Syllabus

Information given on each module:

- ***Lecturer***
- ***Objectives***
- ***Content***
- ***Literature***

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[SSE] SYSTEM ANALYSIS AND SIMULATION ENGINEERING

Prof. Dr. D. Kraus, Prof. Dr. S. Wolter

Core Module for Metrology and Communication Systems Engineering
1st Semester (4 hrs./week/sem. = 6 credits)

Prerequisite:
Basic Lecture on Signals and Systems

Objectives:
To gain mathematical and engineering skills in the analysis of complex systems. The module enables students to apply tools of advanced modelling and simulation of systems. Working on examples in selected engineering areas leads to a comprehensive knowledge in systems analysis and simulation.

Contents:

1. ***INTRODUCTION***
   Overview, Basic Terms, Definitions and Facts, Motivating Examples, Introduction to Matlab

2. ***FUNDAMENTALS OF NUMERICAL AND COMPLEX ANALYSIS***
   Linear and Nonlinear Equation Solver, Eigenvalue and Singular Value Decomposition, Interpolation, Extrapolation, Regression-Techniques, Numerical Differentiation and Integration, Integral Transforms and their Numerical Perspectives

3. ***MODELLING OF DYNAMIC SYSTEMS***
   Ordinary Differential Equations, Impulse Response, Transfer Function, State Space Modelling, Exercises with Matlab

4. ***SYSTEM IDENTIFICATION TECHNIQUES***
   Random variables, Stochastic Processes, Parameter Estimation, Local and Global Optimisation Methods, Neural Networks, Exercises with Matlab

5. ***ADVANCED MODELLING AND SIMULATION APPROACHES***
   Partial Differential Equations, Numerical Methods for solving Ordinary and Partial Differential Equations, Ray-Tracing-Methods, Normal Modes, Wavenumber Integration Techniques, Exercises with Matlab

6. ***EXAMPLES IN SELECTED AREAS***
   e.g. in Hydrodynamics, Acoustics, Electrodynamics and Optics, Exercises with Matlab

Literature:

G.H. Golub, C.F. Van Loan, ***Matrix Computations***, John Hopkins University Press, 1996.
U. Kramer, M. Neculau, ***Systemtechnik,*** Hanser, 1998
L. Ljung, ***System Identification: Theory for the user,*** Prentice Hall, 1999
A. Papoulis, S.U. Pillai, ***Probability, Random Variables and Stochastic Processes,*** McGraw-Hill, 2001
W.H. Press, ***Numerical Recipes in C++,*** Cambridge University Press, 2002
R.L. Woods, ***Modelling and Simulation of Dynamic Systems,*** Prentice Hall, 1997

[MAM] ADVANCED MEASURING TECHNIQUES Prof. Dr. Friedrich Fleischmann

(Quality Assurance Aspects of Module „Manufacturing, Quality and Reliability“ integrated)

Core Module for Metrology
1st Semester (4 hrs./week/sem. = 6 credits)

Objectives:
Students develop a sound understanding of the impact of mathematical basics of probability theory and statistics to hypothesis testing and quality control. They know principles of design of experiments and statistical process control and are able to use NIST-GUM.

Contents:

1. THEORETICAL BASICS
- Probability axioms, repeated trials
- random variables, functions of r.v.
- statistics

2. HYPOTHESES TESTING

3. PROCESS CONTROL

4. DESIGN OF EXPERIMENTS

5. UNCERTAINTY IN MEASUREMENT
- significance of uncertainty
- ISO9000
- generalized procedure for modeling a measurement uncertainty
- GUM workbench, analysis model

6. COMPUTERIZED DATA ACQUISITION
- Bus systems
- signal conditioning
- visualization

Literature:

Papoulis, Pillai: ***Probability, random variables and stochastic processes***, McGraw-Hill
Tummala, R.: ***Microsystems Packaging***, McGraw-Hill
ISO Guide to the Expression of Uncertainty in Measurement
NIST Technical Note 1297
DIN ENV 13005

[*MFQ*] *MANUFACTURING, QUALITY AND RELIABILITY*

Core Module for Metrology
1st Semester (contents are integrated in Module MAM; see previous page)

Contents:

1. ***PRINCIPLES OF QUALITY AND RELIABILITY***
   Establishing needs and specifications in product design, product life cycle, system design, component tolerance analysis.

1. ***BASICS OF QUALITY CONTROL***
   Statistics, distribution functions, parameters, significance tests

3. ***RELIABILITY OF COMPONENTS AND SYSTEMS***
   Failure rate date and modes, life time tests and distribution models, design for reliability

4. ***MANUFACTURING***
   Scheduling, components and production technologies, automation, planning and economics, methods of quality management: QFD, FMEA, DoE

5. ***QUALITY***
   Quality in the design process, quality and reliability in manufacturing.

Literature:

J.P. Bentley, ***Reliability and Quality Engineering***, Longman Scientific and Technical, 1993.
T Ward/J. Angus, ***Electronic Product Design***, Chapman and Hall, 1996.
A.H. George, ***Reliability and Quality Assurance: basic concepts and their application to microcircuits***, Hybrid circuits, No.5, pp. 12-14 (1984).
Pugh, ***Total Design***, Addison Wesley, 1991.
O'Connor, ***Practical Reliability Engineering***. Wiley, 1991.
Landers/Brown/Fant/Malstrom/Schmitt, ***Electronic Manufacturing Processes***, Prentice Hall, 1994.
Eversheim und Schuh (Eds), ***Betriebshütte: Produktion und Management***, Band I und II, Springer, 1996.
A. Birolini, ***Zuverlässigkeit von Geräten und Systemen***, Springer 1997
L. Papula: ***Mathemathik für Ingenieure, Bd. 3***, Vieweg 1999

[MEA] ELECTRICAL MEASUREMENT OF NON-ELECTRICAL QUANTITIES

Prof. Dr. Friedrich Fleischmann

1st Semester (4 hrs./week/sem. = 6 credits)

Objectives :
Students get an in-depth understanding of physical effects used to sense physical properties. Realization of sensors and application to the measurement of specific properties like pressure or flow will be conveyed.

Contents:

1. FUNDAMENTALS

2. SENSOR CHARACTERIZATION

3. PHYSICAL EFFECTS
- electric charges, fields; potentials; resistance, capacitance, magnetism, induction
- piezoelectric, -resistive effect; Hall effect, Gauss effect
- magnetoresitive, thermoresitive, -electric effect; photoeffect

4. INTERFACE ELECTRONICS

5. POSITION, ANGLE, LEVEL
- resitive, capacitive, inductive sensors; magnetic sensors; optical sensors
- ultrasonic transducers; position encoders

6. FORCE, STRAIN, TORQUE
- strain gauges, principle, measuring bridges; piezoelectric, magnetoelastic, inductive transducers
- applications to measurement of torque

7. VELOCITY, ACCELERATION
- electromagnetic velocity sensor; spring-mass-system, measurement of deflection
- principle of accelometers, sensitivity, noise

8. PRESSURE
- bellows,membranes, thin plates; piezoresitive sensors; capacitive sensors

9. TEMPERATURE
- Thermoresitive sensors; Thermoelectric sensors; PN-Junction sensors; optical temperature sensors
- bolometers

10. FLOW
- pressure gradient technique;thermal transport technique; electromagnetic sensor
- laser doppler anemometry; ultrasonic sensors

11. HUMIDITY
- capacitive sensors
- electrical, thermal conductivity sensors
- optical hygrometer
- oscillating hygrometer

12. ELECTROMAGNETIC FIELD DETECTORS
- Photodiods, -transistors, -resistors; CCD, Light-light converters;
- magnetic field sensors

13. RADIATION

Literature:
J. Fraden: ***Handbook of Modern Sensors***, AIP Press
Gardner: ***Microsensors***, John Wiley
Tränkler, Obermeier: ***Sensortechnik***, Springer

Schaumburg: ***Sensoranwendungen***, Teubner
E. Schrüfer: ***Elektrische Messtechnik***, Hanser
Tränkler: ***Taschenbuch der Messtechnik***, Oldenbourg
Schanz: ***Sensoren-Fühler der Messtechnik***, Hüthig

[*SSY*] *HARDWARE SYNTHESIS* Prof. Dr. Stefan Wolter

2nd Semester (4 hrs./week/sem. = 6 credits)

Objectives:
To gain a systematic understanding of the digital design process using VHDL and synthesis. The student will be able to develop simulation and synthesis models and do apply appropriate tools. The learning outcome will be assessed by three assignments.

Contents:

1. INTRODUCTION

Motivation for hardware synthesis, domains and levels of modelling, synthesis in the design process.

2. VHDL LANGUAGE AND SYNTAX

VHDL structural elements, data types, extended data types, operators, sequential statements, concurrent statements, subprograms.

3. VHDL SIMULATION

Simulation flow, process execution, delay models, testbenches, stimuli programing, response analysis, file I/O.

4. VHDL SYNTHESIS

Synthesisable types and operators, synthesisable descriptions of combinational and sequential logic, Finite State Machine synthesis, advanced synthesis modelling.

5. PROJECT MANAGEMENT

Libraries, packages.

Laboratory Assignments:

1. VHDL Simulation with Modelsim

2. VHDL Synthesis with Design Compiler

3. FPGA Design with ISE/Webpack

Literature:

U. Heinkel et al.: ***The VHDL Reference***, John Wiley & Sons, 2000.

B. Cohen: ***VHDL–Coding Styles and Methodologies***, Kluwer Academic Publishers, 1999.

P. J. Ashenden: ***The Designer's Guide to VHDL***, Morgan Kaufmann Publishers, 2000.

W. F. Lee: ***VHDL–Coding and Logic Synthesis with Synopsys***, Academic Press, 2000.

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[SSP] DIGITAL SIGNAL PROCESSING
Core Module for Communication Systems Engineering
1st Semester (4 hrs./week/sem. = 6 credits)

Prof. Dr. Stefan Wolter

Objectives:

To provide a comprehensive and in-depth knowlegde in the essential digital signal processing techniques. This module will provide students with the understanding of computer-based design techniques using MATLAB. The learning outcome will be assessed by eight assignments.

Contents:

1. TIME-DOMAIN REPRESENTATION OF SIGNALS AND SYSTEMS

Discrete-time signals, basic sequences, operations, classification, sampling process, discrete-time systems, classification of discrete-time systems, correlation.

2. TRANSFORM-DOMAIN REPRESENTATION OF SIGNALS

Discrete-time Fourier transform and DFT, DFT properties, computation of the DFT of real sequences, linear convolution using the DFT, z-transform, inverse z-transform.

3. TRANSFORM-DOMAIN REPRESENTATION OF LTI SYSTEMS

LTI discrete-time systems, frequency response, transfer function, types of transfer functions, simple digital filters, special transfer functions, algebraic stability test.

4. DIGITAL PROCESSING OF CONTINOUS-TIME SIGNALS

Sampling of continous-time signals, analog filter design.

5. DIGITAL FILTER STRUCTURES

Block diagram representation, equivalent structures, basic FIR and IIR filter structures, allpass filters, tunable IIR filters, FIR and IIR cascaded lattice structures.

6. DIGITAL FILTER DESIGN

Bilinear transform method, spectral transformations of IIR filters, FIR filter design based on truncated Fourier series, computer-aided design of digital filters.

7. COMPUTATION OF THE DISCRETE FOURIER TRANSFORM

Goertzel's algorithm, decimation-in-time/frequency FFT algorithms, inverse DFT computation, Cooley-Tukey algorithms, Prime factor and Chirp z-transform algorithm

8. SPECTRAL ANALYSIS OF SIGNALS

Spectral analysis of sinusoidal signals, spectral analysis of nonstationary signals, short time Fourier transform.

Laboratory Assignments with MATLAB

Literature:

S. K. Mitra: ***Digital Signal Processing–A Computer-Based Approach***, McGraw-Hill, 2001

K. D. Kammeyer und K. Kroschel: ***Digitale Signalverarbeitung***, Teubner, 1998

A. V. Oppenheim and R. W.: Schafer: ***Digital Signal Processing***, Prentice Hall, 1975

E. O. Brigham: ***The Fast Fourier Transform and its Applications***, Prentice Hall, 1988

[SDS] MICROELECTRONIC CIRCUITS FOR DIGITAL SIGNAL PROCESSING

Prof. Dr. Stefan Wolter

2nd Semester (4 hrs./week/sem. = 6 credits)

Objectives:

This module will provide students with the knowledge of the implementation of DSP systems by means of programmable digital signal processors and specialized hardware. The students will acquire an understanding of the interdependencies between the two fields of microelectronics and signal processing.

Contents:

1. INTRODUCTION

Digital Signal Processing and Microelectronic, implementation considerations.

2. VARIOUS DSP ALGORITHMS

Digital filters, convolution and correlation, DFT, DCT, motion estimation, basic operations in DSP algorithms.

3. ASPECTS OF CMOS TECHNOLOGY

IC technologies, technology trends, MOS transistors and MOS logic, propagation delays, power dissipation, power estimation

4. ARITHMETIC BUILDING BLOCKS

Number representations, two's complement arithmetic, IEEE 754 floating point standard, adders and subtractors, accumulators, multipliers.

5. PARALLEL AND PIPELINE PROCESSING

Computation power, throughput rate, latency, computation time, parallel processing, pipelining, efficiency of architectures, pipelined adders and multipliers.

6. ARRAY PROCESSORS

Classification, systolic arrays, algorithm mapping to systolic arrays, FIR filter arrays, FFT array processors.

7. PROGRAMMABLE DIGITAL SIGNAL PROCESSORS

Overview, Harvard architectures, instruction pipelining, arithmetic units in DSP processors, address generators, programme sequencers, superscalar architectures, VLIW architectures, DSP multiprocessor systems.

Literature:

K. K. Parhi: ***VLSI Digital Signal Processing Systems***, John Wiley & Sons, 1999.

L. Wanhammar: ***DSP Integrated Circuits***, Academic Press, 1999.

P. Pirsch: ***Architekturen der digitalen Signalverarbeitung***, Teubner, 1996.

V. K. Madisetti: ***VLSI Digital Signal Processors***, IEEE Press, Butterworth-Heinemann, Boston, 1995.

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[***SLI]* ANALOG INTEGRATED CIRCUIT DESIGN** Prof. Dr. Heinrich Warmers

Core module for Communication Systems Engineering
1st Semester (4 hrs./week/sem. = 6 credits)

Objectives:
This module provides students with a detailed understanding of advanced analogue integrated circuits. It will allow the student to develop circuits by using electronic design tools from the layout to the circuit level.

Contents:

1. DEVICE MODELLING
SPICE DC, AC, noise and transient models for bipolar and MOS devices, model characterisation by simulation.

2. TECHNOLOGY AND SEMICONDUCTOR FABRICATION PROCESSES
Bipolar-, NMOS-, CMOS- and BiCMOS- Processes, Layout techniques.

3. DESIGN TOOLS
Symbolic analysis, numeric analysis, Layout system (LASI or Cadence Design)

4. INTEGRATED CIRCUIT BUILDING BLOCKS
Switches, active resistors, current sources and sinks, current mirrors, amplifiers, voltage and current references, differential amplifiers, level shifter, power stages, adder, multiplier, oscillator circuits.

5. COMPLEX FUNCTIONS
Operational amplifiers, current feedback amplifier, transconductance amplifier, digital to analogue and analogue to digital converters.

Literature:
P.R. Grey/R.G. Meyer, ***Analysis and Design of Analog Integrated Circuits***, John Wiley, 1994.
P.E. Allen/D.R. Holberg, ***CMOS Analog Circuit Design***, Holt Rinehart and Winston, 1987.
R. Gregorian/G.C. Temes, ***Analog MOS Integrated Circuits for Signal Processing***, John Wiley, 1986.
Richard C. Jaeger, ***Microelectronic Circuit Design***, McGraw-Hill, 1997
R.Jacob Baker, Harry W. Li, and David E. Boyce. ***CMOS Design, Layout and Simulation***, IEEE Press, 1998.
D. Ehrhardt, ***Integrierte analoge Schaltungstechnik***, Vierweg, 2000
P. Antognetti/G. ***Massobrio, Semiconductor Device Modelling with SPICE***, McGraw-Hill, 1988.

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[***ACC]*** ***CHANNEL CODING*** Prof. Dr. Werner Henkel

2nd Semester (4 hrs./week/sem. = 6 credits)

Objectives:
This module provides an in-depth understanding of error-correcting channel coding in current transmission systems. It starts from the mathematical basics and finally introduces the students to up-to-date research topics.

Contents:

1. INTRODUCTION
Channels and channel modeling, metrics, basic definitions, generator and parity-check matrices, some important binary block codes

2. CONVOLUTIONAL CODES BASICS
Formal description, graphical representation, distance properites, tables of max. free distance codes

3. VITERBI, SOVA, AND BCJR ALGORITHMS
MAP and ML decoding, blocking of convolutional codes, BCJR Algorithm for symbol detection, punctured convolutional codes

4. SEQUENTIAL DECODING
Fano metric, Fano and stack decoding

5. UNGERBÖCK'S TRELLIS-CODED MODULATION
Coding gain, set partitioning and code construction, 4-D codes

6. TRELLIS SHAPING
Maximum shaping gain of mean power reduction, one- and multidemensional shaping, necessary modifications of the Viterbi algorithm, constellation expansion ratio and peak-to-average ratio

7. INTRODUCTION INTO DISCRETE ALGEBRA
Galois fields and their extension, log and anti-log tables, pseudo-random sequences, multiplication and division of polynomials, conjugates in extension fields

8. REED-SOLOMON CODES
Coding and decoding as interpolation problems, RS codes and the Discrete Fourier Transform, encoding

9. BERLEKAMP-MASSEY AND EUCLIDEAN ALGORITHMS
Matrix and shift-register description of the BMA, correction of errors and erasures

10. ERROR VALUES
Recursive and direct (Forney) method, correction of errors and erasures

11. BCH CODES
BCH codes as a specialization of RS codes, encoding and decoding

12. CONSTRUCTION OF LONG CODES FROM SHORT ONES
(u,u+v) construction, burst-error correction, interleaving, product codes, "Turbo" codes, Low-Density Parity-Check (LDPC) codes, concatenated codes, generalized concatenation

13. ERROR PROBABILITIES AND BOUNDS
Probabilities for false correction and decoding failure, union bound, coding bounds

14. TRELLISES OF BLOCK CODES
Wolf Trellis, trellis construction with the (u,u+v) and Turyn extensions

15. MULTI-LEVEL CODES AND LATTICES
Construction rules, rotational invariance, differential en- and decoding

16. BLOCK-ORIENTED SHAPING (SHELL MAPPING)

Literature: (Comprehensive lecture text is provided!)
Blahut, R.E., ***Algebraic Codes for Data Transmission,*** Cambridge University Press, 2003
Lin, S., Costello, D.J., ***Error Control Coding***, Prentice Hall 1983.
Bossert, M., ***Channel Coding for Telecommunications***, John Wiley & Sons 1999
Vucetic, B. Yuan, J., ***Turbo Codes: Principles and Applications***, Kluwer 2000

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[MMM] MICROTECHNOLOGY AND MICROSTRUCTURING

Prof. Dr. Birgit Hannemann

Core module for Microsystems Engineering
1st semester (4 hrs./week/sem. = 6 credits)

Objectives:
The student will gain comprehensive knowledge and practical experience of typical processes in advanced silicon microtechniques. The module aims at understanding and applying relevant processes in microstructuring of silicon. It includes Integrated laboratory exercises and report of results.

Contents:

1. INTRODUCTION
Development of Si-microtechnique, integration density, 2- and 3-dimensional structuring of Si and layer materials,

2. DEMANDS ON MATERIAL AND EQUIPMENT
Pure silicon and crystal growth, wafer fabrication, clean room concepts

3. THERMAL PROCESSES
Oxidation, diffusion

4. DEPOSITION PROCESSES
PVD, CVD, electrodeposition

5. LITHOGRAPHY
Mask layout and fabrication, kinds of resists and lithography, minimising of structure dimensions

6. ETCH PROCESSES
Wet and dry, selectivity, anisotropy, crystal orientation dependence, some typical processes (RIE, KOH-wet, ASE)

7. TYPICAL PROCESS FLOWS FOR
Si-planartechnique, Si-surface microtechnique, Si-bulk microtechnique
and combinations of them, wafer bonding

Literature:
S. Fatikow; U. Rembold, ***Microsystem technology and microrobotics***, Springer, 1997
Wolfgang Menz, Jürgen Mohr, Oliver Paul, ***Microsystem Technology***, Wiley-VCH, January 2001
Julian W. Gardner, Vijay K. Varadan, Osama O Awadelkarim, Microsensors, ***MEMS, and Smart Devices,*** Wiley-VCH, December 2001Processing of Semiconductors / vol. ed.: Kenneth A. Jackson, Weinheim [u.a.] : Wiley-VCH, 1996

John E. Mahan, ***Physical Vapor Deposition of Thin Films,*** Wiley-VCH, 2000

[OSE] OPTICAL SENSOR TECHNOLOGY

Prof. Dr. Gerhard Wenke

1st Semester (4 hrs./week/sem. = 6 credits)

Objectives:
This module provides a comprehensive knowledge of optoelectronic and fiber optic sensors and their applications. It emphasizes physics in sensor elements and signal transmission as well as processing in sensor components. Advantages of optical sensors in ranging, gyroscopes and anemometry are discussed and clarified.

Contents:

1. OVERVIEW
Measured quantities, areas of application, sensor systems, microsensors, optical sensors

2. OPTOELECTRONIC SEMICONDUCTOR SENSORS

2.1 OPTICAL DETECTORS AS TRANSDUCERS
Photoconductor, photodiode, position- and coloursensitive detectors, MSM-detector, phototransistor, arrays and CCD

2.2 OPTICAL SOURCES FOR SENSOR APPLICATIONS

2.3 SENSOR APPLICATIONS
Light barriers, distance measurement, range finder, speed measurement, laser-doppler-anemometer

3. IMAGE INTENSIFIER DEVICES

4. FIBEROPTIC SENSORS

4.1 WAVEGUIDES AND FIBERS FOR FIBEROPTIC SENSORS

4.2 CLASSIFICATION OF FIBEROPTIC SENSORS

4.3 SENSORAPPLICATIONS
Multimode fiber sensors, temperature sensors, singlemode fiber sensors, fiberoptic interferometers, gyroscope, application of special fibers

4.4 INTEGRATED-OPTIC SENSORS
Advantage of monolithic integration,
materials, examples of implementation

Literature:
Hauptmann, ***Sensoren***, Hanser Verlag
Grattan/Meggitt, ***Optical Fiber Sensor Technology***, Chapman and Hall
Bludau, ***Lichtwellenleiter in Optischer Sensortechnik und Optischer Nachrichtentechnik***, Springer Verlag
Opielka, ***Optische Nachrichtentechnik***, Vieweg Verlag
Tamir, ***Integrated Optics***, Springer Verlag

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[OLT] LASER SYSTEMS AND APPLICATIONS

Prof. Dr. Thomas Henning

Core module for Laser Systems Engineering
1st Semester (4 hrs./week/sem. = 6 credits)

Objectives:
To provide understanding of physics behind lasers and optical technologies. To equip students with knowledge of laser systems development and applications. To gain special skills in generation of short pulses and beam shaping for microprocessing with lasers.

Contents:

1. ***FUNDAMENTALS***
   Atomic rate equations, laser pumping and population inversion, laser amplification, laser resonators, Young´s experiment, Michelson interferometer, temporal and spatial coherence, SVE approximation, beam waist, Rayleigh range

2. ***OPTICAL RESONATORS***
   Fabry-Perot resonator, stability in spherical resonators, mode selection, Gaussian-Hermite-modes, Gaussian-Laguerre modes

3. ***LASER SYSTEMS***
   CO2-laser, Helium-Neon-laser, Excimer laser, Diode laser, Nd:YAG laser

4. ***OPTICAL ELEMENTS FOR BEAM SHAPING***
   Mirrors, lenses, telescopes, grating, scanner

5. ***NON-LINEAR OPTICS***
   Electro-optic phenomena, frequency doubling

6. ***GENERATION OF SHORT PULSES***
   Saturation phenomena, Q-switching, mode locking

7. ***LASER MICRO TECHNOLOGY***
   Laser ablation, soldering, welding, fine cutting, micro bending

Literature:

A.E. Siegman: ***Lasers***, University Science Book
O. Svelto: ***Principles of Lasers***, Plenum Press
M. Young: ***Optics and Lasers***, Springer
J. Eichler, H.J. Eichler: ***Laser***, Springer

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[OTK] OPTICAL ENGINEERING Prof. Dr. Thomas Henning

2nd Semester (4 hrs./week/sem. = 6 credits)

Objectives:
To gain comprehensive knowledge of materials used in optical engineering and the construction and application of optical instruments. To understand and apply tools of optical system design, including aberrations and aspects of Fourier Optics.

1. INTRODUCTION

2. GEOMETRICAL OPTICS
Ray sketching, paraxial approximation, thin lenses, image formation, mirrors, prisms

3. INTRODUCTION TO RAYTRACING
Refraction at a single surface, paraxial raytracing through several surfaces, introduction to ZEMAX

4. ABERRATIONS
Seidel aberrations, chromatic aberrations, aberration variation with lens shape, correction of aberrations

5. PHYSICAL OPTICS
Polarization, interference, coherence, diffraction, modulation transfer function, Fourier optics

6. RADIOMETRY AND PHOTOMETRY
Radiance, lamberts law, black body radiation, spectral radiometry

7. ***OPTICAL MATERIALS AND COATINGS***
Optical glass, glass map, absorption filters, polarization materials

8. BASIC OPTICAL DEVICES
Telescope, microscope, telephoto lens, zoom objectives, photographic objectives, condenser systems

Literature:
Hecht, ***Optics***, Addison Wesley
W. J. Smith, ***Modern Optical Engineering***, McGraw-Hill
M. Born, E. Wolf, ***Principles of Optics***, Cambridge University Press
W. T. Welford, ***Aberrations of Optical Systems***, Institute of Physics Publishing

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[OLP] LASER MICROPROCESSING Prof. Dr. Thomas Henning

2nd Semester (4 hrs./week/sem. = 6 credits)

Objectives:
To provide the students with a solid grounding in physical aspects relevant to laser microprocessing. To understand the potential of laser application in microtechnology. The module enables a comprehensive knowledge of laser systems appropriate in the area of microprocessing of e.g. silicon and polymer optical materials. To gain skills in the application of laser radiation by study of selected application examples.

Contents:

1. ***FUNDAMENTALS OF LASER MATERIAL PROCESSING***
   Process characteristics, market for laser applications, laser systems, beam shaping, interaction of laser radiation with matter, laser beam characteristics

2. ***HEAT FLOW THEORY***
   Analysis models in one dimensional heat flow, stationary point source, moving point source, key hole models, stress models

3. ***LASER CUTTING AND WELDING***
   Process characteristics, methods of cutting and welding, applications

4. ***LASER SURFACE TREATMENT***
   Transformation process, surface melting, surface alloying, laser cladding, chemical vapor deposition, laser cleaning

5. ***LASER ABLATION***
   Cold cutting, chemical bonds, hole drilling, mask projection techniques, applications

6. ***NON CONTACT BENDING***
   Models of bending process, generation of surface stress, applications

7. ***LASER AUTOMATION AND IN-PROCESS SENSING***

Literature:

W. M. Steen, ***Laser Material Processing***, Springer
David Elliott, ***Ultraviolet Laser Technology and Applications***, Academic Press
S. M. Metev, V. P. Veiko***, Laser-Assisted Microtechnology,*** Spinger

[AED] NUMERICAL METHODS IN ELECTROMAGNETICS

Prof. Dr. Sören Peik

1st Semester (4 hrs./week/sem. = 6 credits)

Objectives:
After reviewing the classical Electromagnetic theory the module introduces various numerical methods to solve complex electromagnetic field problems. The module discusses time-domain as well as frequency-domain methods with the emphasis on application oriented modelling. It includes the project "Accurate Yagi Antenna Design by Moment Method".

Contents:

1. INTRODUCTION
Introduction to course, history of the modern electromagnetic field theory

2. REVIEW OF VECTOR ALGEBRA
coordinate systems, review of vector operations, integrals containing vector functions, gradient of a scalar field, divergence of a vector field, divergence theorem, curl of a vector field and stokes' theorem, vector algebra theorems and identities

3. REVIEW OF ELECTROSTATICS
fundamental postulates of electrostatics, Coulomb's Law, electric field, charge distributions, Gauss' law and applications, electric potential, poisson and laplace Equation, Green's theorem, formal Solution of static boundary problems, potential energy, variational approach to the solution of field problems

4. NUMERICAL METHODS IN ELECTROSTATICS
finite-difference method, finite element method, moment method in electrostatics

5. REVIEW OF ELECTRODYNAMICS
Maxwells displacement currents, derivation and interpretation of Maxwells equations, material equations, vector and scalar potentials, Lorenz gauge, Coulomb gauge, Greens function for the wave equation, retarded potentials, energy observations, poynting theorem, Hertz vectors, Helmholtz equation, plane waves in nonconducting media, polarization, reflection, refraction, frequency dispersion, guided waves, resonating structures

6. NUMERICAL METHODS FOR EM-FIELD PROBLEMS
Finite element methods (FEM), moment method (MM), time-domain methods (TLM,FDTM)

7. RADIATION OF ELECTROMAGNETIC WAVES
Electric dipoles, magnetic dipoles, elementary antennas, Multipole expansion of radiating sources, Scattering, near fields and far fields

Literature:
M.N.O. Sadiku ***, Numerical Techniques in Electrodynamics*** , Oxford Press, 2000
R.F. Harrington, ***Field Computation by Moment Method, I***EEE Press, 1993, ISBN 0-7803-1014-4
D.J. Griffiths***, Introduction to Electrodynamics,*** Prentice-Hall, Englewood Cliffs, New Jersey, 1989
J. D. Jackson , Classical Electrodynamics (Third Edition) , John Wiley & Sons, Inc., 1998, ISBN 0-471-43132-X
Bo Thiede , Classical Electrodynamics, On-Line Textbook, http://www.plasma.uu.se/CED/Book/

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[AMW] MICROWAVE CIRCUITS AND SYSTEMS Prof. Dr. Sören Peik

2nd Semester (4 hrs./week/sem. = 6 credits)

Objectives:
The aim of this module is to gain an understanding of today's design process of active and passive microwave circuits. Secondly, the module provides an overview of typical microwave circuit applications for modern wireless communication systems. The module includes the project „Low-Noise Amplifier Design".

Contents:

1. INTRODUCTION
Applications of microwaves, the history of microwave engineering, Overview of Microwave Systems

4. MICROWAVE NETWORK ANALYSIS
Impedance and admittance matrix, scattering matrix, transmission (ABCD) matrix, two-port networks, signal flow graphs, discontinuities

5. IMPEDANCE MATCHING AND TUNING
Matching with lumped elements, single-stub matching, double-stub matching, the quarter wave transformer, Chebychev multi-section matching transformer, tapered lines

6. MICROWAVE POWER DIVIDERS, COUPLERS, AND FILTERS
Basic properties of power dividers, couplers and hybrids, T-junction power divider, Wilkinson divider, directional couplers, quadrature hybrid, Lange coupler

7. MICROWAVE AMPLIFIER DESIGN
types of amplifiers, transistor models, gain definitions, stability, design by S-parameters, low-noise amplifier design, biasing, power amplifier design, balanced amplifier design

8. MICROWAVE SYSTEMS
resonators, filters, oscillators, amplifiers, wireless communication systems, radar, satellite communication, microwave heating

The Module includes the Project "Design, Manufacturing, and Measurement of an S-Band Low-Noise Amplifier"

Literature:
David M. Pozar, ***Microwave and RF Design of Wireless Systems***, Addison-Wesley, 2002
R. Ludwig, P. Bretchko, ***RF Circuit Design***, Prentice Hall, 2000
Robert E. Collin, ***Foundations For Microwave Engineering,*** McGraw-Hill, 1992
G. Gonzalez, Microwave Transistor Amlifiers, Prentice Hall, 1997
P. Abrie, Design of RF and Microwave Amplifiers and Oscillators, Artech House, 2000
P. Abrie, ***The Design of Impedance-Matching Networks for Radio-Frequency and Microwave Amplifiers***, Artech House, 2000

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[ONT] OPTICAL COMMUNICATIONS

Prof. Dr. Gerhard Wenke

Core module for Laser Systems Engineering
1st Semester (4 hrs./week/sem. = 6 credits)

Objectives:
This module provides the students with the necessary knowledge of optoelectronic components and their integration to fiber optic transmission and sensor systems. It conveys systematic skills to design and apply fiber optic systems including WDM components and high-capacity transmission systems.

Contents:

1. INTRODUCTION TO FIBER OPTIC SYSTEMS

2. OPTICAL FIBERS
Fundamentals, waveguide modes, modal dispersion, V-Parameter, chromatic dispersion, attenuation in fibers, special structures, manufacturing, cabling

3. OPTICAL SOURCES
Fundamental Processes, semiconductors in optoelectronics, double heterostructure

3.1 LED AND LASERDIODES
SLED and ELED, amplitude and phase conditions in lasers, longitudinal modes, gain- and index-guiding, radiation pattern, light-current characteristic, spectral behaviour, longitudinal mode control and tunability, noise, modulation, driving circuits

4. DETECTORS
Principles of optical detection, photoeffect, spectral responsivity, PIN, APD, MSM, noise, preamplifier design

5. OPTICAL INTERCONNECTION
Multimode- and singlemode coupling, attenuation and feedback, chip-fiber coupling, optical connectors and splices, wavelength multiplexer, optical isolator

5. SYSTEM DESIGN CONSIDERATIONS
Transmission channel, system design, quantum noise, repeater spacing, level diagram, coding, BER, eye-pattern, Q-parameter, optical amplifier, WDM

Literature:

Agrawal, ***Fiber-Optic Communications***, Wiley Interscience
Derickson, ***Fiber Optic Test and Measurement***, Prentice Hall
Senior, ***Optical Fiber Communications***, Prentice Hall
Voges, Petermann, ***Optische Kommunikationstechnik***, Springer
Jansen, ***Optoelektronik***, Vieweg Verlag

[MAV] COMPONENT ASSEMBLY AND BONDING Prof. Dr. Friedrich Fleischmann

2nd Semester (4 hrs./week/sem. = 6 credits)

Objectives:
This module conveys knowledge on the design and specification of PCB's, fabrication basics, classes of packages as well as basic technologies of packaging.

Contents:

1. ***PRINCIPLES OF CIRCUIT DESIGN***
   Principles of circuit design, design tools, layout techniques.

2. ***PRINTED BOARDS***
   Characteristics and materials of printed boards, layout and simulation

3. ***PCB FABRICATION***
   Mechanical production, pick and place, conventional components and SMD, via and plated through connections, soldering, surface coating, multilayer boards, thermal effects.

4. ***HYBRIDS***
   Thick film and thin film technology, material properties and fabrication.

5. ***PACKAGING***
   Packaging of ICs, PCBs and hybrids, cases and thermal effects.

6. ***MEASUREMENT***
   Measurement and testing of components and systems.

Literature:
Hering/ Bressler et al., ***Elektronik für Ingenieure***, VDI-Verlag/ Springer
Schade, ***Mikroelektroniktechnologie***, VT Berlin.
Hanke, ***Baugruppentechnologie: Leiterplatten***, VT Berlin.
Hanke, ***Baugruppentechnologie: Hybridträger***, VT Berlin.
Zisler, ***SMD - Praxis***, Franzis.
Heinemann, ***PSPICE Elektronik Simulation***, Hanser.

[MAU] COMPUTER-AIDED DATA AQUISITION

Prof. Dr. Friedrich Fleischmann

2nd Semester (4 hrs./week/sem. = 6 credits)

Objectives:

Students are introduced to different types of test circuits and acquisition hardware as well as interfaces and instrumentation buses. They will be trained to select hardware, bus systems and to implement small automated test systems.

Contents:

1. ANALOGUE TEST CIRCUITS

2. DIGITAL TEST CIRCUITS

- Counters, DAC, ADC
- Sampling, sample-hold, errors

3. ACQUISITION HARDWARE

- Computer systems architecture,
- IO-boards,
- instrumentation

4. BUS SYSTEMS

- principles,
- serial communication,
- GPIB/IEEE-Bus,
- CAMAC,
- VME/VXI,
- PXI

5. SIGNAL PROCESSING

- sampling theorem,
- up/down sampling,
- time and frequency domain
- digital filtering,
- analysis of correlation
- digital image processing

6. VISUALIZATION

7. SOFTWARE

Literature:

R. Lerch: ***Elektrische Messtechnik***, Springer
A.V. Oppenheim, Schafer: ***Digital Signal Processing***, Prentice-Hall
A.V. Oppenheim, ***Applications of Digital Signal Processing***, Prentice-Hall
Hamming: ***Digitale Filter***, VCH-Wiley
Hesselmann: ***Digitale Signalverarbeitung***, Vogel
P. Addison: ***The illustrated wavelet transform handbook***, IOP

[MMS] MATERIAL SCIENCE Prof. Dr. Birgit Hannemann

Core module for Microsystems Engineering
1st (4 hrs./week/sem. = 6 credits)

Objectives:
To enable a comprehensive understanding of physics and chemistry of relevant materials in microtechnology. To provide knowledge of the relation between structures and properties of materials in microsystems engineering. To learn about new materials and approaches in microtechnology. This module includes Integrated laboratory exercises and report of results.

Contents:

1. ***ATOMS AND BONDING***
   Structure of atoms, types of chemical bonding in connection with typical electronical and mechanical properties of materials (pure elements and compounds)

2. ***STRUCTURE OF SOLIDS***
   Crystalline and amorphous solids, crystal classes, indexing of faces and directions, anisotropy of properties and its description using tensors, crystal defects, phase diagrams

3. ***CONDUCTORS, SEMICONDUCTORS AND DIELECTRICS***
   Electrical, electronical and dielectrical properties and band structure, alloying of metals, doping of semiconductors, polarisation of dielectrics, examples of materials

4. ***MECHANICAL PROPERTIES***
   Elastic and plastic deformation, annealing or tempering and its effects on electrical and mechanical properties, fatigue and creep effects

5. ***MAGNETISM***
   Kinds of magnetism and magnetic polarisation, examples of materials

6. ***TRANSDUCERS***
   Selected transducer effects of materials and their applications, piezoresistivity, piezoelecticity, magnetoresistivity, magnetostriction

Literature:

Ian P. Jones, ***Materials science for electrical and electronic engineers,*** Oxford Univ. Press, 2001
Donald R. Askeland; Pradeep P. Phule,***The science and engineering of materials,*** Pacific Grove, Calif. [u.a.] : Brooks/Cole-Thomson Learning, 2003
Klaus J. Bachmann, ***The materials science of microelectronics,*** New York, NY [u.a.] : VCH, 1995

[MPM] MODELLING OF PROCESSES AND MICROMECHANICS

Prof. Dr. Birgit Hannemann

2nd Semester (4 hrs./week/sem. = 6 credits)

Objectives:
To provide the students with knowledge and understanding of modelling of microstructuring processes. To gain skills in component design using appropriate processes. To convey knowledge in machining of micromechanical elements, including 3-dimensional microstructuring, and their characterization. The module includes Integrated laboratory exercises and report of results.

Contents:

1. BASICS OF THE MODELLING OF MICROSTRUCTURING PROCESSES
Necessity and system of the modelling; process examples: oxydation, crystal orientation dependent wet etching;

2. SIMULATION OF MICROSTRUCTURING PROCESSES
General overview of basic processes (Planar-CMOS, Bulk-Si, LIGA...); physical-chemical determinated simulation of selected process steps

3. BASICS OF COMPONENT MODELLING
Systematic of MEMS components, layout support, examples of element modelling (DAE, FEM)

4. COMPONENTS CALCULATION AND DIMENSIONING
Examples of micromechanical or microoptical elements like springs, membranes, mirrors, beam splitters will be designed under consideration of mechanical and optical properties of materials and reliability conditions

5. PROCESS SIMULATION ON EXAMPLES
For fixed process conditions and component dimensions etch masks are to calculate.

6. 3-DIMENSIONAL MICROSTRUCTURING
Preparation of an element by crystal orientation dependent wet etching, selective etching (of layers), etch mask removing

7. MEASURING OF MICROSTRUCTURES
Measuring techniques for microstructure dimensions and surface quality, profile and roughness parameters, composition of layers and substrates in the microtechnique

Literature:
M. Elwenspoek, R. Wiegerink, ***Mechanical Microsensors,*** Springer, 2001
J. Frühauf, B. Hannemann: ***Catalogue Shape- & Functional Elements of the Bulk-Silicon Microtechnique,*** s. www.gemac-chemnitz.de
D. Brune, R. Hellborg, H.J. Whitlow, O. Hunderi, ***Surface Characterization,*** Wiley-VCH, 1997
G. Gerlach, W. Dötzel, ***Grundlagen der Mikrosystemtechnik***, Carl Hanser Verlag München, 1997

[SCM] MODELLING AND SIMULATION OF SENSORS AND ACTUATORS

Prof. Dr. Heinrich Warmers

2nd Semester (4 hrs./week/sem. = 6 credits)

Objectives:

This module provides students with an understanding of the modelling and simulation of analogue sensors and actuators as well as entire systems. The students will be able to (a) generate the physical equations, (b) describe the entire system by structure diagrams and (c) simulate with modern CAE tools.

Contents:

1. **INTRODUCTION**
   Modelling and simulation in the design process, modelling levels, simulation systems, simulation tools

2. **BASIC PHYSICAL MODELLING**
   Elementary physical modelling in domains such as mechanical, fluidic, electrical and others, the principles of evaluating the models, how to evaluate the differential equations, the accounting equations, the bond graph, the structure diagram, examples: thermo sensors, force sensors, magnetic drive

3. **FINITE ELEMENT ANALYSIS**
   Introduction to finite element modelling, aspects of finite element discretization, tools, examples

4. **MACROMODELLING, NETWORK AND SYSTEM SIMULATION**
   The principles of network simulation with Spice, the design of macro models with controlled sources, electronic circuits to simulate structure diagrams, introduction in the simulation with Matlab/Simulink, simulation of linear and non- linear systems by given structure diagrams with Spice and Matlab/ Simulink, examples and comparison

5. **MODELLING AND SIMULATION AT THE SYSTEM LEVEL**
   the simulation of complex systems, composed of sensors, signal processing, power electronic and actuators, the partition in blocks, mixed mode simulation, event driven simulation, examples of system simulation

Literature:

G. Gerlach, W. Dötzel, Grundlagen der Mikrosystemtechnik, Hanser, 1997.
M. Kasper, Mikrosystementwurf- Entwurf und Simulation von Mikrosystemen-, Springer, 1999.
J. Hoffmann, MATLAB und SIMULINK, Addison-Wesley, 1998
H. Spiro, Simulation integrierter Schaltungen, Oldenbourg, 1990

[OME] FIBER OPTIC TEST AND MEASUREMENT

Prof. Dr. Gerhard Wenke

2nd Semester (4 hrs./week/sem. = 6 credits)

Objectives:

To enable the student to understand relevant characteristics of fiber-optic systems. To provide the physical background knowledge of optical measurement principles and to gain experience in application of sophisticated measurement equipment in the areas of power, polarization and spectral analysis. The module conveys an understanding of the interactions of components in a fiber-optic system by systematic test and measurement.

Contents:

1. INTRODUCTION TO FIBER OPTIC TEST AND MEASUREMENT

2. OPTICAL POWER MEASUREMENT

Thermal detector and photodetector, quantum efficiency, responsivity, insertion loss, polarization- and wavelength dependent loss, optical reflectometry, photon counting

3. POLARIZATION MEASUREMENT

State of polarization, degree of polarization, polarization ellipse, Stokes parameter, Poincare sphere, polarization measurement, birefringence in crystals, optical activity, state of polarization in optical fibers

4. SPECTRAL ANALYSIS

Measurement principles, wavelength filter, diffraction gratings in transmission and reflection, resolving power, blazed grating, Fabry-Perot Interferometer, transmission characteristics, free spectral range, finesse, design example

5. INVITED TALKS ABOUT CURRENT SPECIAL TOPICS

Literature:

Derickson, ***Fiber Optic Test and Measurement***, Prentice Hall
Agrawal, ***Fiber-Optic Communications***, Wiley Interscience
Hecht, ***Optics***, Addison Wesley
Voges, Petermann, ***Optische Kommunikationstechnik***, Springer
Schröder, ***Technische Optik***, Vogel Fachbuch
Pedrotti, ***Optik***, Prentice Hall Verlag
Hering/Martin/Stohrer, ***Physik für Ingenieure***, Springer Verlag

[AAK] ACOUSTIC ENGINEERING Prof. Dr. Dieter Kraus

2nd Semester (4 hrs./week/sem. = 6 credits)

Objectives:
To provide a comprehensive knowledge of acoustics in different application areas. To understand processes of sound generation and sound propagation. The student will gain insight into physiological acoustics as well as application of ultrasound in acoustic engineering.

Contents:
1. Physical Fundamentals
2. Sound and Sound Fields
3. Sound Generation
- mechanical
- electrical
- thermal

4. Sound Propagation
- open space
- closed space

5. Physiological Acoustics
6. Noise insulation
7. Electro-acoustical Transducers
8. Acoustic Measurement Engineering
9. Ultrasound and its Applications
10. Underwater Acoustics

Literature:
D.T. Blackstock, ***Fundamentals of Physical Acoustics,*** John Wiley, 2000
L. Cremer, M. Hubert, ***Vorlesungen über Technische Akustik,*** Springer, 1990
P. Filippi, A. Bergassolo, D. Habault, J.-P. Lefebvre ***The General Theory of Acoustics*** Academic Press, 1998
I. Veit, ***Technische Akustik***, Springer, 1998.
M. Zollner, Zwicker, E. Porter, ***Elektroakustik***, Springer, 1998.

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[AHA] HYDROACOUSTICS

Prof. Dr. Dieter Kraus

2nd Semester (4 hrs./week/sem. = 6 credits)

Objectives:
This module conveys a comprehensive knowledge and understanding of underwater acoustics. The student gains detailed knowledge of sound propagation, scattering and ambient noise. Skills in development, characterization and application of sonar systems are obtained.

Contents:
1. Fundamentals of Ocean Acoustics
- Sound Absorption
- Sound Velocity
- Reflection, Transmission,

2. Sound Propagation in inhomogeneous media
- Wave Equation
- Ray Methods
- Normal Modes

3. Scattering of Sound at a Rough Surface
- Sea Surface reverberation
- Sea Bottom reverberation

4. Scattering of Sound within the
- Water column (water volume reverberation)
- Sediment (sediment volume Reverberation)

5. Sound Scattered by
- Bodies
- Bubble Clouds

6. Ambient Noise

7. Sonar Systems
- Transmitter
- Receiver
- Signal Conditioning
- Spatial Filtering
- Display

8. Sonar System Performance Analysis

Literature:

L.M. Brekhovskikh, Y.P. Lysanov, ***Fundamentals of Ocean Acoustics***, Springer, 1990.
W.S. Burdic, ***Underwater Acoustic System Analysis***, Prentice-Hall, 1991.
F.B. Jensen, W.A. Kuperman, M.B. Porter, H. Schmidt, ***Computational Ocean Acoustics***, Springer, 2000.
H. Medwin, C.S. Clay, ***Fundamentals of Acoustical Oceanography***, Academic Press, 1998.
R.J. Urick, ***Principles of Underwater Sound***, McGraw-Hill, 1983.

[ASC] SATELLITE COMMUNICATION

Prof. Dr. H. Michalik
Prof. A. Ginati

2nd Semester (4 hrs./week/sem. = 6 credits)

Objectives:
The module provides a comprehensive introduction to satellite communications and a thorough grounding in the design issues of orbit selection, link design, and signal processing. Throughout the term references to and discussions of today's satellite sytems are included.

Contents:

1. INTRODUCTION
Space System Engineering, Designing for Space Environment, Orbits & Astrodynamics, Fundamentals and Application of global Satellite Navigation Systems (GPS, Galileo etc.)

2. SATELLITE COMMUNICATION SYSTEM DESIGN

2.1 COMMUNICATION SATELLITES
Communications Architectures, Communications Frequencies, Design Process, Geostationary Orbit (GEO), Low Earth Orbit (LEO), Molniya Orbit

2.2 THE COMMUNICATION LINK
Propagation Path Characteristics, Network Components/Optical link, Ground Stations, Link Budget, Store and forward.

2.3 COMMUNICATION TECHNOLOGY
Fundamentals of: Digital Modulation & Coding, Baseband Signals, Multiple Access Techniques, Information Security Aspects

2.4 IMPLEMENTATION ASPECTS OF SATELLITE COMMUNICATION
Command receivers, decoders, and processors. Command messages. Synchronization, error detection and correction. Telemetry systems. Sensors, signal conditioning, and A/D conversion. Frame formatting. Packetization. Data compression.

3. SPACECRAFT TECHNOLOGY

4. CASE STUDY

Literature:
Space Mission Analysis and Design, Larson & Wertz
M. Richharia, ***Satellite Communication Systems***,MacMillan
B. Sklar, ***Digital Communications***, Prentice Hall
H. Dodel, ***Satellitensysteme für Kommunikation, Fernsehen und Rundfunk***, Hüthig
H. Dodel, ***Handbuch der Satelliten-Direktempfangstechnik***, Hüthig
A. Werner, ***Satelliten-Mobildienste***, Franzis
W. Mansfeld, ***Satellitenortung und Navigation***, Vieweg

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[WPM] PROJECT MANAGEMENT David Ashworth
(incl. ***TEAMBUILDING***)

1st Semester (4 hrs./week/sem. = 6 credits)

Course Objectives:

On entering the workforce, graduates from all disciplines are finding that they need to manage many projects at the same time and often with limited resources. Thus, project management has become a standard work-skill, no student can go without. Project Management may be regarded as a powerful tool to assist in the management of very large projects. The aim of the Project Manager is to bring the project in on time, within budget and to the satisfaction of the client.

Contents:

- What constitutes a PROJECT? .
- Project selection and evaluation
- The project life cycle
- The Project Manager
- Organisation and planning
- Project implementation; Scheduling, Monitoring and Control
- Budgeting and Costing
- Scheduling tools such as PERT, CPM and Gantt Charts
- Successful completion
- Use will be made of the Microsoft Project® program
- Case studies will be used where they help to illustrate aspects of the topics covered.

Literature:

Gray and Larson (2000): ***Project Management: The Managerial Process***
Meredith, J. and Mantel, S. (1999): ***Project Management, A Managerial Approach***, 4th Ed., ISBN 0471 29829 8

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[WOB] ORGANISATIONAL BEHAVIOUR Birgit Zich

1st Semester (4 hrs./week/sem. = 6 credits)

Course Objectives:
Managers generally appreciate how important it is to understand the workings of the economy and the industries in which they are employed. But no less important are the people that comprise a firm. Understanding what motivates people at work and what causes people to behave as they do are essential skills for managers at all levels in an organisation. This kind of knowledge is especially important for those entering leadership and supervisory positions.
In the twenty-first century, the environment in which organisations operate is increasingly turbulent, rocked by forces such as globalisation and rapid technological change. Social and demographic forces have dramatically changed the make-up of today's workforce which is now the most educated and ethnically diverse in history, in addition to having the greatest representation of women. These developments are profoundly affecting the way in which organisations structure themselves, just as they are influencing individuals' attitudes to and expectations of both organisations and work.

Contents:
The impact of organisational structure on individual and organisational effective-ness; leadership; conflict management; decision-making; motivation and stress.

UNIT 1 - The Individual
- Introduction - What Is Organisational Behaviour?
- Foundations of Individual Behaviour
- Perception and Individual Decision Making
- Values, Attitudes, and Job Satisfaction
- Basic Motivation Concepts
- Motivation: From Concepts to Applications

UNIT 2 - The Group
- Foundations of Group Behaviour
- Understanding Work Teams
- Communication
- Leadership
- Power and Politics
- Conflict, Negotiation, and Intergroup Behaviour

Literature:
Kreitner, Robert & Kinicki, Angelo (1997): ***Organizational Behavior***, Hardcover - Irwin; ISBN 0-25-622512-5
Mattock, John [Editor] (1999): ***International Management - an essential guide to cross-cultural business***, London, New Hampshire 2d Edition, ISBN 0-74-942827-9
Robbins, Stephen P. (2001): ***Organizational Behavior : Concepts, Controversies, Applications***, 9th edition, Hardcover, Prentice Hall; ISBN 0-13-016680-4

[WEI] ENTREPRENEURSHIP AND INTRAPRENEURSHIP AND MARKETING Soili Mäkimurto-Koivumaa

2nd Semester (4 hrs./week/sem. = 6 credits)

Objectives:
To familiarize the student with the concept and significance of entrepreneurship for the society. To make the student understand the meaning of intrapreneurship and also realize the importance of intra-preneurship to a successful firm. To learn the phases an entrepreneur should take before starting a new business.

Contents:
1. The meaning of entrepreneurship: what is the purpose of entrepreneurship, some cultural aspects and differences.
2. The concept of entrepreneurship: entrepreneurship and intrapreneurship, entrepreneurship in different cultures, the profile of an entrepreneur.
3. The environment of a firm: SWOT- analysis and PEST-analysis, interest groups.
4. How to start a firm: finding the business idea, choosing the company form, creating the business image, business planning.
5. Corporate financing: the need of working capital, sources of corporate finance.

Hours:
Lectures, assignments, teamwork and project work.

Indicative reading Handouts
Hisrich – Peters: Entrepreneurship (Irwin/McGraw-Hill)
GEM-report

(WGM) GLOBAL MARKETING H.-H. König

2nd Semester (4 hrs./week/sem. = 6 credits)

Objectives:

This module takes into consideration that international marketing underwent fundamental changes over the last two decades. Global, political and economic liberalization trends created tremendous business opportunities and challenges for international marketers. The opening up of new markets in Eastern Europe and a tendency toward economic liberalization in the developing world have spawned new business opportunities. Similarly, the emergence of regional trading blocks (EU, NAFTA, MERCOSUR) have necessitated reorganization in the production and marketing strategies of firms. The changes in strategy include serving different markets from one production source or the shifting of production facilities for greater efficiency. The so- called strategic dilemma of multinational enterprises is the question of global integration vs. local responsiveness. However, it is no longer an either/or dichotomous issue. Forward-looking, proactive firms have the ability and willingness as well as the necessity to strive to accomplish both tasks simultaneously (Masaaki Kotabe).

The objective of this module is to explore the challenges of the changes in the global arena on marketing and on marketing research. At the same time, the impact of new technologies, namely the internet, on marketing methods must be explored and investigated how every business has to determine what combination of internet tools and traditional marketing methods are appropriate for which specific purpose.

Contents

1. ***INTRODUCTION***
   Nature of international and global marketing; the international marketing concept and the international marketing mix
2. ***SELECTION OF MARKETS***
   International marketing research; use of the internet; international market segmentation
3. ***INTERNATIONAL PROMOTION POLICY***
   International advertising; international direct marketing; relationship marketing; international sales promotion
4. ***INTERNATIONAL BRANDING***
   Nature of branding; valuation of brands; country-of-origin effects
5. ***INTERNATIONAL PRICING***
   Determinants of selling prices; transfer pricing

References:

Masaaki Kotabe, ***Contemporary Research Trends in International Marketing***: The 1990s, in: Alan M. Rugman,, Thomas L. Brewer (Ed.), ***The Oxford Handbook of International Business***, 2001
David Ford, ***Understanding Business Markets***, 2nd Edition 1997
Raymond Frost, ***Marketing on the Internet***, 1999
Roger Bennett, ***International Business***, 2nd Edition 1999
John D. Daniels, Lee H. Radebaugh, ***International Business***, 9th Edition 2001

(WHM) INTERNATIONAL HUMAN RESOURCE MANAGEMENT (IHRM)

Prof. Dr. H.-J. Busse

2nd Semester (4 hrs./week/sem. = 6 credits)

Objectives:

IHRM and expatriate management are not virtually synonymous because IHRM covers a far broader spectrum: the worldwide management of people. The key determinant of effectiveness for multinational enterprises (MNE) is the extent to which their various operating units across the world are to be differentiated and at the same time, integrated, controlled and coordinated. Evidence of different solutions adopted by MNEs to the tension between differentiation and integration, otherwise termed the „global vs. local" dilemma, are seen to result from the influence of a wide variety of exogenous and endogenous factors. Exogenous factors include industry characteristics such as type of business and technology available, the nature of competitors and the extent of change and country-regional characteristics such as political, economic and socio-cultural conditions and legal requirements. Endogenous factors include the structure of international operations, the international orientation of the organization´s headquarters, the competitive strategy being used, and the MNE´s experience in managing international operations (Harris and Brewster).

Contents:

1. Relation between international business strategy and strategic IHRM
the added value of the HR department

2. STRATEGIES FOR IHRM
Need for HRM strategies; standardization

3. INTERNATIONAL EMPLOYEE RELATIONS STRATEGIES
Employee relations; MNE relations with trade unions; employer´s organizations; models of high skills in national competition – skill formation systems and globalization

4. INTERNATIONAL COMPARISONS OF HRM PRACTICE
Competitive advantage and culture change; the quest for the multicultural global organization

5. STAFFING THE MNE
Recruitment of managers; expatriate staff; selection of staff for foreign postings; management of an international sales force

References:

Chris Brewster, Hilary Harris, ***International HRM***, 1999
John L. Graham, ***Culture and HRM***, in: ***The Oxford Handbook of International Business***, 2001
Michael Allen, Edward Finn, ***Globalization and human resources management***, in: Robin John, Grazia Jetto-Gillies et al., ***Global Business*** Strategy, 1998
Phillip Brown, Andy Green, Hugh Lauder, High Skills, ***Globalization, Competitiveness, and Skill Formation***, 2001
Roger Bennett, ***International Business***, 2nd Edition 1999
John D. Daniels, Lee H. Radebaugh, ***International Business***, 9th Edition 2001

[MA] MASTER THESIS Members of Master Course

3rd Semester (20 hrs./week/sem. = 30 credits)

In the Master thesis, the student has to show that she or he is able to treat a scientific or technical subject by her-/himself within a given period of time and to integrate it into a larger interdisciplinary context. The technical/research part can be carried out in a university laboratory, in industry or at a partner institution in Germany or abroad, as desired.The written part should be completed in English (exceptions have to be approved by the examination board).

In a final colloquium the subject will be presented orally and discussed.