Table of Courses

Master in Electrical Engineering, shared mandatory modules

Module / Sub-Modules	Aims/Content	Semester	Type of Course	Professors/ Teaching Personal
M01 (System Design)	Economic Background, System Design, and Programming Techniques	1	Mandatory	Fromm
1) Advanced Programming Techniques and Engineering Processes	Review of fundamental concepts of a modern object oriented programming language. The course will cover class design and class relations in C++, operator overloading, polymorphism, generic programming and an introduction to the STL, string and stream library of C++. Design aspects like modularity and software re-use will be discussed. Developing software designs using the UML and CASE tools as well as extensive hands-on programming assignments in C/C++ are an integral part of the course.	1		
M02 (Technical Management)	Administration, Execution and Monitoring Technical Projects	2	Mandatory	Fromm
1) Project Management and Management Processes	Gain theoretical and tool experience in project management: The course covers aspects like the role of a project manager, communicating in a multi-discipline project environment, systematic planning of a project, project monitoring, quality assurance and control and agile project management (SCRUM).	2		
2) Team Project	Participate in an actual project of technical content, to learn: launch, planning, organisation, and execution, based on competencies gained within sub-module 1), and to gain experience working in a team (formation, task assignment, responsibilities, leadership, negotiation, resolving conflicts)	2		

Module / Sub-Modules	Aims/Content	Semester	Type of Course	Professors/ Teaching Personal
M03 (Industrial placement (BPP))	R&D Applied Work in an Industrial Environment	3	Mandatory[1]	BPP responsible
	Working in established teams and settings on today's technological problems in relevant industries, participants will gain experience in an actual industrial environment	3		
M04 (Master Thesis)	Independent Comprehensive Research and Development Work	4	Mandatory	Any professor
		4		

[1] Unless at least 6 month of professional experience can be proven.

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Master in Electrical Engineering, specialisation in Automation

Module / Sub-Modules	Aims/Content	Semester	Type of Course	Professors/ Teaching Personal
MA01 (Advanced Automation)	Modelling, Design, Analysis, and Simulation of Event-discrete Systems and of Safe Processes and Products	1	Mandatory	Simons
1) Intelligent automation for safe processes and products	Gain theoretical and practical knowledge in modern automation technology for safe processes and products covering basics of safety critical systems, design and development, fault detection and fault tolerance, verification and validation, approval procedures, production and lifecycle safety; case study	1		Simons
2) Event-discrete systems	Gain knowledge on theory, design and simulation of process modelling methods, characterization of event-discrete control systems, Petri nets, Markov theory, deterministic and non-deterministic automata, hybrid systems, computer-based simulation, as supported by case studies	1		Kleinmann
MA02 (Advanced Information Technology)	JAVA and GUI programming, Android	1	Mandatory	Rücklé
1) High Level Languages and Frameworks	The course will cover JAVA classes and interfaces, Threads and synchronization, Network interfaces, Framework development tools, e.g. Android, Graphical user interfaces. Practical programming assignments in JAVA and Android will be part of the course.	1		Rücklé
2) Distributed Systems	Participants will be introduced to the principals of distributed computing environments. The course will cover hardware and software components of distributed systems, network layers and protocols, network services and security concepts.	1		Rücklé
MA03(Advanced Feedback	Modern Control Engineering Using State-Space Control and Adaptive and	2	Mandatory	Weigl-Seitz

Module / Sub-Modules	Aims/Content	Semester	Type of Course	Professors/ Teaching Personal
Control)	Learning Control			
1) Synthesis of dynamic systems using state-space models	Gain theoretical and practical knowledge on modelling and synthesis of dynamic systems using state variables: state space representation, canonical forms, transformations, controllability , observability, design of state variable feedback controllers and observers, state feedback by optimal control	2		Weigl-Seitz
2) Adaptive and learning control	Gain knowledge on theory and simulation of adaptive and learning control systems: system classification, digital process modelling and online identification, adaptation and deadbeat controllers, controller design, dynamic behaviour, configuration issues, structure of learning control loops, neural networks in learning control	2		Kleinmann
MA04 (Advanced Robotics)	Tele-Manipulators and Nonlinear Robot Control	2	Mandatory	Weber
1) Tele-Manipulators	Gain experience with telemanipulation, its requirements and fields of applications of telepresence, modes of operation, human machine interfaces, mobile telemanipulators, overall control schemes, force feedback, sensor-based and sensorless feedback	2		Weber
2) Model-based non-linear robot control	Gain experience with and analyse dynamics of robot arms, iterative and closed forms of dynamics, numeric and symbolic modelling schemes, schemes of model-based nonlinear control methods, design of model-based controllers, Cartesian-based and non-analytical control schemes as neural network or fuzzy, hybrid position/force control schemes	2		Weber
MA05 (Autonomous Systems)	System Design, Control and Task Planning for Autonomous Mobile Systems	1	Elective	Weigl-Seitz
1) Mobile robots	Gain theoretical knowledge on system design and control of autonomous	1		Simons,

Module / Sub-Modules	Aims/Content	Semester	Type of Course	Professors/ Teaching Personal
	mobile robots: Locomotion, kinematics, sensors, mobile robot localization (odometry), control structures, basics of motion planning and navigation, obstacle avoidance			Weigl-Seitz
2) Task planning in unstructured environments	Gain knowledge on task planning issues for cooperating autonomous systems: system characteristics, methods for task specification by the operator, path planning using maps, autonomous map generation, motion planning/interaction of manipulator and platform, knowledge representation, task execution in cooperating mobile swarms	1		Kleinmann, Weigl-Seitz
MA06 (Information and simulation systems in industrial development and automation	Model based real-time simulation of mechatronic systems and modern information systems in industrial automation.	2	Elective	Schnell
1) Model-based real-time simulation of mechatronic systems	The course covers modelling and classification of mechatronic systems, real time simulation and rapid prototyping methods, hardware in the loop, software in the loop and processor in the loop, automatic code generation.	2		Schnell
2) Information systems in industrial automation	This course provides an introduction to the concepts of information systems used in industrial automation. It covers the areas - Enterprise management levels - Manufacturing Execution Systems (tasks, aims and structures of MES) - Data Acquisition (e. g. OPC-technologies) - Data exchange to ERP-systems	2		Garrelts

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Master in Electrical Engineering, specialisation in Communications

Module / Sub-Modules	Aims/Content	Semester	Type of Course	Professors/ Teaching Personal
MC01 (Advanced Modulation and Coding)	Theory and Applications of Advanced Modulation and Coding	1	Mandatory	Kuhn
1) Lecture	Participants will gain expertise, with communications systems and their transmission components. They will be acquainted with digital signal coding, and applications thereof, specifically with topics as: Foundations of information theory, digital modulation, channel coding, source coding, applications and practical systems	1		Kuhn, Götze
2) Laboratory		1		
MC02 (Information Networks)	Protocols, Structures and Performance of Local and Wide Area Wire-Line Networks	1	Mandatory	Chen
1) Lecture	Gain understanding in analysing, planning and optimizing modern packet networks to learn: topology and technology of metropolitan area network and wide area network, availability of networks, Layer 1 protocols like SDH, Layer 2 protocols like Ethernet and ATM, Internetworking including IP, routing and MPLS, analysis of network performance parameters by application of queue theory.	1		Chen, Gerdes
2) Laboratory	Characterization and measurement of protocol behaviour, network delay and throughput	1		
MC03 (Digital Signal Processing)	Theory and Applications of Digital Signal Processing Systems	2	mandatory	Krauss

Module / Sub-Modules	Aims/Content	Semester	Type of Course	Professors/ Teaching Personal
1) Lecture	Participants will master theory and applications of discrete signals and systems, by being exposed to topics as: Discrete-time signals and systems, principles and methods of digital filter design (IIR and FIR), DSP in image with applications to image enhancement, restoration and segmentation, DSP in speech processing with applications to speech analysis and synthesis	2		Götze, Wirth
2) Laboratory		2		
MC04 (Microwave Components and Systems)	Microwave Technology, Systems and Component Characterisation	2	Mandatory	Schmiedel
Microwave Components	Participants will learn to specify and develop microwave components and systems, studying their fields of application, theory of operation and practical use of suitable measurement techniques. They will gain practical understanding of topics as characterisation methods for microwave technology, microwave systems, RF and microwave measurements, and will be equipped for independent R&D tasks concerning: Microwave technology (transmission lines, antennas, circuitry), microwave systems (synthesizers, oscillators, mixers, receivers, transmitters), measurements (network and spectrum analysis, s-parameter, noise)	2		Schmiedel
Microwave Systems	The course will cover receiver and transmitter architectures, design and performance issues, superhet-, low-IF-, DC- and SDR concepts; as well as analysis of microwave sub-systems harmonic balance and its application to nonlinear microwave circuits, e.g. power amplifiers, oscillators and mixers and method of moments and its application to antenna problems	2		Gaspard
MC05 (Mobile and Satellite Communications)	Mobile and,Satellite Communication Techniques and Systems	1	Elective	Kuhn

Module / Sub-Modules	Aims/Content	Semester	Type of Course	Professors/ Teaching Personal
1) Mobile Communications	Participants will learn to understand, design, modify, operate and evaluate modern wireless and mobile communication systems, getting acquainted with topics as: Mobile Communications (use, applications, signal propagation, multiplexing, modulation schemes, cellular systems, media access, wireless telecommunication systems and standards, network protocols, support for mobility, network planning), Satellite Communications (satellite orbits, link analysis, modulation, multiple access, network architecture, communication payload, earth station, satellite applications)	1		Kuhn, Chen
2. Satellite Communications	The course will cover an introduction to satellite orbits, link analysis and communication payloads. A focus will be put on state of the art satellite applications like GNSS, world wide communication systems and remote sensing.			Schmiedel
MC06 (Optical Communications)	Communications Engineering based on Optical Waveguides and Components, Optical Procedures	2	Elective	Loch
1) Lecture	Participants will learn theory and gain practical understanding of fibre optic systems in simple structure as well as in multiplexed structures: in particular, this includes the study of optical fibres and all relevant components, e.g. optical connections, optical sources, optical amplifiers, optical detectors and receivers; coherent optical communication systems and measurement procedures for characterization of fibre based systems are also discussed.	2		Loch, Chen
2) Laboratory	Simulation of optical fibre systems, measurement techniques	2		

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Master in Electrical Engineering, specialisation in Microelectronics

Module / Sub-Modules	Aims/Content	Semester	Type of Course	Professors/ Teaching Personal
MM01 (Complex Digital Architectures)	Functional Description and Design Methodology	2	Mandatory	Meuth
1) Lecture	Use of modern FPGA technology as design and hardware implementation tool, and use of further design software packages, to learn following topics: Automata, state machines, digital coding and number representations of hardware relevance, algorithms and architectures, performance and tradeoffs, interfacing, error coding, error detection, and recovery, hardware-based encryption	2		Meuth / Jakob
2) Laboratory		2		
MM02 (Advanced Embedded Systems)	Embedded Operating Systems and modern microcontroller architectures	1	Mandatory	Fromm
1) Embedded Operating Systems	Participants will be exposed to and gain working experience with processes, threads, memory and data management, reactive systems, state machine design and coding, IP components, system-on-chip, hardware driver concepts, interprocess communications, case studies of operating systems. Practical programming assignments in C using state of the art operating systems are part of the course.	1		Fromm

Module / Sub-Modules	Aims/Content	Semester	Type of Course	Professors/ Teaching Personal
2) Advanced Microcontroller Architectures	Participants will be introduced to the design and programming of modern microcontrollers. The course will cover - microcontroller architectures, - IP components, system on chip design, - microcontroller driver development, - memory protection and memory management, - hardware/software co-design, - embedded code design, - development and test tools	1		Schaefer
MM03 (Microelectronic Systems)	CMOS VLSI Design	1	Mandatory	Schumann
1) Lecture	Participants will be exposed to topics and/or gain practical design tool experience with MOS-transistor and scaling influence. CMOS processing, basic CMOS gates, power dissipation, implementation in arithmetic operations, Hardware Description Language VHDL, design methodology	1		Schumann
2) Laboratory		1		
MM04 (Design and Test of Microelectronic Systems)	Advanced Design and Test Procedures for Integrated Circuits	2	Mandatory	Schumann
1) Lecture	Participants will be exposed to topics and/or gain practical design tool experience with performance parameters of microelectronic systems, high-speed logic design, low-power design concepts, design issues of memory devices, design for testability, self-test methods	2		Schumann
2) Laboratory		2		
MM05 (Signal Processing Hardware)	Hardware Oriented Signal Processing Architectures	2	written and computer examination	Meuth

Module / Sub-Modules	Aims/Content	Semester	Type of Course	Professors/ Teaching Personal
1) Lecture	The module takes a hardware design perspective of the entire signal processing chain, to learn following topics: Anti-aliasing and reconstruction filters, quantization, sampling, conversion and reconstruction, over- and under-sampling, errors and error propagation, digital signal and function generation, binary sin/cos generation, noise shaping, digital filter design, FFT architectures, Z-transform and bit-true representations in time and frequency domain, actual hardware imple-mentations of theses digital systems in FPGA.	2		Meuth / Jakob
2) Laboratory		2		
MM06 (CMOS Analog)	Transistors, Amplifiers and Signal Converters	2	written examination	Hoppe
1) Lecture	Gain understanding in and/or practical design experience with MOS fabrication technology, transistor models, passive components and parasitics, basic analogue building blocks, voltage and current sources, CMOS amplifiers and gain stages, differential amplifiers and comparators, operational amplifiers, global performance parameters as gain, input/output impedance, bandwidth, linear circuit network analysis and feedback stabilisation, mixed signal designs, analog to digital conversion, sample and hold circuits, digital to analog conversion	2		Hoppe
2) Laboratory		2		

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Master in Electrical Engineering, specialisation in Power Engineering

Module / Sub-Modules	Aims/Content	Semester	Type of Course	Professors/ Teaching Personal
ME01 (High Voltage Technology)	High Voltage (HV) Technology, Theory of Electrical Field	1	Mandatory	Betz
1) High Voltage Technology	Participants will learn about voltage effects in HV networks, ac HV sources, impulse voltage sources, influence of voltage and time characteristics on insulating materials, HV properties and behaviour of gaseous, liquid and solid insulating materials, design and development of HV insulating systems and their withstand ability. Participants will learn to execute dielectric and thermal simulations, failure mode analysis (FMEA), type testing and routine testing, standardisation in the field of HV (IEC, DIN VDE, ANSII)	1		Betz, Frontzek
2) Theory of Electrical Fields	Participants will be familiarized with Maxwell Equations basics, field and potential distributions of common geometries, Field distributions of inhomogeneous elements as e.g. spike plates, qualitative 'by hand' concepts to generate field distributions, analysis of electric fields, field solvers (FEM and Boundary Element Methods), simulation tools (performance and limitations)	1		Betz, Frontzek
ME02 (Power System and control technology)	Power Network Structures, Components, Interaction, Operational Control and System Behaviour with Tool Training	1	Mandatory	Metz
1) Power Systems and Control	Participants will be introduced to procedures and technologies, and will acquire theoretical background in: voltage, frequency, load balancing and flow, and stability control, demand side management, system faults, relays and protection, power system	1		Metz, Graf

Module / Sub-Modules	Aims/Content	Semester	Type of Course	Professors/ Teaching Personal
	structures, supervision and control, quality and specification of power supplies, switching, measurements, transmission lines, transformers, neutral point handling			
2) Operational Training Lab	Closely overlapping to sub-module 1), participants will work on a standard SCADA control system and on an actual dynamic training simulator to train all operational tasks and system responses of full 400/110/20 kV power grids, including isolators, breakers, coupling, generators, time-, voltage- and frequency dependent loads, faults and protection relays	1		Metz
ME03 (Control of electrical drives and E-mobility))	Drive control and e-mobility.	2	Mandatory	Wagner
1) Controlled drives	Content Course Controlled Drives: - Basics of torque generation, voltage induction, rules - Basics of electrical machines - DC-motor, dynamics and simulation - Three-phase drives (asynchronous-, synchronous-machines, - Transfer-functions of DC- and asynchronous machines - Transfer-functions of power-converters - Sensors for current-, speed-, position-measurement - Control-Methods and strategies for E-machines (DC- AC-machines) - Simulation of electromechanical systems - Stepper motors	2		Wagner
2) E-mobility	Content Course e-mobility: - History of electric vehicles - Physical and mechanical basics of vehicle technology - Electric power supply on vehicles	2		Bauer

Module / Sub-Modules	Aims/Content	Semester	Type of Course	Professors/ Teaching Personal
	- Electric drives - Hybrids, full-e-vehicles, electrical locomotives - Infrastructure for e-mobility			
ME04 (Power Electronics and Switching Power Supply)	Power Electronic Components, Switching Power Supply	2	Mandatory	Michel
1) Power Electronics	Participants shall understand power electronic devices and circuits. They will be introduced to various devices and circuits for con¬trol¬ling and converting electrical power in the fields of drives and renewable energies. Semiconductor devices, rectifiers and inverters, gate drive circuits and pro-tection, power quality, reactive power and har¬mo¬nics, choppers and converters, mo¬dulation techniques, po¬wer sup¬plies, resonant switching techniques and applications, matrix – and high voltage converters are the topics.	2		Michel
2) Switch.mode Power Supplies	Content of course "Switch-mode Power Supplies" - short repetition of basic switch mode topologies, Buck, Boost, Fly-Back - choking coils - Forward- and Push-Pull-Converter - Resonant Converter - Power-Factor Control - Control of switch mode power supplies, - Transistor drive circuits - Calculation of transformers and choking coils - Radio Interference Filter - Design of printed circuit boards	2		Jakob

Module / Sub-Modules	Aims/Content	Semester	Type of Course	Professors/ Teaching Personal
3) Laboratory	Characterization of various types of converters and machines: double-way converter and dc-machine, frequency converter and induction motor, chopper schemes	2		Wagner, Michel
ME05 (Renewable Energy Systems)	Global and Technical Aspects of Renewable Energy Systems, Their Use and Implementation	1	Elective	Jakob
1) Renewable Energy	Participants will gain insight into physics, technology and economics of renewable energy production of high technological and market potential: environment, climate change and renewable energy vs. conventional sources: World energy stock, geothermal energies, resources and technology, solar energy, solar radiation and photo-voltaics, wind power, resources and technology, future perspectives	1		Jakob
2) Fuel Cells and Hydrogen Techniques	Participants will gain insight into hydrogen, combustion, storage, and handling, fuel cell function, efficiency, and types (AFC, PEMFC, MCFC, SOFC, DMFC), fuel cell systems, components and assemblies	1		Schmidt-Walter
ME06 (Smart Grids)	Introduction to smart grids incl. operational training.	2	Elective	Metz
1) Smart Grids	Content of course "Smart Grids" - Power systems history, Environment effects, Needs for new structures - Overview to the vision - Power stability and regulations - Power grid components - TSO and DSO Grids and operational tasks - Legislation and regulation - Concepts and components for Smart Grids - Smart Communication and Smart Metering - Standardizations	2		Metz, Graf

Module / Sub-Modules	Aims/Content	Semester	Type of Course	Professors/ Teaching Personal
	- Energy Management in Smart Grids - Role of storages - Energy Butler and Energy Assistants - Smart Grid Control Centre and operational Tasks for Smart Grids - Future Challenges			