *Digital network analysis* • *State-space description* *FIR filter approximations* • *Introduction* • *Ideal characteristics of standard filters* • *FIR filter approximation by frequency sampling* • *FIR filter approximation with windows function* • *Maximally flat FIR filter approximation* • *FIR filter approximation by optimisation* *IIR filter approximations* • *Introduction* • *Analog filter approximations* • *Continuous-time to discrete-time transformations* • *Frequency transformation in the discrete-time domain* • *Magnitude and phase approximation* • *Time-domain approximation* *Finite-precision effects* • *Introduction* • *Binary number representation* • *Product quantization* • *Signal scaling* • *Coefficient quantization* • *Limit cycles* *Multirate systems* • *Introduction* • *Basic principles* • *Decimation* • *Interpolation* • *Rational sampling-rate changes*
Program examination requirements:	*Written examination*
Media forms:	*Beamer, blackboard*
Literature:	• *Paulo S.R. Diniz, etc: Digital Signal Processing – system analysis and design, Cambridge University Press, 2002* • *Joyce Van de Vegte: Fundamentals of Digital Signal Processing, Cambridge University Press, 2002* • *A.V. Oppenheim & R.W. Schäfer: Discrete-time Signal Processing, Englewood Cliffs, NJ: Prentice-Hall, 1089*

Program:	*AIMS: Analytical Instruments, Measurement and Sensor Technology*
Module designation:	***Summer School on Novel Applications***
Abbreviation, if any:	--
Subtitle, if any:	--
Instruction events, if any:	*Different venues*
Semester:	*1 + 3 (in the time May to September)*
Person responsible for the module:	*Prof. Dr. Gerhard Lindner*
Lecturer:	*All professors participating in the AIMS programme, guest lecturers, lecturers at conferences*
Language:	*English*
Assignment to the curriculum:	*obligatory*
Form of instruction/lecture hours per week:	*Topical lectures, conference participation, visit of industrial fairs, visit of companies, guest lectures, fulfilment of tasks at fairs (e.g. selection of suitable sensors for a given problem and corresponding suppliers), individual dates, no regular lecture hours.*
Level of work:	*180 hours*
Credit points:	*6 points*
Prerequisites:	*Profound knowledge in sensor technology; Ability to work in a self dependent way; Language skills sufficient for a written report and communication with partners from science and industry*
Course objectives/skills:	*Acquisition of a broad overview about different applications of sensors and recent developments* *Ability to understand the content and the context of conference contributions;* *Ability to write a well structured and consistent report about contributions to conferences and the matter of scientific discussions as well as about visits of companies and of technical fairs;* *Ability to communicate with representatives of companies about novel products and applications in sensor technology*
Content:	*Participation at Nürnberg Sensor+Test Fair, interviews with exhibitors* *Participation at Nürnberg SPC-Drives Fair, interviews with exhibitors* *Participation at Nürnberg Sensor Congress* *Participation at International Workshop on Novel Developments and Applications in Sensor Technology in Coburg* *Participation in guest lectures of representatives from industry* *Visits at companies applying sensor and measurement systems*
Program examination requirements	*Written reports, oral presentation, poster presentation*
Media forms:	*Conference equipment, PC, beamer and visualizer, posters, guided excursions, expositions*
Literature:	• *Conference proceedings of the conferences outlined above.* • *Information brochures and home pages of visited companies* • *Information materials of companies provided at fairs*

Program:	*AIMS: Analytical Instruments, Measurement and Sensor Technology*
Module designation:	***Practical Project***
Abbreviation, if any:	*PP*
Subtitle, if any:	*--*
Instruction events, if any:	*Locations: Companies or research institutions – in Germany for Chinese or international students, in China for German students*
Semester:	*3*
Person responsible for the module:	*Prof. Dr. Martin Springer*
Lecturer:	*All professors participating in the AIMS programme*
Language:	*English*
Assignment to the curriculum:	*obligatory*
Form of instruction/lecture hours per week:	*Project work and report*
Level of work:	*750 hours*
Credit points:	*25*
Prerequisites:	*Detailed knowledge of all relevant topics of the programme;* *Ability to work in a self dependent way;* *Language skills sufficient for a written report and communication in a company*
Course objectives/skills:	*Ability to carry out practical studies on a specific project in a self-reliant way;* *Ability to write a well structured and consistent report about the results;* *Ability to solve a practical problem in a well structured procedure under industrial conditions;* *Ability for productive work in a team;* *Ability to communicate with colleagues about the project work and to give an oral presentation of the results*
Content:	*Join a company or a research institute and work on a practical project in cooperation with the employees there, leading to a significant contribution to the project result and a written report*
Program examination requirements:	*Report, oral presentation*
Media forms:	*multi-media equipment, PC, black board*
Literature:	• *Project-specific documents and publications, patents, instructions of the company or the research institute*

Program:	*AIMS: Analytical Instruments, Measurement and Sensor Technology*
Module designation:	***Master Thesis***
Abbreviation, if any:	--
Subtitle, if any:	--
Instruction events, if any:	--
Semesters:	*4*
Person responsible for the module:	*Prof. Dr. Martin Springer*
Lecturer:	*All professors participating in the AIMS programme*
Language:	*English*
Assignment to the curriculum:	*obligatory*
Form of instruction/lecture hours per week:	*Project work and thesis*
Level of work:	*810 hours*
Credit points:	*27*
Prerequisites:	*Detailed knowledge of all relevant topics of the programme;* *Ability to work in a self dependent way;* *Language skills sufficient for a written thesis and an oral presentation*
Course objectives/skills:	*Ability to carry out scientific studies on a specific subject in a self-reliant way;* *Ability to write a well structured and consistent report about the results compliant to the standards of scientific publishing;* *Thorough knowledge of methods of scientific information retrieval;* *Ability to give an oral presentation of the results*
Content:	*Studies on a topic specified by a lecturer of the AIMS programme, leading to a written thesis and an oral presentation to the faculty*
Program examination requirements:	*Thesis, oral presentation*
Media forms:	*multi-media equipment, PC, black board*
Literature:	--

Program:	*AIMS: Analytical Instruments, Measurement and Sensor Technology*
Module designation:	***Flow Measurement in Waste Water Systems***
Abbreviation, if any:	*FMWWS*
Subtitle, if any:	--
Instruction events, if any:	--
Semesters:	*1 or 2*
Person responsible for the module:	*Prof. Dipl.-Ing. Dieter Sitzmann*
Lecturer:	*Prof. Dipl.-Ing. Dieter Sitzmann*
Language:	*English*
Assignment to the curriculum:	*elective*
Form of instruction/lecture hours per week:	*Lecture/2 hours per week, study trip, field practice*
Level of work:	*Tuition time: 30 hours, field instructions: 10 hours* *Self-study/study trip/field experience: 50 hours*
Credit points:	*3*
Prerequisites:	*basic knowledge of velocity and height measurement sensors*
Course objectives/skills:	*Detailed knowledge about sensor functionality and application for flow and height measurements in waste and drinking water systems and their limitations;* *ability to select a suitable type of sensor or a combination of sensors for a specific application;* *knowledge of current trends in sensor technology*
Content:	***Lecture:*** *Basic sensor principles:* - *velocity (Ultrasonic Doppler, ultrasonic time of flight, magnetic-inductive, radar, propeller)* - *depth (ultrasonic time of flight, radar, pressure, capacitive)* *Basics of hydraulics of flow in open channels and pipes* - *velocity and pressure distribution, flow calculation, flow measurements based on hydraulic effects* *Application of sensors/sensor combinations to waste water flow monitoring* *Special applications (fluorescent and conductivity tracer technology)* ***Study trips and practical field work:*** - *Visit of manufacturers of sensors and flow monitoring devices in Germany, visit of laboratory test stands, visit of professional users and discussion on experiences* - *Practical experience in using different flow monitoring devices, field test and analysis*
Program examination requirements:	*Written examination, summarizing report on study trips and practical field tests*
Media forms:	*multi-media equipment, PC, black board, experiments*
Literature:	• *Bos, M. G. (Hrsg.): Discharge measurement structures, ILRI publication 20, Wageningen (Niederlande), 1989* • *Wotherspoon, D.; Ashley, R. M.; Woods, S. P.: Imaging in Sewer Systems, in: Applications of Information Technology, in Construction; Ed.: J. Maxwell et al., pub. Thos Telford, UK Institution of civil engineering, 1991*

Program:	*AIMS: Analytical Instruments, Measurement and Sensor Technology*
Module designation:	***Risk of Investment into Emerging Technologies***
Abbreviation, if any:	--
Subtitle, if any:	--
Instruction events, if any:	--
Semesters:	*2*
Person responsible for the module:	*Prof. Dr. Gerhard Lindner*
Lecturer:	*Prof. Dr. Gerhard Lindner*
Language:	*English*
Assignment to the curriculum:	*elective*
Form of instruction/lecture hours per week:	*Lecture, exercises, presentation of a proposal for a venture capital application based on a business plan related to an emerging technology to a fictive committee, participation in a fictive committee deciding about investment of venture capital into business concepts proposed by fictive applicants, 2 SWS*
Level of work:	*Tuition: 30 hours* *Self-study: 60 hours*
Credit points:	*3*
Prerequisites:	*Immatriculation in one of the master programs AIMS or Financial Management*
Course objectives/skills:	*Obtain overview about emerging technologies* *Understand risk factors affecting the market success of such technologies* *Acquire knowledge about venture capital funding concepts and the structure of business plans* *Learn to prepare an application for venture capital funding into a business concept related to emerging technologies.* *Understand the concept of patent grants and the procedure of patent applications.* *Basic understanding of hedging highly volatile investment positions in emerging technology stocks using derivatives (e.g. stock options)*
Content:	*A) Examples of emerging technologies* *B) Different risk factors with respect to investments into such technologies* *C) How to obtain money for risky investments: The mechanism of venture capital funds* *D) How to convince potential investors: The structure of a business plan* *E) Protection of intellectual property rights: How to apply for a patent* *F) Protection of investments by hedging with derivatives: The mechanics of financial markets.*
Program examination requirements:	*Closed-book exam*
Media forms:	*Beamer, visualizer, digital information packages provided by the lecturer*
Literature:	• *Day, G.S., Schoemaker P.J.H, Gunther, R.E. (eds.): Wharton on Managing Emerging Technologies. Wiley.2000.* • *Voit, J.: The Statistical Mechanics of Financial Markets. Springer. 2005.*

Program:	*AIMS: Analytical Instruments, Measurement and Sensor Technology*
Module designation:	***Microoptical Sensors***
Abbreviation, if any:	*MoS*
Subtitle, if any:	--
Instruction events, if any:	--
Semesters:	*1 or 2*
Person responsible for the module:	*Prof. Dr. Kufner*
Lecturer:	*Prof. Dr. Kufner*
Language:	*English*
Assignment to the curriculum:	*Elective*
Form of instruction/lecture hours per week:	*Lecture, exercises, laboratory experiments / 2 hours per week*
Level of work:	*Tuition: 30 hours* *Self-study: 60 hours*
Credit points:	*3*
Prerequisites:	*Basic knowledge of sensor principles* *….*
Course objectives/skills:	*…*
Content:	*…*
Program examination requirements:	*Written examination*
Media forms:	*Multi-media equipment, PC, blackboard* *“Hands-on” experiments …*
Literature:	--

Program:	*AIMS: Analytical Instruments, Measurement and Sensor Technology*
Module designation:	***Microacoustic Sensors***
Abbreviation, if any:	*MS*
Subtitle, if any:	--
Instruction events, if any:	--
Semesters:	*1 or 2*
Person responsible for the module:	*Prof. Dr. Gerhard Lindner*
Lecturer:	*Prof. Dr. Gerhard Lindner*
Language:	*English*
Assignment to the curriculum:	*Elective*
Form of instruction/lecture hours per week:	*Lecture, exercises, laboratory experiments 2 SWS*
Level of work:	*Tuition: 30 hours* *Self-study: 60 hours*
Credit points:	*3*
Prerequisites:	*Basic knowledge of acoustic* *Basic knowledge of sensor principles*
Course objectives/skills:	*Understanding of physical properties of acoustic sensors and of the sensing mechanisms of acoustic sensors* *Understanding of the construction, function and fabrication of microacoustic devices* *Experience with microacoustic measurements* *Knowledge of applications of microacoustic sensors and measurement systems.*
Content:	*Basic elasticity theory and acoustics.* *Materials for microacoustic devices* *Sensor principles and their realization with microacoustic concepts (surface acoustic wave sensors, quartz microbalances).* *Excitation and detection of surface acoustic waves, construction and function of devices and measurement systems.* *Examples of applications ofmicroacoustic sensors and measurement systems(thermal, flow, force, layer formation, liquid sensors, laser acoustic material testing).*
Program examination requirements:	*Written examination (closed book)*
Media forms:	*Multi-media equipment, PC, blackboard* *“Hands-on” experiments in the Institute of Sensor and Actuator Technology*
Literature:	• *Rose J L 1999 Ultrasonic Waves in Solid Media (Cambridge: Cambridge University Press)* • *Ballantine jr. D S, White R M, Martin S J, Ricco A J, Frye G C, Zellers E T and Wohltjen H 1997 Acoustic Wave Sensors: Theory, Design and Physico-chemical Applications (San Diego: Academic Press)* • *Fischerauer G, Mauder A and Müller R 1995 Acoustic wave devices Sensors A Comprehensive Survey Vol. 8 ed W Goepel, J Hesse and J N Zemel (Weinheim: VCH) p 135* • *Grate J W and Frye G C 1996 Acoustic wave sensors Sensors Update Vol. 2 ed H Baltes, W Goepel and J. Hesse (Weinheim: Wiley) p 37*

Program:	*AIMS: Analytical Instruments, Measurement and Sensor Technology*
Module designation:	***Methods of Instrumental Analysis***
Abbreviation, if any:	*MIA*
Subtitle, if any:	--
Instruction events, if any:	--
Semesters:	*1*
Person responsible for the module:	*Dr. Denise Müller-Friedrich*
Lecturer:	*Dr. Denise Müller-Friedrich*
Language:	*English*
Assignment to the curriculum:	*Elective*
Form of instruction/lecture hours per week:	*Lecture and laboratory work / 4 hours per week*
Level of work:	*Tuition time: 60 hours* *Self-study: 120 hours*
Credit points:	*3*
Prerequisites:	--
Course objectives/skills:	*Learning aim: Thorough acquaintance with modern physico-chemical instrumental techniques (soft- and hardware) in separation science and the qualitative and quantitative analysis of stuff species like atoms, molecules, ions, in different materials and biological compounds.* *Taught competences: Familiarity with the principles of modern instrumental analysis* *Taught skills: Analytical problem solving; Experience with selected instrumental techniques*
Content:	• *Physico-chemical basics* • *Spectroscopical basics* • *Chromatographical basics* • *Atomic spectrometry* • *Molecular spectrometry* • *Chemical sensors* • *Applications in the following fields: environment, fuel, materials, archaeometry*
Program examination requirements:	*Parallel oral tests, experiment reports and final examination*
Media forms:	*(Intra-)Net based information flow; Small group laboratory courses; seminaristic lecture style*
Literature:	• *P. Atkins: Physical Chemistry, Oxford University Press* • *G.W. Ewing: Instrumental Methods of Chemical Analysis, McGraw-Hill (New York etc.)* • *R. Keller et al. (Eds.) : Analytical Chemistry, Wiley-VCH (Weinheim)* • *R.M. Silverstein, F.X. Webster, D.J. Kiemle: Spectrometric Identification of Organic Compounds*

Program:	*AIMS: Analytical Instruments, Measurement and Sensor Technology*
Module designation:	***Chemical Sensors***
Abbreviation, if any:	--
Subtitle, if any:	--
Instruction events, if any:	--
Semesters:	*1*
Person responsible for the module:	*Dr. Denise Müller-Friedrich*
Lecturer:	*Dr. Denise Müller-Friedrich*
Language:	*English*
Assignment to the curriculum:	*Elective*
Form of instruction/lecture hours per week:	*Lecture and laboratory work / 2 hours per week*
Level of work:	*Tuition time: 30 hours* *Self-study: 60 hours*
Credit points:	*3*
Prerequisites:	--
Course objectives/skills:	*After having successfully completed the course, the students should* *• know the different chemical sensor concepts and their specific design features,* *• know the advantages and limitations of the sensor concepts on the basis of the theoretical knowledge of sensor principles, the materials used and sensor technologies,* *• be able to decide which sensor concept is suitable for which application*
Content:	*Various Chemical Sensor principles with specific selectivities and sensitivities have been developed as innovative tools due to the growing need of effective devices for the identification and quantification of chemical and biochemical substances for process control, environmental monitoring or medical investigations.* *The theoretical concepts of electrochemical sensors e.g. pH-sensors, ion-selective electrodes (ISEs) Lambda Probe, membrane-covered amperometric cells as well as novel sensor approaches like fiber optics and acoustic sensor devices are introduced with special emphasis on the materials used, their properties and of technological aspects related to sensor fabrication* *The laboratory portion of the course compliments the lecture by providing a venue to practice current available techniques by using different chemical sensor types.*
Program examination requirements:	*Parallel oral tests, experiment reports and final examination*
Media forms:	*(Intra-)Net based information flow; Small group laboratory courses; seminaristic lecture style*
Literature:	• *Florinel-Gabriel Banica "Chemical Sensors and Biosensors: Fundamentals and Applications", Wiley VCH* • *Gründler, Peter "Chemical Sensors: An Introduction for Scientists and Engineers", Springer Verlag* • *Eggins, Brian R. "Chemical Sensors and Biosensors" , Wiley VCH* • *P.W. Atkins, "Physical Chemistry", Wiley VCH* • *Scientific journals: Sensors & Actuators: Chemical*

Program:	*AIMS: Analytical Instruments, Measurement and Sensor Technology*
Module designation:	***Computer Simulation***
Abbreviation, if any:	*CS*
Subtitle, if any:	--
Instruction events, if any:	--
Semesters:	*3*
Person responsible for the module:	*Prof. Dr. Conrad Wolf*
Lecturer:	*Dr. Liang Wei*
Language:	*English*
Assignment to the curriculum:	*elective*
Form of instruction/lecture hours per week:	*Lecture, exercises, laboratory experiments / 2 hours per week*
Level of work:	*Tuition: 30 hours* *Self-study: 60 hours*
Credit points:	*3*
Prerequisites:	*Numerical solution processes*
Course objectives/skills:	*Understand the Finite Element Method.* *Use the Finite Element Software "COMSOL Multiphysics"*
Content:	*Based on the Finite Element Software "COMSOL Multiphysics", know how to solve a project, in respects of, e.g. Heat Transfer, Electromagnetic, Acoustic, Structural Mechanics, Fluidics, and Wave Optics.*
Program examination requirements:	*Written examination*
Media forms:	*Beamer and board/whiteboard,* *Electronic scripts and working documents,* *PCs with programming environment*
Literature:	• *1COMSOL Multiphysics User Book.* https://www.comsol.de/ • *2Reddy,J.N. An Introduction to the Finite Element Method (Third ed.). McGraw-Hill.2005.* • *Zienkiewicz, O.C.; Taylor, R.L.; Zhu, J.Z. . The Finite Element Method: Its Basis and Fundamentals (Sixth ed.). Butterworth-Heinemann.2005.* • *Bathe, K.J. Finite Element Procedures. Cambridge, MA: Klaus-Jürgen Bathe.2006.*

Program:	*AIMS: Analytical Instruments, Measurement and Sensor Technology*
Module designation:	***Scientific Reporting and Documentation***
Abbreviation, if any:	--
Subtitle, if any:	--
Instruction events, if any:	--
Semesters:	*3*
Person responsible for the module:	*Dr. Inga Emmerling*
Lecturer:	*Dr. Inga Emmerling*
Language:	*English*
Assignment to the curriculum:	*Elective*
Form of instruction/lecture hours per week:	*Lecture and practical exercises, 90 Minutes per week, 2 SWS*
Level of work:	*Tuition: 30 hours* *Self-study: 60 hours*
Credit points:	*3*
Prerequisites:	*Basic knowledge of scientific writing*
Course objectives/skills:	*Become acquainted with scientific writing on a researchers level* *Knowing of different sorts of scientific writing* *Ability in using correct citation of different styles for different publications*
Content:	*How to plan and write a report for an experiment or a project* *How to write a thesis, expectations for a thesis at University of Coburg,* *Differences for different reports* *How to concept and prepare a scientific poster for a conference* *How to write paper for a journal*
Program examination requirements:	*Written examination (closed book)*
Media forms:	*Multi-media equipment, PC, visualizer, blackboard practical exercises, homework*
Literature:	• *Rabinowitz, H., Vogel S. (Eds.): The Manual of Scientific Style. A Guide for Authors, Editors and Researchers,Elsevier professional, 2009 (ebook)* • *http://www.ieee.org/conferences_ events/conferences/publishing/style_references_manual.pdf* • *http://www.scientificstyleandformat.org/Home.html*

Program:	*AIMS: Analytical Instruments, Measurement and Sensor Technology*
Module designation:	***Design of Experiments***
Abbreviation, if any:	*DOE*
Subtitle, if any:	--
Instruction events, if any:	--
Semester:	*3*
Person responsible for the module:	*Prof. Dr. Gerhard Lindner*
Lecturer:	*Prof. Dr. Gerhard Lindner; F. Singer, M.Eng.*
Language:	*English*
Assignment to the curriculum:	*Elective*
Form of instruction/lecture hours per week:	*Lecture, exercises, laboratory experiments* *2 SWS*
Level of work:	*Tuition: 30 hours* *Self-study: 60 hours*
Credit points:	*3*
Prerequisites:	*Basic knowledge of statistics and basic experience with experiments*
Course objectives/skills:	*Understanding of design concepts for experiments* *Ability of calculating confidence intervals and testing of hypotheses with simple statistical approaches.* *Understanding of full factorial design and ability of evaluation of the significance of effects by an analysis of variance.* *Knowledge of fractional factorial design concepts.*
Content:	*The experimental planning process* *Statistical methods, hypothesis testing* *Evaluation of an experiment: Measurement of gravitational constant* *Full factorial designs and ANOVA analysis* *Fractional designs..*
Program examination requirements:	*Written examination (closed book)*
Media forms:	*Multi-media equipment, PC, visualizer* *“Hands-on” experiments*
Literature:	• *Dean, A., Voss, D.: Design and Analysis of Experiments, Springer, New York, 1999* • *Box G.E.P., Hunter, J.S., Hunter, W.G.: Statistics for Experimenters, Wiley-Interscience, Hoboken, 2005*

Program:	*AIMS: Analytical Instruments, Measurement and Sensor Technology*
Module designation:	***Medical Imaging Technologies***
Abbreviation, if any:	*MIT*
Subtitle, if any:	*Image Reconstruction Algorithms*
Instruction events, if any:	--
Semesters:	*1 or 2*
Person responsible for the module:	*Prof. Dr. Conrad Wolf*
Lecturer:	*Prof. Dr. Conrad Wolf* *Prof. Dr. Gerhard Lindner*
Language:	*English*
Assignment to the curriculum:	*elective*
Form of instruction/lecture hours per week:	*Seminar-based tuition* *Computer exercises*
Level of work:	*Tuition time: 30 hours* *Self-study: 60 hours*
Credit points:	*3*
Prerequisites:	--
Course objectives/skills:	*The students gain a deep understanding of the physics and mathematics involved in CT and MRT data acquisition.* *Based on this knowledge the students are enabled to apply appropriate image reconstruction algorithms to obtain medically usable images from CT and MRT raw data.* *The application of this theoretical knowledge is practiced in several Matlab exercises.*
Content:	*Computed Tomography (CT):* *Lambert-Beer law of absorption and projections* *Radon transform* *Algebraic reconstruction technique* *Back projection* *Filtered back projection* *Fourier slicing theorem* *PET & SPECT* *Magnetic Resonance Tomography (MRT):* *Spatial encoding and gradient fields* *k space formalism* *2D Fourier transform* *Properties of 2D FT* *Aliasing effect in MRT*
Program examination requirements:	*Written examination*
Media forms:	*Beamer and board/whiteboard,* *Electronic scripts and working documents,* *PCs with programming environment*
Literature:	• *T. M. Buzug: Computed Tomography – From Photon Statistics to Modern Cone-Beam CT , Springer (2008)* • *D. Weishaupt, V. D. Köchli, B. Marincek: How Does MRI Work? – An Introduction to the Physics and Function of Magnetic Resonance Imaging Springer (2006)* • *S. Webb: The Physics of Medical Imaging Adam Hilger (1988)*

Program:	*AIMS: Analytical Instruments, Measurement and Sensor Technology*
Module designation:	***Automotive Electronics and Simulation Testing***
Abbreviation, if any:	*AEST*
Subtitle, if any:	--
Instruction events, if any:	--
Semesters:	*3*
Person responsible for the module:	*Prof. Huang*
Lecturer:	*Prof. Huang*
Language:	*English*
Assignment to the curriculum:	*elective*
Form of instruction/lecture hours per week:	*Lecture/ 2 hours per week, lab session, seminar*
Level of work:	*Tuition time: 30 hours* *Self-study: 60 hours*
Credit points:	*3*
Prerequisites:	*Mathematic, physics, information technology, Electronics for engineering graduate students*
Course objectives/skills:	*The module aims to provide students with the up-to-date essential knowledge about electronic systems within a modern vehicle and modelling/simulation skills currently widely used in design and development of automotive electronic systems.* *Upon completion of this module the student should be able to:* *1. Understand the electronic architecture of a modern vehicle including various vehicle networks and structure of a Electronic Control Unit.* *2. Describe the principle of operation of a range of automotive sensors, and understand data acquisition system.* *4. Evaluate control systems objective and strategies, understand basic control theories.* *5. Employ computer tools in system modelling and simulation for vehicle control system design and analysis, i.e. MATLAB and SIMULINK.* *6. Understand model-based design and testing method.* *7. Understand diagnostics and advanced driver assistance systems.*
Content:	*1. Electrical architecture of a modern vehicle, vehicle network(CAN, LIN, Flexray, MOST).* *2. Automotive sensors, Data acquisition systems, Operational amplifiers.* *3. Electronic Control Units,Control principles and theories.* *4. Electronic Motor, Vehicle Anti-lock brake control.* *5. Modelling and Simulink of an electric kart* *6. Model-based design and testing.* *7. Vehicle Electronic diagnostics.* *8. Advanced driver assistance systems, Hybrid vehicles.*
Program examination requirements:	*coursework*

Media forms:	*Beamer, white/blackboard, PPT, PC lab with MALAB/SIMULINK*
Literature:	*Essential reading:* *1. Course notes* *Recommended Reading:* *2. Robert Bosch, "BOSCH Automotive Electrics – Automotive Electronics", 5th edition, JohnWiley &Sons Ltd.* *3. William B. Ribbens, "Understanding Automotive Electronics", Newnes - ISBN 0-2506-7008-8* *4. W. Bolton "Mechatronics – Electronic Control Systems in Mechanical and Electrical Engineering"* *5. John Turner , "Automotive Sensors"* *6. Tranter, A (2008) " Automotive Electrical and Electronic Systems" Haynes Techbooks ISBN 9781844252510*

Program:	*AIMS: Analytical Instruments, Measurement and Sensor Technology*
Module designation:	***Interferometric Testing***
Semesters:	*1*
Person responsible for the module:	*Prof. Dr. Sen Han*
Lecturer:	*Prof. Dr. Sen Han*
Language:	*English*
Relation to curriculum:	*Obligatory*
Type of teaching, contact hours:	*Seminar based tuition with several instrumental instruction / 16 lecture hours in two weeks.*
Workload:	*Tuition time: 36h, including 4h for lab practices* *Self-study: 60h*
Credit points:	*6*
Recommended prerequisites:	*Prerequisite course are of optics physics, and electrics.*
Module objectives/intended learning outcomes:	*The purpose of this course is to train student to learn interferometric technique and its application, which is one of nanotechnology or one of most promising technology in the new century.* *To achieve this purpose, first of all, students should learn basic knowledge of interferometry. Second, they should know various interferometers. Third, they should study measurement methods. Finally, they should understand typical applications with micro/nano-level accuracy, be able to use them in both academic and industrial fields, and further research/develop some new techniques or applications.*
Content:	*Course is divided into 12 chapters, including fundamentals of interferometry, phase-shifting interferometry, system metrics, data analysis options, common measurement terms, optical element testing, optical system testing, typical analysis for measurement results, special measurements, interferometry at different wavelength, modular combined interferometer, and applications.*
Study and examination requirements and forms of examination:	*Written examination or report*
Media forms:	*Beamer and board/whiteboard, electronic scripts and working documents*
Literature:	*1. D. Malacara, editor, <u>Optical Shop Testing</u> (Wiley, New York, 1992)* *2. James C. Wyant, Chiayu Ai, “Absolute testing of flats by using even and odd functions”, Applied Optics Vol 32 No. 25, Sept 1993 pp 4698-4705* *3. Jamse C. Wyant, “Interferometric Testing of Aspheric Surfaces” SPIE Vol 816, 1987, pp 19-39* *4. D.A. Thomas and J.C. Wyant, “Determination for the dihedral angles of a corner cube from its Twyman-Green Interferogram”, JOSA, Vol 67, 1977, pp 467* *5. G Schulz and J. Schwider, “Interferometertir testing of smooth surfaces,*

	Progress in Optics Vol XIII, Edited by E. Wolf, 197, pp 93-167 *6. K. Creath and J.C. Wyant, “Absolute measurement of spherical surfaces,”Proc SPIE 1332 (1990)* *7. J. Schwider, R. Buro, K-E Elssner, R. Splacyz, and J. Grzanna, “Homogeneity testing by phase sampling interferometry”, Applied Optics, Vol 24, No. 18, Sept 1985, p 3059-3061*

Program:	*AIMS: Analytical Instruments, Measurement and Sensor Technology*
Module designation:	***Chinese/German***
Abbreviation, if any:	--
Subtitle, if any:	--
Instruction events, if any:	*German*
Semesters:	*1 or 2*
Person responsible for the module:	*Katja Zimmer (M.A.)*
Lecturer:	*Angelika Ruthenberg-Burchert, MA,* *Sabine Gudehus* *u.a.*
Language:	*German*
Assignment to the curriculum:	*Obligatory for Chinese and International Studenten*
Form of instruction/lecture hours per week:	*Seminar-based-tuition / 4 hours per week*
Level of work:	*Tuition: 60 hours* *Self-study: 120 hours*
Credit points:	*6*
Prerequisites:	--
Course objectives/skills:	*Basic understanding of German Language structure, listening and speaking and reading on the level of „Certificate German“; writing of texts*
Content:	• *Basic grammar* • *Listening* • *Reading* • *Oral and written expression*
Program examination requirements:	*Written exam*
Media forms:	*Working templates, blackboard, overhead-projector*
Literature:	• *Stief/Stang: German Grammar in a Nutshell Deutsche Grammatik – kurz und schmerzlos Berlin und München, 2002 (Langenscheidt)* • *Reimann: Grundstufen-Grammatik für DaF Ismaning, 2000 (Hueber)* • *Apelt & Apelt: plus deutsch 1 Ismaning, 2000 (Hueber)* • *AufderStraße, Müller, Storz: Delfin Lehrwerte für DaF Ismaning, 2005 (Hueber)*

Program:	*AIMS: Analytical Instruments, Measurement and Sensor Technology*
Module designation:	***Chinese/German***
Abbreviation, if any:	--
Subtitle, if any:	--
Instruction events, if any:	*Chinese (Mandarin)*
Semesters:	*1 or 2*
Person responsible for the module:	*Katja Zimmer (M.A.)*
Lecturer:	*Frau Scheidmantel*
Language:	*Chinese (Mandarin)*
Assignment to the curriculum:	*Obligatory for German students*
Form of instruction/lecture hours per week:	*Seminar-based tuition / intensive block course*
Level of work:	*Tuition: 60 hours* *Self-study: 120 hours*
Credit points:	*6*
Prerequisites:	--
Course objectives/skills:	*Basic understanding of Mandarin. Language structure, listening and speaking, understanding of important characters.* *The students shall be able to perform basic communications in daily life affairs in Mandarin and shall be able to read simple texts.*
Content:	*Basics of Mandarin: vocabulary and grammar for self-presentation, name, work, numbers, vocabulary and grammar for Chinese cooking and visiting a restaurant, time and appointments, money and shopping*
Program examination requirements:	*Written and oral examination*
Media forms:	*Working templates, blackboard, role plays, songs, exercises, films*
Literature:	• *Langenscheidt Praktisches Lehrbuch Chinesisch,* • *Langenscheidt Schreibübungsbuch Chinesisch: Schriftzeichen Strich für Strich* • *Eigene Materialien (www.chinacompetence.com)*