TECHNISCHE UNIVERSITÄT DRESDEN

Fakultät Elektrotechnik und Informationstechnik

Directory of Modules for Visiting Students *Diplom* Programme in Electrical Engineering

Faculty of Electrical and Computer Engineering

Information Package for International Visiting and Exchange Students

Oktober 2017

FAKULTÄT ELEKTROTECHNIK UND INFORMATIONSTECHNIK

The Faculty of Electrical and Computer Engineering (*Fakultät Elektrotechnik und Informationstechnik*) at the Technische Universität Dresden offers the *Diplom* degree programme in Electrical Engineering. This programme is an integrated five-year (single-tier) programme and thus includes Bachelor as well as Master's level.

Structure of the *Diplom* degree programme in Electrical Engineering

The degree programme in Electrical Engineering is divided into basic studies and main studies. The basic studies include semester 1 until semester 4 (= the first two years of the programme); the main studies start in the 5th semester and are concluded in the 10th semester (= 3rd until 5th year of the programme).
The following catalogue is organized according to these two stages. In the first part, you will find the modules listed that are part of our basic studies (please see here for the list). From page 3 on, you will find information on the modules that are part of our main studies (please see here for a list).

Specialization areas

In their main studies, our students choose one of the following specialization areas:

- Automation, Measurement and Control (*Automatisierungs-, Mess- und Regelungstechnik*), list of modules
- Electrical Power Engineering (*Elektroenergietechnik*), list of modules
- Electronic Systems and Technolgy (*Geräte- und Mikrotechnik*), list of modules
- Communications and Information Technology (*Informationstechnik*), list of modules
- Microelectronics (*Mikroelektronik*), list of modules

International exchange students can choose modules from different specialization areas.

SWS – Semesterwochenstunden

In the module descriptions (line „modes of teaching and learning") you will find the abbreviation *SWS*. This abbreviation stands for the German term *Semesterwochenstunde* and gives the amount of lessons per week.

1 SWS = 1 lesson of 45 minutes per week during the semester

At the TU Dresden, lessons usually last for 90 minutes (= 1 Doppelstunde (DS)).

1 DS = 2 SWS

What does this mean for your timetable?
For example, for the module ET-12 08 06 Measurement and Sensor Techniques, the amount of SWS is given as follows: 2/1/1. This means that the module includes the following modes of teaching: 2 SWS lecture (1st number), 1 SWS tutorial (2nd number), 1 SWS lab course (3rd number); which means:

- 90 minutes lecture every week during the semester
- 90 minutes tutorial every 2nd week during the semester
  (Also possible, but less common: 45 minutes tutorial every week during the semester)
- 90 minutes lab course every 2nd week during the semester (lab courses are also often taught as a block course)

Academic calendar of the TU Dresden

The academic year at the TU Dresden is divided into the winter semester (October–March) and summer semester (April–September). The semester dates for the following academic years can be found here.
Our module descriptions inform you in which semester, i.e. winter or summer semester, the respective module is offered. When setting up your learning agreement, it is important to consider at first which semester you are coming to the TU Dresden (either the winter or summer semester) and then choose appropriate modules.

Note: The English version of our module descriptions is not legally binding.

Basic studies modules (Bachelor level)

Module number	Module name	Winter semester	Summer semester	Level	Language of instruction	ECTS-credits
ET-12 08 01	Fundamentals of Electrical Engineering (*Grundlagen der Elektrotechnik*)	2/2/0 PL		1st year	German	**6**
ET-12 08 02	Electric and Magnetic Fields (*Elektrische und magnetische Felder*)		4/2/0 PL	1st year	German	**6**
ET-13 00 01	Materials and Engineering Mechanics (*Werkstoffe und Technische Mechanik*)	2/1/0 PL	2/2/0 PL	1st year	German	**7** (3+4)
ET-12 05 01	Electronic Systems Design (*Geräteentwicklung*)		2/2/0 PL	1st year	German	**4**
ET-12 08 03	Dynamic Networks (*Dynamische Netzwerke*)	2/2/1 PL	0/0/2 PL	2nd year	German	**8** (6+2)
ET-12 09 01	Systems Theory (*Systemtheorie*)	2/1/0	2/2/0 PL	2nd year	German	**7**
ET-12 01 02	Automation Engineering and Measurement (*Automatisierungs- und Messtechnik*)		3/2/0 PL	2nd year	German	**5**
ET-12 04 01	Electrical Power Engineering (*Elektroenergietechnik*)	3/1/0 PL	0/0/1 PL	2nd year	German	**5** (4+1)
ET-12 08 11	Microelectronic Technologies and Devices (*Technologien und Bauelemente der Mikroelektronik*)	5/1/0 PL		2nd year	German	**6**
ET-12 10 24	Communications (*Nachrichtentechnik*)		2/1/0 PL	2nfd year	German	**3**
ET-12 06 10	Project Electronics Technology (*Projekt Elektronik-Technologie*)	0/0/2 PL		2nd year	German	**3**

The numbers in the columns "winter semester" and "summer semester" indicate in which semester the respective module is delivered. Further, these numbers refer to the SWS for the respective module. The 1st number refers to the SWS for the lecture, the 2nd to the SWS for the tutorial and the 3rd to the SWS for the lab course (Please see here for more details).

PL = Prüfungsleistung / assessment

Main studies modules (5th until 10th semester)

Module number	Module name	Winter semester	Summer semester	Level	Language of instruction	ECTS- credits
ET-12 02 01	Electromagnetic Theory (*Theoretische Elektrotechnik*)	2/2/0 PL	2/2/0 PL	3rd year	German	**10** (5+5)
ET-12 02 02	Numerical Analysis (*Numerische Mathematik*)	2/1/0 PL		3rd year	German	**4**
ET-12 08 04	Circuit Design (*Schaltungstechnik*)	0/0/2 (2nd part) PL	4/2/0 (1st part) PL	2nd and 3rd year	German	**10** (7+3)
ET-12 08 06	Measurement and Sensor Techniques (*Mess- und Sensortechnik*)	2/1/1 2 PL		3rd year	German	**4**

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Specialization area: Automation, Measurement and Control

Module number	Module name	Winter semester	Summer semester	Level	Language of instruction	ECTS-credits
ET-12 01 06	Advanced Seminar Automation, Measurement and Control (*Hauptseminar Automatisierungs-, Mess- und Regelungstechnik*)	0/2/0 PL		3rd year	German	**4**
ET-12 01 03	Discrete event systems and control (*Ereignisdiskrete Systeme und Steuerungen*)	2/1/0 PL	2/0/1 2 PL	3rd year	German	**6** 3+(2+1)
ET-12 01 05	Modelling and Simulation (*Modellbildung und Simulation*)	1/1/0 PL	2/1/1 2 PL	3rd year	German	**8**
ET-12 13 01	Control of Continuous-Time Processes (*Regelungstechnik*)	3/1/1 PL	2/1/1 2 PL	3rd year	German	**9**
ET-12 01 04	Process Control (*Prozessleittechnik*)		6/2/2 3 PL	3rd year	German	**11**
ET-12 01 10	Industrial Automation Engineering 1 (*Industrielle Automatisierungstechnik – Basismodul*)	0/0/2 (2nd part) PL	3/1/0 (1st part) PL	4th year	German	**7**
ET-12 01 21	Project Planning for Process Automation Systems (*Projektierung von Automatisierungssystemen*)		2/4/0 2 PL	4th year	German	**7**

ET-12 08 20	Laser Sensor Technology (*Lasersensorik*)		4/1/1 2 PL	4th year	German	**7**
ET-12 13 10	Nonlinear Systems und Process Identification (*Nichtlineare Systeme und Prozessidentifikation*)		4/2/0 2 PL	4th year	German	**7** (3,5+3,5)
ET-12 01 11	Industrial Automation Engineering 2 (*Industrielle Automatisierungstechnik – Aufbaumodul*)		3/2/1 2 PL	4th year	German	**7**
ET-12 01 12	Robotics (*Robotik*)	2/1/0 (2nd part) PL	2/2/0 (1st part) 2 PL	4th and 5th year	German	**7**
ET-12 13 11	Nonlinear Control Systems, Advanced (*Nichtlineare Regelungssysteme – Vertiefung*)	2/1/0 (2nd part) PL	2/0/0 (1st part) PL	4th and 5th year	German	**7**
ET-12 13 12	Optimal and Robust Multivariable Control Systems (*Optimale, robuste und Mehrgrößenregelung*)	2/1/0 (2nd part)	2/0/0 (1st part)	4th and 5th year	German	**7**
ET-12 01 13	Systems Design (*Systementwurf*)	4/2/0 2 PL		5th year	German	**7**
ET-12 01 20	Human Machine System Technology (*Mensch-Maschine-Systemtechnik*)	4/2/0 2 PL		5th year	German	**7**
ET-12 01 22	Process Management Systems (*Prozessführungssysteme*)	4/2/0 3 PL		5th year	German	**7**
ET-12 08 21	Photonic Measurement System Techniques (*Photonische Messsystemtechnik*)	4/2/0 2 PL		5th year	German	**7**

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Specialization area: Electrical Power Engineering

Module number	Module name	Winter semester	Summer semester	Level	Language of instruction	ECTS-credits
ET-12 02 04	Electrical Machines (*Elektrische Maschinen*)	3/1/1 2 PL		3rd year	German	**5**
ET-12 04 02	High Voltage and High Current Engineering (*Hochspannungs- und Hochstromtechnik*)	2/1/1 2 PL		3rd year	German	**5**
ET-12 04 03	Fundamentals of Electrical Power Systems (*Grundlagen elektrischer Energieversorgungssysteme*)	3/2/0 2 PL		3rd year	German	**5**
ET-12 02 03	Power Electronics (*Leistungselektronik*)	2/1/0	1/1/1 2 PL	3rd year	German	**7**
ET-12 02 05	Electric Drives (*Elektrische Antriebe*)		3/1/1 2 PL	3rd year	German	**6**
ET-12 02 06	Advanced Seminar Electrical Power Engineering (*Hauptseminar Elektrische Energietechnik*)		0/2/0 PL	3rd year	German	**4**
ET-12 04 04	Operating of Electrical Power Systems (*Betrieb elektrischer Energieversorgungssysteme*)		2/1/2 3 PL	3rd year	German	**6**
ET-12 02 08	Numerical Methods for Electromagnetic Theory (*Numerische Verfahren der Theoretischen Elektrotechnik*)		3/1/2 2 PL	4th year	German	**7**
ET-12 02 07	Electromagnetic Compatibility (*Elektromagnetische Verträglichkeit*)	2/0/1 (2nd part) 2 PL	2/0/2 (1st part)	4th and 5th year	German	**7**
ET-12 02 09	Selected Topics of Electromagnetic Theory (*Ausgewählte Kapitel der Theoretischen Elektrotechnik*)	2/1/0 (2nd part) PL	2/1/0 (1st part)	4th and 5th year	German	**7**
ET-12 02 10	Power Electronics, advanced (*Vertiefung Leistungselektronik*)		3/2/1 2 PL	4th year	German	**7**
ET-12 02 11	Microprocessor Control in Power Electronics (*Mikroprozessorsteuerung in der Leistungselektronik*)		3/2/0 2 PL	4th year	German	**7**
ET-12 04 05	Grid Integration, System Performance and Supply Quality (*Netzintegration, Systemverhalten und Versorgungsqualität*)		3/2/1 3 PL	4th year	German	**7**
ET-12 04 06	Planning of Electrical Power Systems (*Planung elektrischer Energieversorgungssysteme*)		4/3/0 3 PL	4th year	German	**7**
ET-12 04 07	High Voltage Engineering (*Vertiefung Hochspannungstechnik*)		5/0/1 2 PL	4th year	German	**7**

ET-12 02 12	Electromagnetic power transformers (*Elektromagnetische Energiewandler*)	2/0/0 (2nd part) 2 PL	2/1/0 (1st part)	4th and 5th year	German	**7**
ET-12 02 13	Electrical Drive Engineering (*Elektrische Antriebstechnik*)	2/0/0 (2nd part) PL	2/1/1 (1st part) PL	4th and 5th year	German	**7**
ET-12 02 15	Controlled Power Systems (*Geregelte Energiesysteme*)	2/1/0 (2nd part) 2 PL	2/0/1 (1st part)	4th and 5th year	German	**7**
ET-12 02 16	Design of Power Electronic Systems (*Entwurf leistungselektronischer Systeme*)	4/2/0 2 PL		5th year	German	**7**
ET-12 02 17	Application of Electric Drives (*Anwendung elektrischer Antriebe*)	4/1/1 PL		5th year	German	**7**
ET-12 04 08	Protection and Control of Electrical Power Systems (*Schutz- und Leittechnik in elektrischen Energieversorgungssystemen*)	3/2/1 3 PL		5th year	German	**7**
ET-12 04 09	Stress of Electrical Equipment (*Beanspruchung elektrischer Betriebsmittel*)	3/1/2 4 PL		5th year	German	**7**
ET-12 04 10	Experimental High Voltage Engineering (*Experimentelle Hochspannungstechnik*)	4/0/2 2 PL		5th year	German	**7**

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Specialization area: Electronic Systems and Technolgy

Module number	Module name	Winter semester	Summer semester	Level	Language of instruction	ECTS-credits
ET-12 05 02	Advanced Seminar „Electronic Systems and Technology“ (*Hauptseminar Geräte- und Mikrotechnik*)	0/2/0 PL		3rd year	German	**4**
ET-12 05 04	Design Methodologies (*Konstruktion*)	1/3/0 PL	1/1/0 PL	3rd year	German	**6** (4+2)
ET-12 06 01	Technologies for Electronic Packaging and Assembly (*Technologien der Elektronik*)	2/0/1 PL	2/0/1 2 PL	3rd year	German	**6** (2+4)
ET-12 07 01	Biomedical Engineering (*Biomedizinische Technik*)	2/1/0	1/1/0 PL	3rd year	German	**6**
ET-12 05 03	System Design (*Gerätetechnik*)		3/4/0 2 PL	3rd year	German	**8**
ET-12 05 05	Physical Design and Physical Design Automation (*Rechnergestützter Entwurf*)		2/0/1 2 PL	3rd year	German	**4**
ET-12 06 03	Quality Assurance (*Qualitätssicherung*)		2/1/0 PL	3rd year	German	**4**
ET-12 05 06	Product and Precision Device Engineering (*Entwicklung feinwerktechnischer Produkte*)		2/0/4 2 PL	4th year	German	**7**
ET-12 05 07	Simulation Methodologies in System Design (*Simulation in der Gerätetechnik*)		2/4/0 PL	4th year	German	**7**
ET-12 06 05	Board Level Reliability of Electronic Products (*Funktionsmaterialien der Aufbau- und Verbindungstechnik der Elektronik*)		4/0/2 PL	4th year	German	**7**
ET-12 06 06	Computer-Aided Electronics Manufacturing (*Rechnergestützte Elektronikfertigung*)		4/2/0 PL	4th year	German	**7**
ET-12 07 02	Medical and Physiological Principles (*Medizinisch-physiologische Grundlagen*)		4/1/1 PL	4th year	German	**7**
ET-12 07 05	Medical Imaging (*Medizinische Bildgebung*)		3/1/2 2 PL	4th year	German	**7**
ET-12 05 08	Electromechanical Design (*Gerätekonstruktion*)	4/2/0 2PL		5th year	German	**7**
ET-12 05 09	Electronic Design Automation (*Entwurfsautomatisierung*)	2/4/0 2 PL		5th year	German	**7**
ET-12 06 07	Hybrid Integration (*Hybridintegration*)	4/0/2 2 PL		5th year	German	**7**
ET-12 06 08	Nondestructive Testing	4/0/2		5th year	German	**7**

	(*Zerstörungsfreie Prüfung*)	2 PL				
ET-12 07 03	Biomedical Devices (*Biomedizinisch-technische Systeme*)	3/2/1 2 PL		5th year	German	**7**
ET-12 07 04	Co-operative Systems in Biomedical Engineering (*Kooperative Systeme der BMT*)	4/1/1 2 PL		5th year	German	**7**

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Specialization area: Communications and Information Technology

Module number	Module name	Winter semester	Summer semester	Level	Language of instruction	ECTS-credits
ET-12 08 12	Integrated Analogue Circuits (*Integrierte Analogschaltungen*)	2/2/0 PL		3rd year	German	**4**
ET-12 09 02	Signal Theory (*Signaltheorie*)	4/2/0 2 PL		3rd year	German	**7**
ET-12 08 18	Integrated Circuit Design (*Schaltkreis- und Systementwurf*)	2/1/0	0/2/0 PL	3rd year	German	**7**
ET-12 09 06	Acoustics (*Akustik*)		2/2/0 PL	3rd year	German	**4**
ET-12 10 01	Information Theory (*Informationstheorie*)		2/2/0 PL	3rd year	German	**4**
ET-12 10 02	Advanced Seminar Communication Systems (*Hauptseminar Kommunikationssysteme*)		0/2/0 PL	3rd year	German	**4**
ET-12 10 03	RF Engineering (*Hoch- und Höchstfrequenztechnik*)		2/2/0 PL	3rd year	German	**4**
ET-12 10 04	Communication Networks, Basic Module (*Kommunikationsnetze, Basismodul*)		2/2/0 PL	3rd year	German	**4**
ET-12 08 16	Radio Frequency Integrated Circuits		3/1/2 PL	4th year	English	**7**
ET-12 08 20	Laser Sensor Technology (*Lasersensorik*)		4/1/1 2 PL	4th year	German	**7**
ET-12 09 03	Intelligent Audio Signal Processing (*Intelligente Audiosignalverarbeitung*)		4/1/1 PL	4th year	German	**7**

ET-12 09 08	Room Acoustics/Virtual Reality (*Raumakustik / Virtuelle Realität*)		4/0/2 2 PL	4th year	German	**7**
ET-12 10 05	Communication Networks, Advanced I (*Kommunikationsnetze, Aufbaumodul*)		4/2/0 2 PL	4th year	German	**7**
ET-12 10 09	Network Information Theory (*Netzwerk-Informationstheorie*)	4/2/0 PL		5th year	German	**7**
ET-12 10 12	Antennas and Propagation (*Antennen und Wellenausbreitung*)		4/2/0 PL	4th year	German	**7**
ET-12 10 14	Optical Communications (*Optische Nachrichtentechnik*)		4/2/0 PL	5th year	German	**7**
ET-12 10 15	Basics Mobile Communications Systems (*Grundlagen mobiler Nachrichtensysteme*)		4/2/0 PL	4th year	German	**7**
ET-12 10 13	RF Systems (*Hochfrequenzsysteme*)		4/2/0 PL	4th year	German	**7**
ET-12 10 21	Network Coding: Theory and Practice (*Netzwerkkodierung in Theorie und Praxis*)		4/2/0 2 PL	4th year	English/German	**7**
ET-12 10 22	Cooperative Communications (*Kooperative Kommunikation*)		4/2/0 2 PL	4th year	English/German	**7**
ET-12 08 07	Introduction to the Theory of Nonlinear Systems (*Einführung in die Theorie nichtlinearer Systeme*)	2/1/0 (2nd part) PL	2/1/0 (1st part) PL	4th and 5th year	English/German	**7**
ET-12 08 08	Circuit Simulation and System Identification (*Schaltungssimulation und Systemidentifikation*)	2/1/0 (2nd part) PL	1/1/0 (1st part) PL	4th and 5th year	German	**7**
ET-12 09 05	Electro-Acoustics (*Elektroakustik*)	2/0/2 (2nd part) 2 PL	2/0/0 (1st part) PL	4th and 5th year	German	**7**
ET-12 10 08	Statistics (*Statistik*)	2/1/0 (2nd part) PL	2/1/0 (1st part) PL	4th and 5th year	German	**7**
ET-12 10 16	Digital Signal Processing and Hardware Implementation (*Digitale Signalverarbeitung und Hardware-Implementierung*)	0/1/2 (2nd part) PL	2/1/0 (1st part) PL	4th and 5th year	German or English	**7**
ET-12 08 17	Integrated Circuits for Broadband Optical Communications	3/1/2 PL		5th year	English	**7**
ET-12 08 21	Photonic Measurement System Techniques (*Photonische Messsystemtechnik*)	4/2/0 2 PL		5th year	German	**7**
ET-12 08 19	VLSI Processor Design (*VLSI-Prozessorentwurf*)	2/2/2 2 PL		5th year	German	**7**
ET-12 09 04	Speech Technology	4/0/2		5th year	German	**7**

	(*Sprachtechnologie*)	2 PL				
ET-12 09 07	Technical Acoustics / Vehicle Acoustics (*Technische Akustik / Fahrzeugakustik*)	2/2/2 2 PL		5th year	German	**7**
ET-12 09 09	Psychoacoustics / Sound Design (*Psychoakustik / Sound Design*)	4/2/0 2 PL		5th year	German	**7**
ET-12 10 19	Optimization in modern Communication Systems (*Optimierung in modernen Kommunikationssystemen*)	4/2/0 2 PL		5th year	German or English	**7**
ET-12 10 20	Communication Networks, Advanced II (*Kommunikationsnetze, Vertiefungsmodul*)	4/2/0 2 PL		5th year	German or English	**7**
ET-12 10 17	Upgrade Mobile Communication Systems (*Vertiefung Mobile Nachrichtensysteme*)	4/2/0 2 PL		5th year	German or English	**7**
ET-12 10 18	Digital Signal Processing Systems (*Digitale Signalverarbeitungssysteme*)	3/1/2 2 PL		5th year	German	**7**

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Specialization area: Microelectronics

Module number	Module name	Winter semester	Summer semester	Level	Language of instruction	ECTS-credits
ET-12 08 12	Integrated Analogue Circuits (*Integrierte Analogschaltungen*)	2/2/0 PL		3rd year	German	**4**
ET-12 06 02	Electronic Packaging (*Aufbau- und Verbindungstechnik der Elektronik*)	2/0/0 PL	0/0/2 PL	3rd year	German	**4**
ET-12 08 13	Physics of selected devices (*Physik ausgewählter Bauelemente*)	2/1/0	2/0/0 2 PL	3rd year	German	**6**
ET-12 08 23	Computer Aided Integrated Circuit Design (*Rechnergestützter Schaltkreisentwurf*)	2/1/0	2/0/2 2 PL	3rd year	German	**8**
ET-12 12 01	Microsystems and Semiconductor Technology (*Mikrosystem- und Halbleitertechnologie*)	2/0/0	6/1/3 2 PL	3rd year	German	**12**
ET-12 08 15	Advanced Seminar: Micro- and Nanoelectronics (*Hauptseminar Mikro- und Nanoelektronik*)		0/2/0 PL	3rd year	German	**4**
ET-12 05 11	FEM – Probabilistic Simulation and Design Optimization (*FEM – Probabilistische Simulation und Optimierung*)		2/4/0 PL	4th year	German	**7**
ET-12 08 14	Characterization and Modeling of Electronic Devices (*Charakterisierung und Modellierung elektronischer Bauelemente*)		2/2/2 PL	4th year	German	**7**
ET-12 08 16	Radio Frequency Integrated Circuits		3/1/2 PL	4th year	English	**7**
ET-12 11 01	Solid-State and Nano Electronics (*Festkörper- und Nanoelektronik*)		4/2/0 PL	4th year	German	**7**
ET-12 11 03	Ultrasound (*Ultraschall*)		4/1/1 PL	4th year	German	**7**
ET-12 12 02	Design of Microsystems (*Entwurf von Mikrosystemen*)		4/2/1 PL	4th year	German	**7**
ET-12 12 03	Applied Thin-Film and Solar Technology (*Angewandte Dünnschicht- und Solartechnik*)		6/0/0 PL	4th year	German	**7**
ET-12 12 04	Memory Technology	2/1/0 (2nd part) PL	2/1/0 (1st part)	4th and 5th year	English/German	**7**
ET-12 05 09	Electronic Design Automation (*Entwurfsautomatisierung*)	2/4/0 2 PL		5th year	German	**7**

ET-12 06 07	Hybrid Integration (*Hybridintegration*)	4/0/2 2 PL		5th year	German	**7**
ET-12 08 17	Integrated Circuits for Broadband Optical Communi-cations	3/1/2 PL		5th year	English	**7**
ET-12 08 19	VLSI Processor Design (*VLSI-Prozessorentwurf*)	2/2/2 2 PL		5th year	German	**7**
ET-12 11 02	Theoretical Acoustics (*Theoretische Akustik*)	3/3/0 PL		5th year	German	**7**
ET-12 11 04	Sensors and Sensor Systems (*Sensoren und Sensorsysteme*)	4/1/1 2 PL		5th year	German	**7**
ET-12 12 05	Characterization of Microstructures (*Charakterisierung von Mikrostrukturen*)	6/0/1 PL		5th year	German	**7**
ET-12 12 06	New Actuators and Actuator Systems (*Neue Aktoren und Aktorsysteme*)	4/1/1 3 PL		5th year	German	**7**
ET-12 12 07	Innovative Concepts for Active Nanoelectronic Devices (*Innovative Konzepte für aktive nano-elektronische Bauelemente*)	4/2/0 3 PL		5th year	German	**7**

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Research oriented elective modules

Module number	Module name	Winter semester	Level	Language of instruction	ECTS-credits
ET-12 01 23	Seminar for Graduate Students on Human-Machine-Interaction (*Oberseminar Mensch-Maschine-Interaktion*)	0/2/0 PL	5th year	German	**4**
ET-12 01 24	Seminar for Graduate Students on Automation (*Oberseminar Automatisierungstechnik*)	0/2/0 PL	5th year	German	**4**
ET-12 02 18	Seminar for Graduate Students on Electromagnetic Theory and Compatibility (*Oberseminar Theoretische Elektrotechnik und Elektromagnetische Verträglichkeit*)	0/2/0 PL	5th year	German	**4**
ET-12 02 19	Seminar for Graduate Students on Power Electronics (*Oberseminar Leistungselektronik*)	0/2/0 PL	5th year	German	**4**
ET-12 02 20	Seminar for Graduate Students on Machines and Drives (*Oberseminar Maschinen und Antriebe*)	0/2/0 PL	5th year	German	**4**
ET-12 04 11	Seminar for Graduate Students on Electrical Power Engineering (*Oberseminar Elektrische Energieversorgung*)	0/2/0 PL	5th year	German	**4**
ET-12 05 10	Seminar for Graduate Students on System Design (*Oberseminar Gerätetechnik*)	0/2/0 PL	5th year	German	**4**
ET-12 06 09	Seminar for Graduate Students on Electronic Packaging (*Oberseminar Aufbau- und Verbindungstechnik*)	0/2/0 PL	5th year	German	**4**
ET-12 07 06	Seminar for Graduate Students on Biomedical Engineering (*Oberseminar Biomedizinische Technik*)	0/2/0 PL	5th year	German	**4**
ET-12 08 22	Seminar for Graduate Students on Measurement System Technology (*Oberseminar Messsystemtechnik*)	0/2/0 PL	5th year	German	**4**
ET-12 10 23	Seminar for Graduate Students on Information Technology (*Oberseminar Informationstechnik*)	0/2/0 PL	5th year	German	**4**
ET-12 12 08	Seminar for Graduate Students on Microelectronics (*Oberseminar Mikroelektronik*)	0/2/0 PL	5th year	German	**4**
ET-12 08 25	Seminar for Graduate Students on Micro- and Nanoelectronics (*Oberseminar Mikro- und Nanoelektronik*)	0/2/0 PL	5th year	German	**4**
ET-12 13 13	Seminar for Graduate Students on Control Theory (*Oberseminar Regelungs- und Steuerungstheorie*)	0/2/0 PL	5th year	German	**4**

Module descriptions

Module descriptions – basic studies (1st–4th semester)

Module number	Module name	Lecturer in charge
ET-12 01 02 (MT-12 01 02 RES-G11)	Automation Engineering and Measurement (Automatisierungs- und Messtechnik)	Prof. Dr. techn. K. Janschek
Contents and objectives	Content: 1. Fundamentals of automation engineering wit the focus on behavioural description, control design in the frequency domain, digital control loops, industrial standard controllers, discrete-event control systems, elementary control concepts and automation technologies 2. Fundamentals of measuring with the focus on measurement principles, SI units, analogue measurement technology (fundamentals, measurement bridges, lock-in measurement technique, quadrature demodulation technique, measurement of transit times and distances) and statistical measurement data evaluation (calculation of standard deviation and confidence intervals, propagation of the measurement uncertainty, setup of uncertainty budget for measurement) Objectives: Having successfully completed the modules, the students 1. understand fundamental behaviour description forms for technical systems. Further, they master the basic theoretical and computer-aided handling of linear, time-invariant and discrete-event behaviour models for the control of technical systems. They are able to design control algorithms for simple tasks. 2. are familiar with the principles of analogue measuring procedures and are able to evaluate measurement results by using statistical methods. They are able to calculate and interpret random and systematic measuring uncertainties.	
Modes of teaching and learning	3 SWS lecture, 2 SWS tutorial, and self-study	
Prerequisites	Competences acquired in basic modules on Physics	
Usability	This module is a compulsory module within the *Diplom* degree programmes in Electrical Engineering, Mechatronics and Renewable Energy Systems.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The module assessment consists of a written test of 210 minutes.	
ECTS credit points and grades	5 ECTS credit points The module grade is the grade of the written exam.	
Frequency	annually, in the summer semester	
Workload	150 working hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 04 01 (MT-12 04 01 RES-G09)	Electrical Power Engineering (*Elektroenergietechnik*)	Prof. Dr.-Ing. P. Schegner
Contents and objectives	Contents: - Generation, transformation, transport, distribution and usage of electrical energy - Structure of electrical energy supply - Fundamentals of three-phase power and their mathematical description - Electrical safety and coordination of stress and strength - Fundamentals of power electronics - Electromechanic energy converters Objectives: Having successfully completed this module, the students are able to undertake basic calculations and measurements for simple three-phase systems. They are familiar with principles of safety measures in electrical networks. They are able to calculate simple insulation configurations. The students are familiar with the fundamental mode of operation of power electronic circuits, electrical machines and three-phase transformers.	
Modes of teaching and learning	3 SWS lecture, 1 SWS tutorial, 1 SWS lab course, and self-study	
Prerequisites	None	
Usability	The module is a compulsory module for the basic studies in the *Diplom* programmes in Electrical Engineering, Mechatronics, and Renewable Energy Systems. It provides various tools for the passing of the modules within the the main studies.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The module assessment consists of a written exam of 150 min. (PL1) and a lab course (PL2). Both elements of assessment have to be passed.	
ECTS credit points and grades	5 ECTS credit points The module M grade is calculated as follows: M = (2PL1 + PL2)/3	
Frequency	annually, in the winter semester	
Workload	150 working hours	
Duration	2 semester	

Module number	Module name	Lecturer in charge
ET-12 05 01 (MT-12 05 01 RES-G19)	Electronic Systems Design *(Geräteentwicklung)*	Prof. Dr.-Ing. habil. J. Lienig
Contents and objectives	Content: The module focuses on constructional fundamentals with technical illustration and CAD, device design and device requirements, reliability of electronic systems, thermal dimensioning and electromagnetic compatibility. Objectives: Students completing this module obtain basic knowledge for the construction and development of electronic assembly groups and devices. They will have an understanding of engineering tasks as well as related requirements. Thus, the students will be enabled to follow engineering principles while developing and constructing such products under consideration of all relevant aspects.	
Modes of teaching and learning	2 SWS lectures, 2 SWS tutorial, and self-study	
Prerequisites	none	
Usability	This module is a compulsory module for the basic studies within the *Diplom* programmes in Electrical Engineering, Mechatronics, and Renewable Energy Systems.	
Requirements for the award of ECTS credit points	The credit points are obtained by passing the module examination. This examination is conducted as a written exam (120 minutes).	
ECTS credit points and grades	4 ECTS credit points The module grade is the grade of the written exam.	
Frequency	annually, during the summer semester	
Workload	120 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 08 01 (MT-12 08 01 RES-G06)	Fundamentals of Electrical Engineering (*Grundlagen der Elektrotechnik*)	Prof. Dr. phil. nat. habil. Ronald Tetzlaff
Contents and objectives	Content: The calculation of direct current (DC) electrical networks Objectives: Having successfully completed this module, the students have basic knowledge of electrical engineering and electronics and master methods for solving electrical engineering problems as a basis for further modules. The focus is on resistive circuits. Students are able to describe linear and nonlinear two poles and to consid-er the temperature dependence of their parameters, to analyze systemati-cally electrical DC circuits and to apply simpli-fied analysis methods (two pole theory, superposition theorem). They are able to calculate the power dissipation in circuits as well as to analyze and determine their thermal behaviour.	
Modes of teaching and learning	2 SWS lecture, 2 SWS tutorial, and self-study	
Prerequisites	Basic knowledge in mathematics and physics from higher education.	
Usability	The module is a compulsory module of the basic studies in the *Diplom* degree programmes in Electrical Engineering, Information Systems Technology, Mechatronics, and Renewable Energy Systems. It is designed to enable the students to pass the module exam of the module Dynamic Networks.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The module assessment consists of a written exam of 150 minutes.	
ECTS credit points and grades	6 ECTS credit points The module grade is the grade of the written exam.	
Frequency	annually, in the winter semester	
Workload	180 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 08 02	Electric and Magnetic Fields (*Elektrische und magnetische Felder*)	Prof. Dr. phil. nat. habil. Ronald Tetzlaff
Contents and objectives	The module contents: fundamentals of electric and magnetic fields. Outcomes: After completing this module, students understand basic concepts, know physical quantities, and apply methods for calculating basic electric and magnetic fields. They are able to calculate the stored field energy, force effects, and induction phenomena of magnetic fields. Basic principles and the elementary electronic components resistor, capacitor, inductor, and transformer are known.	
Modes of teaching and learning	4 SWS lecture, 2 SWS tutorial, and self-study	
Prerequisites	Competences acquired in modules such as ET-12 08 01 Fundamentals of Electrical Engineering, ET-01 04 01 Principles of Algebra and Analysis and ET-02 06 04 01 Physics (1st semester of the module), or equivalent	
Usability	The module is a compulsory module of the basic studies in the *Diplom* degree programmes in Electrical Engineering, and Information Systems Technology. It is designed to enable the students to pass the module exam of the module *Dynamic Networks*.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The module assessment consists of a written exam of 150 minutes.	
ECTS credit points and grades	6 ECTS credit points The module grade is the grade of the written exam.	
Frequency	annually, in the summer semester	
Workload	180 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 08 03	Dynamic Networks (*Dynamische Netzwerke*)	Prof. Dr. phil. nat. habil. Ronald Tetzlaff
Contents and objectives	The module contents: the analysis of linear dynamic networks. Outcomes: After completing this module, students are able to apply methods for analyzing linear dynamic circuits excited by periodic signals and to determine the transient behavior between stationary states. They are able to describe, to model and to analyze linear two-ports. They can determine transfer functions, analyze and graphically represent the network behavior for different frequencies, and determine basic filter structures. Phasor representations and Nyquist plots are mastered.	
Modes of teaching and learning	2 SWS lecture, 2 SWS tutorial, 3 SWS lab course, and self-study	
Prerequisites	Knowledge acquired in modules such as ET-12 08 01 Fundamentals of Electrical Engineering, ET-01 04 01 Principles of Algebra and Analysis, ET-01 04 02 Multivariable Calculus, ET-02 06 04 01 Physics, or equivalent. The prerequisite for participation in the lab course is to pass the module exam of the module ET-12 08 01 Fundamentals of Electrical Engineering.	
Usability	The module is a compulsory module of the basic studies in the *Diplom* programme in Electrical Engineering and Information Systems Technology. It is designed to enable the students to pass additional module exams of basic studies.	
Requirements for the award of ECTS credit points	The credit points are awarded if the module assessment is passed. The module assessment consists of a written exam of 150 minutes and a lab course. Both assessments must be passed.	
ECTS credit points and grades	8 ECTS credit points The module grade is determined by the weighted average of the grades of both elements of assessment. The module grade consists to 2/3 of the grade of the written exam and to 1/3 of the lab course grade.	
Frequency	annually, starting in the winter semester	
Workload	240 hours	
Duration	2 semester	

Module number	Module name	Lecturer in charge
ET-12 08 04	Circuit Design (*Schaltungstechnik*)	Prof. Dr. sc. techn. habil. F. Ellinger
Contents and objectives	This modulegives an introduction to electronic circuits, such as basic analogue circuits, differential amplifiers, power amplifiers, operational amplifiers and its applications, power supply, basic digital circuits, combinational und sequential logic. Students learn fundamental principles and practical realisations of analogue and digital circuits. They understand the properties of these circuits using different structures and the properties of the electronic devices. They can handle the methods of circuit analysis and they can dimension the circuits for specific applications.	
Modes of teaching and learning	4 SWS lecture, 2 SWS tutorial, 2 SWS lab course, and self-study	
Prerequisites	Competences acquired in modules such as ET-01 04 01 Principles of Algebra and Analysis, ET-01 04 02 Multivariable Calculus, ET-12 08 01 Fundamentals of Electrical Engineering, ET-12 08 11 Microelectronic Technology und Devices, ET-12 09 01 Systems Theory (1st semester of module), or equivalent	
Usability	The module is a compulsory module for the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The module assessment consists of a written exam of 180 minutes (in the summer semester) and a lab course. Both assessments must be passed. Note: It is possible to obtain credit points in exceptional cases (Erasmus students) only for the written exam. This rule applies only to the summer semester!	
ECTS credit points and grades	10 ECTS credit points The module grade consists to ¾ of the exam grade and to ¼ of the lab course grade. Credit points in exceptional cases (ERASMUS-students): 7 ECTS credits points for the summer semester There is no possibility to earn credits points for the lab courses only.	
Frequency	annually, starting in the summer semester	
Workload	300 hours	
Duration	2 semesters	

Module number	**Module name**	**Lecturer in charge**
ET-12 08 06	Measurement and Sensor Techniques (*Mess- und Sensortechnik*)	Prof. Dr.-Ing. habil. J. Czarske
Contents and objectives	Contents: - Principles of digital measuring methods and of electric sensors for determining non-electric quantities - Application of analogue and digital measuring methods with respect to sensors Intended learning outcomes: Students will acquire skills to use analogue and digital measurement methods for the detection of e.g. position, velocity, force and temperature. They will be able to handle calculation methods for determining measurement uncertainties in consideration of noise processes.	
Modes of teaching and learning	2 SWS lecture, 1 SWS tutorial, 1 SWS lab course, and self-study	
Prerequisites	Competences acquired in modules such as ET-02 06 04 01 Physics and ET-12 09 01 Systems Theory	
Usability	The module is a compulsory module for the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	Credit points are earned if the module assessment is passed. The assessment consists of a written exam (120 min) and the rated lab course reports. Both assessments must be passed.	
ECTS credit points and grades	4 ECTS credit points The module grade consists to 4/5 of the exam grade and to 1/5 of the lab course grade.	
Frequency	annually, during the winter semester	
Workload	120 hours	
Duration	1 semester	

Module number	**Module name**	**Lecturer in charge**
ET-12 08 11	Microelectronic Technologies and Devices (*1. Modulteil: Elektronische Bauelemente, 2. Modulteil: Mikrotechnologien*)	Prof. Dr.-Ing. habil. M. Schröter
Contents and objectives	The module includes - the physical fundamentals of electronic devices - the physical-technical fundamentals for their production by means of microtechnologies Objectives: The students are capable of: - understanding the fundamental functioning and electrical features of the most important semiconductor electronic devices on basis of a simplified description of the physical potential ratio and transport mechanisms in semiconductors - discussing the most important characteristic lines - constructing physical modell descriptions (including equivalent circuit diagrams) of semiconductor electronic devices for their application - working with fundamental principles for the production and miniaturisation of devices and circuits - understanding the modes of functioning of the individual technologies as well as their coaction resulting in simple process flows	
Modes of teaching and learning	5 SWS lecture, 1 SWS tutorial, and self-study	
Prerequisites	Competences acquired in modules such as ET-01 04 01 Principles of Algebra and Analysis, ET-01 04 02 Multivariable Calculus, ET-12 08 01 Fundamentals of Electrical Engineering, and ET-02 06 04 01 Physics	
Usability	The module is a compulsory module for the basic studies within the *Diplom* programme in Electrical Engineering. It provides the various tools necessary for passing the assessments of the modules of the specialization areas.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. This assessment is a written exam of 210 minutes.	
ECTS credit points and grades	6 ECTS credits The module grade is the grade of the exam.	
Frequency	annually, in the winter semester	
Workload	180 hours	
Duration	1 Semester	

Module number	**Module name**	**Lecturer in charge**
ET-12 09 01 (MT-12 09 01)	Systems Theory (*Systemtheorie*)	Prof. Dr.-Ing. habil. E. Jorswieck
Contents and objectives	Content: The module deals with the fundamentals of systems theory with focus on digital systems, analogue time-continuous systems, analogue time-discrete systems and selected applications. Objectives: Having successfully completed the module, the students are familiar with the regulative significance of the system concept in engineering. They master the application of signal transformations for the effective description of the system behaviour in the area of image. In particular, they are able to apply the approach of system theory to important areas of their own discipline, e.g. to the calculation of electrical networks in the case of non-sinusoidal or stochastic excitation and to the realization of systems with desired transfer behaviour in time-discrete form (digital filter).	
Modes of teaching and learning	4 SWS lecture and 3 SWS tutorial and self-study	
Prerequisites	Competences acquired in modules on Principles of Algebra and Analysis and on Multivariable Calculus Competences acquired in modules such MT-12 08 01 Fundamentals of Electrical Engineering, and MT-12 08 23 Electric and Magnetic Fields	
Usability	The module is a compulsory module within the basic studies for the Diplom programme in Electrical Engineering and Mechatronics.	
Requirements for the award of ECTS credit points	The ECTS credit points are awarded when the module assessment is passed. The module assessment is a written exam of 120 minutes.	
ECTS credit points and grades	7 ECTS credit points The module grade is the grade of the written exam.	
Frequency	Annually, beginning in the winter semester	
Workload	210 hours	
Duration	2 semesters	

Module number	Module name	Lecturer in charge
ET-12 10 24	Communications (*Nachrichtentechnik*)	Prof. Dr.-Ing. Dr. h.c. G. Fettweis
Course contents and intended learning outcomes	The module includes: Signal theory (sine waves, Dirac function, convolution, Fourier transform), linear time-invariant systems (transfer function, impulse response), bandpass signals (real and complex up and down mixing of signals, equivalent lowpass signal), analogue modulation (modulation, demodulation, properties of AM, PM, FM), analogue-digital conversion (sampling, signal reconstruction, quantization, sub- and oversampling), digital modulation schemes (modulation methods, matched-filter receiver, bit error probability). Outcomes: After completing this module, the students master the basic principles and the practical application of communications engineering. The students will be able to understand the basic signal processing in communications systems and to describe them mathematically. They are familiar with the transmission in base-band and band-pass area and know the basic analogue and digital modulation methods. They understand the impact of noise on the transmission quality for simple analogue and digital transmission scenarios.	
Teaching methods	2 SWS lecture, 1 SWS tutorial and self-study	
Required previous knowledge	Competences provided in modules such as ET-01 04 01 Principles of Algebra and Analysis, ET-01 04 02 Multivariable Calculus, ET-01 04 03 Special Chapters of Mathematics (1st semester of module) and ET-12 09 01 Systems Theory (1st semester of module)	
Usability	The module is a compulsory module in the *Diplom* programme in Electrical Engineering. It creates the conditions for passing the module assessments of the modules in the specialization areas.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The module assessment consists of a written exam of 120 minutes.	
ECTS credit points and grades	3 ECTS credit points The module grade is the grade of the written exam.	
Frequency	annually in the summer semester	
Workload	90 hours	
Duration	1 semester	

Module number	**Module name**	**Lecturer in charge**
ET-13 00 01 MT-13 00 01 RES-G14	Materials and Engineering Mechanics (Werkstoffe und Technische Mechanik)	Prof. Dr.-Ing. habil. J. Bauch
Contents and objectives	Content: Materials with focus on: 1. Overview of materials in Electrical Engineering and Mechatronics, practical examples 2. Fundamentals of materials science 3. Status diagrams and alloys 4. Conductor, semiconductor, dielectric and magnetic materials 5. Materials testing and diagnostics Statics and science of strength of materials with focus on: 1. Rigid bodies 2. Independent loads, power and torque, method of sections 3. Balance of planar structures (balances of forces and moments) 4. Tensile, compressive and shear stresses including elementary dimensioning concepts 5. Torsion of bars with circular cross-section, straight bending of prismatic beams, strength theories and bar buckling Objectives: Having successfully completed this module, the students are familiar with the interrelation between the microscopic structure, the macroscopic properties and the practical aspects of application of materials. They know the theoretical principles of the atomic structure, the bond type, the crystal structure, the real structure as well as the microstructure and are familiar with material testing. Further, they are familiar with the fundamental laws of statics as well as the simplified interrelation between loads, material properties and loads of components. With regard to these topics, they master calculation methods of the structural design and strength evaluation.	
Modes of teaching and learning	4 SWS lecture, 3 SWS tutorial, and self-study	
Prerequisites	Knowledge in mathematics and physics from higher education	
Usability	The module is a compulsory module within the basic studies of the *Diplom* programme in Mechatronics, Electrical Engineering and Renewable Energy Systems.	
Requirements for the award of ECTS credit points	The credit points are awarded when the module assessment is passed. The module assessment consists of a written exam of 90 min. (K1) and a written exam of 120 min. (K2, 120 min.). Both elements of assessment must be passed.	

ECTS credit points and grades	7 ECTS credit points The module grade M is calculated as follows: M = (3PL1 + 4PL2)/7
Frequency	Annually, starting in the winter semester
Workload	210 hours
Duration	2 semesters

Module descriptions – main studies

Module number	**Module name**	**Lecturer in charge**
ET-12 01 03	Discrete event systems and control (*Ereignisdiskrete Systeme und Steuerungen*)	Prof. Dr. techn. Klaus Janschek
Course contents and intended learning outcomes	Modulinhalte sind **1. Discrete event behavioral description forms** Signal based, finite automata, petri-nets, statecharts **2. Discrete event control design** Bottom-up / top-down with automata and petri-nets **3. Practical use of industrial control engineering** Language for specific purposes Objectives: The students 1. understand basic behavioral description forms for discrete event systems. They have a command of theoretical and computational handling of event-discrete behavioral models for the control of technical systems. 2. are able to design discrete event control algorithms independently for manageable tasks. 3. know the basic structure of industrial control technology and are able to implement own control designs on industrial control platforms.	
Teaching methods	4 SWS lecture, 1 SWS tutorial, 1 SWS lab course, and self-study	
Required previous knowledge	Competences aquired in modules such as ET-12 01 02 Automation and Measurement	
Usability	This module is a compulsory module within the specialization area of Automation, Measurement and Control in the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are awarded when the module assessment is passed. The module assessment consists of a written exam of 120 minutes (PL1), of a written exam of 90 minutes (PL2), and an oral exam of 30 minutes (PL3).	
ECTS credit points and grades	6 ECTS credit points The module grade is determined by the weighted average of PL1, PL2 and PL3: M= ½*PL1+1/3*PL2+1/6*PL3	
Frequency	Annually The module starts in the winter semester.	
Workload	180 hours	
Duration	2 semesters	

Module number	**Module name**	**Lecturer in charge**
ET-12 01 04	Process Control (*Prozessleittechnik*)	Prof. Dr.-Ing. habil. L. Urbas
Contents and objectives	Content: The basic principles and practical implementation for the - recording of process data - processing of process data with the aim of conducting the process safely and economcally - influencing the process. Objectives: The students 1. are able to realize cycles in industrial processes, including the functioning, construction and engineering methods for planning and implementing networked process control facilities. The students are able to present their knowledge about causal relationships in fault models. 2. know different measuring systems for the recording of processes, e.g. in the flow and production technology. They are also capable of presenting and evaluating the physical principle and the technical design of the measuring system techniques under real conditions. 3. know the functioning and the methods for the design of facilities for drive technology and actuators to influence a process.	
Modes of teaching and learning	6 SWS lecture, 2 SWS tutorial, 2 SWS lab course, and self-study	
Prerequisites	Competences acquired in basic modules on Physics and modules such as ET-12 09 01 Systems Theory, ET-12 01 02 Automation and Measurement, ET-12 04 01 Electrical Power Engineering.	
Usability	This module is a compulsory module within the specialization area of Automation, Measurement and Control in the *Diplom* programme in Electrical Engineering.	
Requirements for the award of credit points	The credit points are awarded when the module assessment is passed. The module assessment consists of a written exam of 120 minutes (PL1), of a written exam of 180 minutes (PL2), and a lab course (PL3).	
ECTS credit points and grades	11 ECTS credit points The module grade is determined by the weighted average of PL1, PL2 and PL3. PL1 contributes by 40%, PL2 by 50%, and PL3 by 10%.	
Frequency	annually, in the summer semester	
Workload	330 hours	
Duration of module	1 semester	

Module number	**Module name**	**Lecturer in charge**
ET-12 01 05	Modelling and Simulation (*Modellbildung und Simulation*)	Prof. Dr. techn. Klaus Janschek
Content and objectives	Content: **1. Engineering Mechanics – Dynamics** Kinematics of the rigid body, kinematics of the point, kinetics of the rigid body, vibration of single degree of freedom systems **2. Elements of physical modelling** Energy-based modelling paradigms (Euler-Lagrange), tor based modelling paradigms (generalized Kirchhoff networks), signal-based modelling paradigms, differential algebraic equation systems **3. Elements of simulation technology** Numerical integration of ordinary differential equation systems, differential algebraic equation systems (DAE) and hybrid (event discrete continuous) equation systems, modular simulation (signal / object-oriented) Objectives: The students 1. are able to cope with the area of dynamics 2. are qualified in physical modelling paradigms and are capable of creating mathematical models, such as DAE-systems, independently. 3. know the basic structure of numerical integration algorithms and special features in their application for technical, physical systems.	
Modes of teaching and learning	3 SWS lecture, 2 SWS tutorial, 1 SWS lab course	
Prerequisites	Competences aquired in modules such as ET-12 01 02 Automation Engineering and Measurement	
Usability	This module is a compulsory module within the specialization area of Automation, Measurement and Control in the Diplom programme in Electrical Engineering.	
Requirements for the award of credit points	The credit points are awarded when the module assessment is passed. The module assessment consists of a written exam of 60 minutes (PL1), of a written exam of 120 minutes (PL2), and a lab course (PL3).	
ECTS credit points and grades	8 ECTS credit points The module grade is the weighted average of the grades for the elements of assessment: PL1 contributes by ¼, PL2 by ½ and PL3 by ¼.	
Frequency	Annually. The module starts in the winter semester.	
Workload	240 hours	
Duration	2 semesters	

Module number	Module name	Lecturer in charge
ET-12 01 06	Advanced Seminar Automation, Measurement and Control (Hauptseminar Automatisierungs-, Mess- und Regelungstechnik)	
Contents and objectives	The module deals with topics and questions of Automation, Measurement and Control as well as the methodology of scientific and project-orientated work. Objectives: After completing this module, students will be able to apply their skills autonomously, individually or within a team to specific tasks. They are able to document the single steps of the procedures comprehensibly. The students are expected to present and discuss their results.	
Modes of teaching and learning	2 SWS seminar and self-study	
Prerequisites	Competences aquired in modules such as ET-12 01 02 Automation and Measurement	
Usability	This module is a compulsory module within the specialization area of Automation, Measurement and Control in the *Diplom* programme in Electrical Engineering.	
Requirements for the award of credit points	The credit points are awarded when the module assessment is passed. The module assessment consists of a project of 40 hours.	
ECTS credit points and grades	4 ECTS credit points The module grade is determined by the weighted average of the grade of the project and the grade of the colloquium. The grade of the project is weighted with 2/3 and the grade of the colloquium with 1/3 for the module grade.	
Frequency	annually, during the winter semester	
Workload	120 hours	
Duration of module	1 Semester	

Module number	**Module name**	**Lecturer in charge**
ET-12 01 10	Industrial Automation 1 (*Industrielle Automatisierungs-technik, Basismodul*)	PD Dr.-Ing. Annerose Braune
Contents and objectives	Content: Automation technology solutions for locally distributed automation systems using current information technologies such as the Internet, XML and model-driven technologies in automation technology Objectives: The students 1. are capable of working with basic concepts, protocols and services of the Internet technologies 2. have basic experience and skills in dealing with current technologies that are relevant for automation 3. are capable of evaluating basic risks and opportunities of the application of modern information technologies 4. are capable of solving a managebale application with the learned methods as a small project.	
Modes of teaching and learning	3 SWS lecture, 1 SWS tutorial, 2 SWS project, and self-study	
Prerequisites	Competences acquired in modules such as ET-12 01 02 Automation and Measurement	
Usability	The module is an elective module within the specialization area of Automation, Measurement and Control in the *Diplom* programme in Electrical Engineering.	
Requirements for the award of credit points	The credit points are awarded if the module assessment is passed. The module assessment consists of a written exam of 120 minutes (PL1) and a project of 15 weeks (PL2).	
ECTS credit points and grades	7 ECTS credit points The module grade (M) is determined by the weighted average of PL1 and PL2: M = (4PL1 + 3PL2)/7.	
Frequency	annually, beginning in the summer semester	
Workload	210 hours	
Duration	2 semesters	

Module number	**Module name**	**Lecturer in charge**
ET-12 01 11	Industrial Automation Engineering 2 (*Industrielle Automatisierungs-technik, Aufbaumodul*)	Prof. Dr. techn. Klaus Janschek
Content and objectives	Content: Automation technolgy concepts and solutions for selected applications, such as position control for space vehicles, embedded systems, or industrial automation means Objectives: The students 1. are able to design basic concepts, model descriptions and approaches of the respective application domain 2. master fundamental solution methods 3. are capable of dealing with examples of automation devices.	
Modes of teaching and learning	3 SWS lecture, 2 SWS tutorial, 1 SWS project, and self-study	
Prerequisites	Competences acquired in modules such as ET-12 01 02 Automation and Measurement	
Usability	The module is an elective module within the specialization area of Automation, Measurement and Control in the *Diplom* programme in Electrical Engineering.	
Requirements for the award of credit points	The credit points are awarded if the module assessment is passed. The module assessment consists of a written exam of 120 minutes (PL1) and a project of 15 hours (PL2).	
ECTS credit points and grades	7 ECTS credit points The module grade M is determined by the weighted average: M = (3 PL1 + 2 PL2) / 5	
Frequency	Annually, in the summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	**Module name**	**Lecturer in charge**
ET-12 01 12	Robotics (*Robotik*)	Prof. Dr. techn. Klaus Janschek
Content and objectives	Content: **1. Control of serial manipulators** – Kinematic fundamentals – Trajectories – Robot dynamics – Position control – Force control **2. Control of mobile robots** – Kinematic fundamentals – Navigation (localization) – path planning Objectives: The students are capable of 1. applying controlled industrial robot systems. They master the theoretical and computational handling of behavior models and algorithms for the controlling of industrial robot systems (manipulators, serial kinematics). 2. working with behavioral models for the navigation (position, orientation) and path planning of autonomous mobile robot platforms. They master the basic methodological and algorithmic approaches 3. solving a manageable design task with the learned methods as a small project.	
Modes of teaching and learning	4 SWS lecture, 2 SWS tutorial, 1 SWS project	
Prerequisites	Competences acquired in modules such as ET-12 13 01 Control of Continuous-Time Processes and ET-12 01 05 Modelling and Simulation	
Usability	The module is an elective module within the specialization area of Automation, Measurement and Control in the *Diplom* programme in Electrical Engineering.	
Requirements for the award of credit points	The credit points are awarded if the module assessment is passed. The module assessment consists of two written exams of 120 minutes each and a project of 20 hours.	
ECTS credit points and grades	7 ECTS credit points The module grade is the weighted mean of the grades for the elements of assessment: The grades for the written exams contribute by 3/7 each and the grade for the project by 1/7.	
Frequency	Annually. The module starts in the winter semester.	
Workload	210 hours	
Duration	2 semesters	

Module number	**Module name**	**Lecturer in charge**
ET-12 01 13	Systems Design (*Systementwurf*)	Prof. Dr. techn. Klaus Janschek
Content and objectives	Content: **1. System design of mechatronic systems** - Multi-body dynamics - Mechatronic converter principles - Stochastic behavior analysis - System budgets **2. System design of complex automation systems** - Definition of requirements - Function-oriented behavior modeling - Object-oriented behavioral modeling - Fundamentals of project management Objectives: The students are capable of 1. applying methods and tools of physically based behavior modeling and analysis (mechatronic systems). They are able to conduct a sound quantitative evaluation of design and optimization. 2. working with concepts, methods and tools of abstract behavior modeling and analysis (complex automation systems). They are able to conduct a sound quantitative evaluation of design and optimization.	
Modes of teaching and learning	4 SWS lecture, 2 SWS tutorial, and self-study	
Prerequisites	Competences acquired in modules such as ET-12 13 01 Control of Continuous-Time Processes and ET-12 01 05 Modelling and Simulation	
Usability	The module is an elective module within the specialization area of Automation, Measurement and Control in the *Diplom* programme in Electrical Engineering.	
Requirements for the award of credit points	The credit points are awarded if the module assessment is passed. The module assessment consists of two written exams (120 minutes each).	
ECTS credit points and grades	7 ECTS credit points The module grade is the arithmetic mean of both elements of assessment.	
Frequency	Annually, in the winter semester.	
Workload	210 hours	
Duration	1 semester	

Module number	**Module name**	**Lecturer in charge**
ET-12 01 20	Human Machine Systems Technology (*Mensch-Maschine-Systemtechnik*)	Prof. Dr.-Ing. habil. Leon Urbas
Content and objectives	Content: Principles and methods of the human-machine-system to take into account the human factor in the analysis, evaluation and design of complex, interactive technical systems Objectives: The students 1. master fundamental methods of the human-machine systems technology for the description, analysis, evaluation and design of dynamic interactive systems. 2. are capable of working systematically on domain-specific issues of human-machine interaction.	
Modes of teaching and learning	2 SWS lecture, 2 SWS tutorial, 2 SWS project, and self-study	
Prerequisites	Competences acquired in modules such as ET-12 09 01 Systems Theory, ET-12 01 02 Automation and Measurement, and ET-12 01 04 Process Control	
Usability	The module is an elective module within the specialization area of Automation, Measurement and Control in the *Diplom* programme in Electrical Engineering as well as an elective module within the *Diplom* programme in Information Systems Engineering.	
Requirements for the award of credit points	The credit points are awarded if the module assessment is passed. The module assessment consists of a written exam of 120 minutes and a project of 30 hours.	
ECTS credit points and grades	7 ECTS credit points The module grade is determined by the weighted average of both elements of assessment: the written exam contributes by 3/5 and the project by 2/5.	
Frequency	annually, in the winter semester	
Workload	210 hours	
Duration	1 semester	

Module number	**Module name**	**Lecturer in charge**
ET-12 01 21	Project Planning for Process Automation Systems (*Projektierung von Automatisierungssystemen*)	Prof. Dr.-Ing. habil. Leon Urbas
Content and ojectives	Content: Methods for Computer Assisted Engineering in Process Automation (CEA-PA) with the following focus: 1. computer-aided integrated and life-cycle-wide project planning of process automation systems with e.g. requirements analysis, basic, detail and order engineering, implementation and commissioning, information modeling for integrated engineering systems 2. implementation in automation projects Objectives: The students 1. know the methods and means for computer-aided project planning of complex automation systems from process requirements and 2. can implement these in specific domains and application areas or deepen these by means of further computer-based methods.	
Modes of teaching and learning	2 SWS lectures, 2 SWS tutorial, 2 SWS project, and self-study	
Prerequisites	Competences in the field of automation	
Usability	The module is an elective module within the specialization area of Automation, Measurement and Control in the *Diplom* programme in Electrical Engineering as well as en elective module in the *Diplom* programme of Information Systems Engineering.	
Requirements for the award of credit points	The credit points are awarded if the module assessment is passed. The module assessment consists of a written exam of 120 minutes and a project of 30 hours.	
ECTS credit points and grades	7 ECTS credit points The module grade is determined by the arithmetic mean of both elements of assessment.	
Frequency	annually, in the summer semester	
Workload	210 hours	
Duration of the module	1 semester	

Module number	**Module name**	**Lecturer in charge**
ET-12 01 22	Process Management Systems (*Prozessführungsgetriebe*)	Prof. Dr.-Ing. habil. Leon Urbas
Content and ojectives	Content: Knowledge-based methods and algorithms for automated process evaluation, diagnosis and management Objectives: The students are capable of 1. designing, implementing and operating complex knowledge-based process-oriented (partially) automated information processing systems, 2. combining and applying these methods with system theoretical and automation engineering approaches in order to implement complex automation systems.	
Modes of teaching and learning	4 SWS lectures, 2 SWS tutorial, and self-study	
Prerequisites	Competences in the field of automation	
Usability	The module is an elective module within the specialization area of Automation, Measurement and Control within the *Diplom* programme in Electrical Engineering as well as en elective module in the *Diplom* programme of Information Systems Engineering.	
Requirements for the award of credit points	The credit points are awarded if the module assessment is passed. The module assessment consists of two written exam (90 minutes each) and a project of 30 hours.	
ECTS credit points and grades	7 ECTS credit points The module grade is calculated from the weighted average of the grades of the written exams and the grade of the lab course. The grades of the exams contribute by 3/7 each and the grade of the project by 1/7.	
Frequency	annually, in the winter semester	
Workload	210 hours	
Duration of the module	1 semester	

Module number	**Module name**	**Lecturer in charge**
ET-12 01 23	Seminar for Graduate Students on Human-Machine-Interaction (*Oberseminar Mensch-Maschine-Interaktion*)	Prof. Dr.-Ing. habil. Leon Urbas
Content and ojectives	Content: - Specific aspects of the design and empirical evaluation of human-machine interaction - Methods of scientific and project-based engineering Objectives: The students are capable of solving a given task independently, individually, and in teams. They master the documentation of the work and the methods used, and are capable of presenting and discussing the results.	
Modes of teaching and learning	2 SWS seminar, and self-study	
Prerequisites	Competences acquired in modules such as ET-12 01 05 Modelling and Simulation	
Usability	The module is an elective module within the specialization area of Automation, Measurement and Control within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of credit points	The credit points are awarded if the module assessment is passed. The module assessment consists of an assignment and a presentation of 30 minutes.	
ECTS credit points and grades	4 ECTS credit points The module grade is calculated from the weighted mean of the grades for the different means of assessment: the grade for the assignment contributes by 2/3 and the presentation by 1/3.	
Frequency	annually, in the winter semester	
Workload	120 hours	
Duration of the module	1 semester	

Module number	**Module name**	**Lecturer in charge**
ET-12 01 24	Seminar for Graduate Students on Automation (*Oberseminar Automatisierungstechnik*)	Prof. Dr. techn. K. Janschek
Content and ojectives	Content: - Current topics, trends and issues of automation for different applications - Methods of scientific and project-based working as well as the presentation of results Qualifikationsziele: The students are capable of solving a given task independently, individually, and in teams. They master the documentation of the work and the methods used, and are capable of presenting and discussing the results. They are able to master the basic methods of modelling, design and analysis of automatic systems. They are further capable of presenting and discussing the results.	
Modes of teaching and learning	2 SWS seminar, and self-study	
Prerequisites	Competences acquired in modules such as ET-12 01 05 Modelling and Simulation and ET-12 01 02 Automation Engineering and Measurement	
Usability	The module is an elective module within the specialization area of Automation, Measurement and Control within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of credit points	The credit points are awarded if the module assessment is passed. The module assessment consists of an assignment and a presentation of 30 minutes.	
ECTS credit points and grades	4 ECTS credit points The module grade is calculated from the weighted mean of the grades for the different means of assessment: the grade for the assignment contributes by 2/3 and the presentation by 1/3.	
Frequency	annually, in the winter semester	
Workload	120 hours	
Duration of the module	1 semester	

Module number	**Module name**	**Lecturer in charge**
ET-12 02 01	Electromagnetic Theory (*Theoretische Elektrotechnik*)	Prof. Dr. rer. nat. habil. H. G. Krauthäuser
Contents and objectives	With regard to contents, the module comprises the basics of the classical electromagnetic field theory. After completion of the module, the students have the ability to assess the causes and connections between most electromagnetic phenomena and are capable solving field problems with fundamental analytical methods. The students can establish relationships between the different disciplines in electrical engineering, the motivation and the scientific limits.	
Modes of teaching and learning	4 SWS lecture, 4 SWS tutorial and self-study	
Prerequisites	Competences acquired in modules such as ET-01 04 01 Principles of Algebra and Analysis, ET-01 04 02 Multivariable Calculus, ET-01 04 03 Special Chapters of Mathematics, ET-12 08 02 Electric and Magnetic Fields, or equivalent	
Usability	The module is compulsary in the *Diplom* programme Electrical Engineering. It provides fundamentals for other modules in the *Diplom* programme.	
Requirements for the award of credit points	The credit points are awarded when the module assessment is passed. The module assessment consists of two written examinations. Each examination takes 120 minutes.	
ECTS credit points and grades	10 ECTS credit points The module grade is the arithmetic mean of grades of the two examinations.	
Frequency	annually, first part in winter semester, second part in summer semester	
Workload	300 hours	
Duration of module	2 semesters	

Module number	**Module name**	**Lecturer in charge**
ET-12 02 02	Numerical Analysis (*Numerische Mathematik*)	Prof. Dr. rer. nat. habil. H. G. Krauthäuser
Contents and objectives	With regard to contents, the module comprises the basics of numerical analysis with a view to their application in electrical engineering. After completion of the module, the students possess the ability to apply basic numerical methods to engineering problems and are capable to assess the error of the approximation.	
Modes of teaching and learning	2 SWS lectures, 1 SWS tutorial and self-study	
Prerequisites	Competences acquired in modules such as ET-01 04 01 Principles of Algebra and Analysis, ET-01 04 02 Multivariable Calculus, ET-01 04 03 Special Chapters of Mathematics, ET-12 08 01 Fundamentals of Electrical Engineering, ET-12 08 02 Electric and Magnetic Fields, ET-12 08 03 Dynamic Networks, or equivalent	
Usability	The module is compulsary in the *Diplom* programme in Electrical Engineering.	
Requirements for the award of credit points	The credit points are awarded when the module assessment is passed. The module assessment is a written examination. The examination takes 120 minutes.	
ECTS credit points and grades	4 ECTS credit points The module grade is the grade of the examination.	
Frequency	annually in winter semester	
Workload	120 hours	
Duration of module	1 semester	

Module number	**Module name**	**Lecturer in charge**
ET-12 02 03	Power Electronics *(Leistungselektronik)*	Prof. Dr.-Ing. St. Bernet
Contents and objectives	The module deals with - the working principle of power electronical actuators, - the design and function of power diodes and power semiconductor switches which can be turned on actively, - analyses of the function of line-commutated and load-commutated converters, - the simplification of the topologies for simulations, - the design of the main components of power electronic systems, - common modulation methods for the generation of the control signals, - common feed-forward and feed-back control algorithms. Objectives: The module qualifies for the selection and design of usable topologies and the selection and dimensioning of the power semiconductor switches for typical applications. The students are capable of verifying the basic function of the power electronic system by the use of simulation tools.	
Modes of teaching and learning	3 SWS lecture, 2 SWS tutorial, 1 SWS lab course and self-study including a project	
Prerequisites	Competences acquired in modules such as ET-12 08 01 Fundamentals of Electrical Engineering and ET-02 06 04 01 Physics	
Usability	The module is a compulsory module of the specialization area of electrical power engineering within the *Diplom* programm in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessement is passed. The module assessement consists of a written exam of 120 minutes and a project of 40 hours.	
ECTS credit points and grades	7 credit points The module grade consists to 80% of the grade of the written exam and to 20% of the project grade.	
Frequency	annually, starting in the winter semester	
Workload	210 hours	
Duration	2 semester	

Module number	**Module name**	**Lecturer in charge**
ET-12 02 04 RES-H06	Electrical Machines (*Elektrische Maschinen*)	Prof. Dr.-Ing. W. Hofmann
Contents and objectives	Content: *Fundamentals of electrical machines* in structure, function, performance, agitator speed or power setting and efficiency - Fundamentals of electromagnetic energy conversion - Transformers - DC maschines - Synchronous machines - Induction machines - Small machines - Linear motors - Testing of electrical machines Objectives: Having successfully completed the module, the students can follow the steady-state operating performance of electrical machines and evaluate their properties by means of suitable calculations, measurements and tests.	
Modes of teaching and learning	3 SWS lecture, 1 SWS tutorial, 1 SWS lab course, and self-study	
Prerequisites	Competences acquired in modules such as ET-12 08 01 Fundamentals of Electrical Engineering and ET-02 06 04 01 Physics	
Usability	The module is a compulsary module in the *Diplom* programmes in Electrical Engineering and Renewable Energy Systems.	
Requirements for the award of credit points	The credit points are awarded when the module assessment is passed. The module assessment consists of a written examination (180 minutes) and a lab course.	
ECTS credit points and grades	5 ECTS credit points The module grade is the weighted average of both elements of assessment. The grade of the written exam contributes by 70% and the grade of the lab course by 30%.	
Frequency	Annually, in the winter semester	
Workload	150 hours	
Duration of module	1 semester	

Module number	**Module name**	**Lecturer in charge**
ET-12 02 05	Electric Drives (*Elektrische Antriebe*)	Prof. Dr.-Ing. W. Hofmann
Contents and objectives	Content: *Electric Drives* - Basics of electromechanical drives - Agitator speed and torque control of DC and AC drives with power electronic actuators - Control of electrical drives Objectives: Having successfully completed the module, the students can follow the performance of electrical drives on the basis of equivalent circuits and evaluate their control properties by means of suitable calculations, measurements and tests.	
Modes of teaching and learning	3 SWS lecture, 1 SWS tutorial, 1 SWS lab course, and self-study	
Prerequisites	Competences acquired in modules such as ET-12 08 01 Fundamentals of Electrical Engineering and ET-02 06 04 01 Physics	
Usability	The module is a compulsary module within the specialization area of Electrical Power Engineering in the *Diplom* programme in Electrical Engineering.	
Requirements for the award of credit points	The credit points are awarded when the module assessment is passed. The module assessment consists of a written examination (180 minutes) and a lab course.	
ECTS credit points and grades	6 ECTS credit points The module grade is the weighted average of both elements of assessment. The grade of the written exam contributes by 70% and the grade of the lab course by 30%.	
Frequency	Annually, in the summer semester.	
Workload	180 hours	
Duration of module	1 semester	

Module number	**Module name**	**Lecturer in charge**
ET-12 02 06	Advanced Seminar Electrical Power Engineering (*Hauptseminar Elektrische Energietechnik*)	Dean of Studies in Electrical Engineering
Contents and objectives	The module comprises topics and questions of Electrical Power Engineering, as well as the methodology of scientific and project-orientated work. After completion of the module, the students have the ability to independently apply their skills and abilities in a team or individually to solve problems. The workflow will be documented and the results presented and discussed. They can work in teams and develop concepts, which they implement and defend.	
Modes of teaching and learning	2 SWS project work and self-study	
Prerequisites	Competences acquired in modules such as ET-12 08 01 Fundamentals of Electrical Engineering, ET-12 08 02 Electric and Magnetic Fields, ET-12 08 03 Dynamic Network, ET-02 06 04 01 Physics, ET-12 01 01 Microcomputer Technology, ET-12 04 01 Electrical Power Engineering, or equivalent	
Usability	The module is a compulsary module in the specialization area of Electrical Power Engineering in the *Diplom* programme Electrical Engineering.	
Requirements for the award of credit points	The credit points are awarded when the module assessment is passed. The module assessment consists of a project of 40 hours.	
Credit points and grades	4 ECTS credit points The module grade is the grade of the project.	
Frequency	annually in summer semester	
Workload	120 hours	
Duration of module	1 semester	

Module number	Module name	Lecturer in charge
ET-12 02 07	Electromagnetic Compatibility (*Elektromagnetische Verträglichkeit*)	Prof. Dr. rer. nat. habil. H. G. Krauthäuser
Contents and objectives	The module contains topics and questions of the electromagnetic compatibility in electrical systems. After completion of the module, the students have the ability to theoretically and practically assess electromagnetic compatibility problems. They know legal framework and relevants norms. They recognise parasitc coupling phenomena and take appropriate countermeasures.	
Modes of teaching and learning	4 SWS lecture, 3 SWS lab course and self-study	
Prerequisites	Competences acquired in modules such as ET-12 04 03 Fundamentals of Electrical Power Systems, ET-12 02 01 Electromagnetic Theory, or equivalent	
Usability	The module is an elective module for the specialization area of Electrical Power Engineering in the *Diplom* programme Electrical Engineering.	
Requirements for the award of credit points	The credit points are awarded when the module assessment is passed. If 20 students or less take part in the module, the module assessment consists of an oral examination of 30 minutes and laboratory work. If more than 20 students take part in the module, the oral exam can be replaced by a written exam of 120 min.	
ECTS credit points and grades	7 ECTS credit points The module grade is the weighted mean of grades of the laboratory work and the oral examination. The grade of the oral examination counts 2/3 and the grade for the laboratory work 1/3.	
Frequency	annually, first part in summer semester, second part in winter semester	
Workload	210 hours	
Duration of module	2 semesters	

Module number	Module name	Lecturer in charge
ET-12 02 08	Numerical Methods for Electromagnetic Theory (*Numerische Verfahren der Theoretischen Elektrotechnik*)	Prof. Dr. rer. nat. habil. H. G. Krauthäuser
Contents and objectives	With regard to contents, the module comprises numerical and semi-analytical methods for the computation of electromagnetic field problems and electromagnetic compatibility problems. After completion of the module, the students are able to attend a number of electromagnetic field problems with numerical procedures. Afterwards they will be able to distinguish between appropriate and less appropriate procedures for a specific problem, to review results in the context of intrinsic uncertainties, and to optimise the underlying models.	
Modes of teaching and learning	3 SWS lectures, 1 SWS tutorials, 2 SWS lab course and self-study	
Prerequisites	Competences acquired in modules such as ET-01 04 01 Principles of Algebra and Analysis ET-01 04 02 Multivariable Calculus ET-01 04 03 Special Chapters of Mathematics ET-12 02 02 Numerical Analysis ET-12 02 01 Electromagnetic Theory or equivalent	
Usability	The module is an elective module for the specialization area of Electrical Power Engineering in the *Diplom* programme in Electrical Engineering.	
Requirements for the award of credit points	The credit points are awarded if the module assessment is passed. If 20 students or less take part in the module, the module assessment consists of an oral examination of 30 minutes and laboratory work. If more than 20 students take part in the module, the oral exam can be replaced by a written exam of 120 min.	
ECTS credit points and grades	7 ECTS credit points The module grade is the weighted mean of grades of the laboratory work and the oral examination. The grade of the oral examination counts 2/3 and the grade for the laboratory work 1/3.	
Frequency	annually in summer semester	
Workload	210 hours	
Duration of module	1 semester	

Module number	Module name	Lecturer in charge
ET-12 02 09	Selected Topics of Electromagnetic Theory (*Ausgewählte Kapitel der Theoretischen Elektrotechnik*)	Prof. Dr. rer. nat. habil. H. G. Krauthäuser
Contents and objectives	With regard to contents, the module comprises selected topics and questions of electromagnetic field theory. After completion of the module, the students are able to assess currently relevant research topics in electromagnetics. They learn to apply and review the basic concepts of electromagnetic theory.	
Modes of teaching and learning	4 SWS lecture, 2 SWS tutorial, and self-study	
Prerequisites	Competences acquired in modules such as ET-12 02 01 Electromagnetic Theory	
Usability	The module is an elective module for the specialization area of Electrical Power Engineering in the *Diplom* programme Electrical Engineering.	
Requirements for the award of credit points	The credit points are awarded when the module assessment is passed. If 20 students or less take part in the module, the module assessment consists of an oral examination of 30 minutes. If more than 20 students take part in the module, the oral exam can be replaced by a written exam of 120 min.	
ECTS credit points and grades	7 ECTS credit points The module grade is the grade of the oral examination.	
Frequency	annually in summer semester	
Workload	210 hours	
Duration of module	2 semesters	

Module number	Module name	Lecturer in charge
ET-12 02 10	Power Electronics, advanced (*Vertiefung Leistungselektronik*)	Prof. Dr.-Ing. St. Bernet
Contents and objectives	The module deals with - design and function of power semiconductor switches which can be turned on and off actively, - analyses of the function of self-commutated converters, - simplification of the topologies for simulations, - design of the main components of power electronic systems, - common modulation methods for the generation of the control signals, - common feed-forward and feed-back control algorithms. Objectives: The module qualifies for the selection and design of usable topologies and the selection and dimensioning of the power semiconductor switches for a wide range of applications. The students are capable of verifying the function of the power electronic system and its control by the use of simulation tools.	
Modes of teaching and learning	3 SWS lecture, 2 SWS tutorial, 1 SWS lab course and self-study including a project	
Prerequisites	Competences acquired in modules such as ET-12 02 03 Power Electronics	
Usability	The module is an elective module of the specialization area of Electrical Power Engineering within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessement is passed. The module assessement consists of a written exam of 120 minutes and a project of 40 hours.	
ECTS credit points and grades	7 ECTS credit points The module grade consists to 2/3 of the written exam grade and to 1/3 of the project grade.	
Frequency	annually, starting in the summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 02 11	Microprocessor Control in Power Electronics (*Mikroprozessorsteuerung in der Leistungselektronik*)	Prof. Dr.-Ing. St. Bernet
Contents and objectives	The module deals with - the design and function of common power electronic topologies for energy and drive applications, - analyses of the characteristics and simplification of the topologies for the modelling in order to design the control, - common modulation methods for the generation of the control signals and possible implementations on digital control platforms, - common feed-forward and feed-back control algorithms and issues of the implementation on digital control platforms, - programming of the control of a voltage source converter in order to operate an induction motor. Objectives: The students are capable of implementing controllers on a digital control platform by using a high-level programming language. They are capable of understanding the structure and function of a digital control platform, and of rating the main characteristics of a digital control platform in relation to the application, and of evaluating the pros and cons of different solutions.	
Modes of teaching and learning	3 SWS lecture, 2 SWS project and self-study	
Prerequisites	Competences acquired in modules such as ET-12 02 03 Power Electronics	
Usability	The module is an elective module of the specialization area of Electrical Power Engineering within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessement is passed. The module assessment consists of a project of 40 hours and of an oral exam (in groups of up to 3 examinees, 20 minutes each examinee).	
ECTS credit points and grades	7 ECTS credit points The module grade consists to ¾ of the project grade and to ¼ of the oral exam grade.	
Frequency	annually, in the summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 02 12	Electromagnetic power transformers (*Elektromagnetische Energiewandler*)	Prof. Dr.-Ing. W. Hofmann
Contents and objectives	Content: 1. Design and calculation of electrical machines: design of the most important dimensions of electrical machines, winding design, magnetic circuit design, determination and calculation of the machine parameters, losses, efficiency and heating 2. Transformers: specifics of the design, use and application of power transformers and transducers, deepening treatment of special magnetic circuits and the use of ferromagnetics, treatment of new methods and principles of action Objectives: Having successfully completed this modules, the students are capable of designing, of calculating, of simulating with FEM and of rudimentally optimizing electrical machines and transformers.	
Modes of teaching and learning	4 SWS lecture, 1 SWS tutorial, 1 SWS lab course, 20 hours project, and self-study	
Prerequisites	Competences acquired in modules such as ET-12 02 04 Electrical Machines	
Usability	The module is an elective module of the specialization area of Electrical Power Engineering within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessement is passed. The module assessment consists of an oral exam of 40 minutes (PL1) and a lab course (PL2).	
ECTS credit points and grades	7 ECTS credit points The module grade (M) is derived from the weighted average of the grades of the elements of assessment: M=(7PL1+3PL2)/10	
Frequency	Annually The module begins in in the summer semester.	
Workload	230 hours	
Duration	2 semesters	

Module number	Module name	Lecturer in charge
ET-12 02 13	Electrical Drive Engineering (*Elektrische Antriebstechnik*)	Prof. Dr.-Ing. W. Hofmann
Contents and objectives	Content: Elements of the drive system (energetic and information technology components, controllers), automated three-phase drives (inverter, inverter control, field-oriented control, energy-optimized control, converter feedback effects), system integration of automated drives (working mechanisms, process control systems, mechatronics), design of drive components and drive systems as well as analytical and simulative methods for dynamics and digital control of electrical drives. Objectives: The students are capable of setting up modells for the simulation of the dynamic performance of controlled and regulated electrical drives from description methods in time, Laplace and Z-range. They are also able to conduct simulations as well as to design and optimize controllers.	
Modes of teaching and learning	4 SWS lecture, 1 SWS tutorial, 1 SWS lab course, and self-study	
Prerequisites	Competences acquired in modules such as ET-12 02 04 Electrical Machines and ET-12 02 05 Electric Drives	
Usability	The module is an elective module of the specialization area of Electrical Power Engineering within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessement is passed. The module assessment consists of an oral exam of 40 minutes (PL1) and a lab course (PL2).	
ECTS credit points and grades	7 ECTS credit points The module grade (M) is derived from the weighted average of the grades of the elements of assessment: M=(7PL1+3PL2)/10	
Frequency	Annually The module begins in in the summer semester.	
Workload	210 hours	
Duration	2 semesters	

Module number	**Module name**	**Lecturer in charge**
ET-12 02 15 RES-WK-44	Controlled Power Systems (*Geregelte Energiesysteme*)	Prof. Dr.-Ing. W. Hofmann
Contents and objectives	Content: 1. Controlled energy systems: modeling the control circuits of modern electrical energy systems such as wind power, hydroelectric power, steam power and photovoltaic systems and their regulation, in particular voltage, frequency and power control, as well as introduction to power flow control via power electronic actuators and 2. Power flux oriented modelling: introduction to modern performance-oriented modelling of dynamic systems. The focus is on bond graphs. In addition, the students will be indtroduced to POG and EMR as two other current modelling methods. The simulation based on the power flow using conventional software (Simulink) is explained. or 3. Electrical machine dynamics: detecting the theoretical relationship of physical operation principles in machines that determine stationary and dynamic operating behaviour; description of dynamic behaviour as prerequisites for the control treatment of automated energy and drive systems. Objectives: The students are able to understand the controllable components of energy systems in their manifold applications, to design them appropriately, to undertake interpretations and optimizations, and to apply simulative tools in a target-oriented manner. They are able to apply the principles of performance-oriented modelling to electrical and mechanical components of hybrid dynamic systems.	
Modes of teaching and learning	4 SWS lecture, 1 SWS tutorial, 1 SWS lab course, 1 project (20 hours), and self-study	
Prerequisites	Competences acquired in modules such as ET-12 02 04 Electrical Machines and ET-12 02 05 Electric Drives	
Usability	The module is an elective module of the specialization area of Electrical Power Engineering within the *Diplom* programme in Electrical Engineering as well as an elective module within the *Diplom* programme in Renewable Energy Systems.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessement is passed. The module assessment consists of an oral exam of 40 minutes (PL1) and a lab course (PL2).	
ECTS credit points and grades	7 ECTS credit points The module grade (M) is derived from the weighted average of the grades of the elements of assessment: M=(7PL1+3PL2)/10	
Frequency	annually, beginning in the summer semester	

Workload	210 hours
Duration	1 semester

Module number	Module name	Lecturer in charge
ET-12 02 16	Design of Power Electronic Systems (*Entwurf leistungselektronischer Systeme*)	Prof. Dr.-Ing. St. Bernet
Contents and objectives	The module deals with - the function of basic topologies (DC/DC converter, voltage source converter) in order to derive a mathematical model, - modelling of common power semiconductor switches, - calculation of the system variables at a stationary operating regime, - design of the passive components of power electronic systems, - design of common feed-forward and feed-back control algorithms, - verification of the function with simulation tools. Objectives: The students are capable of using basic methods to simplify a power electronic system and its components in order to derive a mathematical model. The students are capable of calculating the system variables with the mathematical model, and of designing the components and the control including observers.	
Modes of teaching and learning	4 SWS lecture, 2 SWS tutorial and self-study including a project	
Prerequisites	Competences acquired in modules such as ET-12 02 03 Power Electronics and ET-12 02 10 Power Electronics, advanced.	
Usability	The module is an elective module of the specialization area of Electrical Power Engineering within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessement is passed. The module assessment consists of an oral exam of 40 minutes and a project of 40 hours.	
ECTS credit points and grades	7 ECTS credit points The module grade is the average of the oral exam grade and the project grade.	
Frequency	annually, in the winter semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 02 17	Application of Electric Drives (*Anwendung elektrischer Antriebe*)	Prof. Dr.-Ing. W. Hofmann
Contents and objectives	Content: - Electric drives in mechatronic systems with direct drives (torque, high-speed and linear actuators) - Magnetic bearing technology (active and passive) and magnetic levitation - Electric Drives in road vehicles and trains Objectives: The students are able to select, to design and to optimize electric drives according to the requirements.	
Modes of teaching and learning	4 SWS lecture, 1 SWS tutorial, 1 SWS lab course, and self-study	
Prerequisites	Competences acquired in modules such as ET-12 02 04 Electrical Machines and ET-12 02 05 Electric Drives	
Usability	The module is an elective module of the specialization area of Electrical Power Engineering within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessement is passed. The module assessment consists of an oral exam of 40 minutes.	
ECTS credit points and grades	7 ECTS credit points The module grade is the grade the oral exam.	
Frequency	annually, in the winter semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 02 18	Seminar for Graduate Students on Electromagnetic Theory and Compatibility (*Oberseminar Theoretische Elektrotechnik und Elektromagnetische Verträglichkeit*)	Prof. Dr. rer. nat. habil. H. G. Krauthäuser
Contents and objectives	The module comprises selected topics and questions of electromagnetic field theory and electromagnetic compatibility, as well as the methodology of scientific and project-orientated work. The students have the ability to independently apply their skills and abilities in a team or individually to solve problems. The workflow will be documented and the results presented and discussed. Their knowledge, skills and abilities will be expanded through this.	
Modes of teaching and learning	2 SWS lecture and self-study	
Prerequisites	Competences acquired in modules such as ET-12 02 01 Electromagnetic Theory and ET-12 02 07 Electromagnetic Compatibility	
Usability	The module is an elective module for the specialization area of Electrical Power Engineering in the *Diplom* programme in Electrical Engineering.	
Requirements for the award of credit points	The credit points are awarded when the module assessment is passed. The module assessment consists of an assignment and an oral presentation of 30 minutes.	
ECTS credit points and grades	4 credit points The module grade is the weighted mean of grades of the assignment and the oral presentation. The grade of the assignment counts 2/3 and the grade for the presentation 1/3.	
Frequency	annually in winter semester	
Workload	120 hours	
Duration of module	1 semester	

Module number	Module name	Lecturer in charge
ET-12 02 19	Seminar for Graduate Students in Power Electronics (*Oberseminar Leistungselektronik*)	Prof. Dr.-Ing. St. Bernet
Contents and objectives	The module deals with - recent topics, trends and problems in the field of power electronics, - methods of scientific and project-based working and the presentation of the results. Objectives: The students are capable of solving a given task independently, individually, and in teams. They master the documentation of the work and the methods used, and are capable of presenting and discussing the results.	
Modes of teaching and learning	2 SWS seminar and self-study	
Prerequisites	Competences acquired in modules such as ET-12 02 03 Power Electronics and ET-12 02 10 Power Electronics, advanced.	
Usability	The module is an elective module of the specialization area of electrical power engineering within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessement is passed. The module assessment consists of an assignment and a presentation of 30 minutes.	
ECTS credit points and grades	4 ECTS credit points The module grade consists to 2/3 of the grade for the assignment and to 1/3 of the grade for the presentation.	
Frequency	annually, in the winter semester	
Workload	120 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 02 20	Seminar for Graduate Students on Machines and Drives (*Oberseminar Maschinen und Antriebe*)	PD Dr.-Ing. habil. G.-H. Geitner
Contents and objectives	Content: - Current issues and questions of control, regulation and modelling - Experimental studies of electrical machines and electrical drives Objectives: After completing this module, the students are capabale of preparing a summarizing presentation on a specific topic on the basis of their scientific research. They are capable of presenting these results and defending these in a discussion. They are further capable of presenting their results on a poster clearly and graphically.	
Modes of teaching and learning	2 SWS seminar and self-study	
Prerequisites	Competences acquired in modules such as ET-12 02 04 Electrical Machines, ET-12 02 05 Electric Drives, ET-12 02 12 Electrical Machines, Advanced and ET-12 02 13 Electrical Drive Engineering	
Usability	The module is an elective module of the specialization area of electrical power engineering within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessement is passed. The module assessment consists of an assignment and a presentation of 30 minutes.	
ECTS credit points and grades	4 ECTS credit points The module grade consists to 2/3 of the grade for the assignment and to 1/3 of the grade for the presentation.	
Frequency	annually, in the winter semester	
Workload	120 hours	
Duration	1 semester	

Module number	**Module name**	**Lecturer in charge**
ET-12 04 02 RES-H04	High Voltage and High Current Engineering (*Hochspannungs- und Hochstromtechnik*)	Prof. Dr.-Ing. S. Großmann
Contents and learning goals	The module contains basics and principles of - High voltage engineering - High current engineering Qualification: After successful completion of the module, the students will be able to comprehend the operating behaviour of components in an electrical power supply network. Furthermore the students will be able to evaluate the stress of a component by electrical and mechanical loads by means of proper measurements and tests.	
Class type	2 SWS lecture, 1 SWS tutorial/seminar, 1 SWS lab course and self-study	
Prerequisites	Competences acquired in modules such as ET-12 08 01 Fundamentals of Electrical Engineering and ET-02 06 04 01 Physics	
Type of module	The module is a compulsory module of the specialization area of Electrical Power Engineering within the *Diplom* programme in Electrical Engineering as well as a compulsory module within the *Diplom* programme in Renewable Energy Systems.	
Requirements for ECTS credit points	The credit points are earned if the module assessement is passed. The module assessment consists of a lab course and an oral exam of 30 min. If more than 20 students take part in the module, the oral exam can be replaced by a written exam of 90 min.	
ECTS credit points and grades	5 ECTS credit points The module consists to 70% of the oral exam grade/the written exam grade and to 30% of the lab course grade.	
Frequency	annually, in the winter semester	
Workload	150 hours	
Duration	1 semester	

Module number	**Module name**	**Lecturer in charge**
ET-12 04 03 RES-H02	Fundamentals of Electrical Power Systems (*Grundlagen der elektrischen Energieversorgungssysteme*)	Prof. Dr.-Ing. P. Schegner
Contents and intended learning outcome	Contents: - Function, parameter estimation and modeling of all important equipment in electrical distribution networks - Simplified methods for the calculation of voltage and current distribution as well as the basic aspects of design and dimensioning of electrical systems Intended learning outcome: Upon successful completion of the module, students are able to create and apply models for equipment in the electrical power system. They have the skills to determine the parameters for the most important equipment from geometrical data, manufacturer's specification or with the help of measurements. The students are familiar with the basics of dimensioning of electrical equipment.	
Modes of teaching and learning	3 SWS lecture, 2 SWS tutorial and self-study	
Prerequisites	Competences acquired in modules such as ET-12 08 01 Fundamentals of Electrical Engineering and ET-02 06 04 01 Physics	
Usability	The module is a compulsory module of the specialization area of Electrical Power Engineering within the Diplom programme in Electrical Engineering as well as a compulsory module within the *Diplom* programme in Renewable Energy Systems.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The module assessment consists of two written tests of 120 minutes and 90 minutes.	
ECTS credit points and grades	5 ECTS credit points The module grade consists to 2/3 of the grade for the exam of 120 min. and to 1/3 of the grade for the exam of 90 min.	
Frequency	annually, in the winter semester	
Workload	150 working hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 04 04	Operating of Electrical Power Systems (*Betrieb elektrischer Energieversorgungssysteme*)	Prof. Dr.-Ing. P. Schegner
Contents and intended learning outcome	Contents: - Calculation of symmetric and unsymmetric normal and failure processes in electrical power systems - Assessing the stress of electrical equipment Intended learning outcome: Upon successful completion of the module, students are able to assess various operating modes and fault conditions in electrical power systems and calculate with simplified methods. They are able to comprehend these processes by measurements and to assess the stability of individual equipment regarding the resulting stress.	
Modes of teaching and learning	2 SWS lecture, 1 SWS tutorial, 2 SWS lab course and self-study	
Prerequisites	Competences acquired in modules such as ET-12 04 01 Electrical Power Engineering	
Usability	The module is a compulsory module in the specialization area of Electrical Power Engineering in the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The assessment consists of one written test of 120 minutes and two lab courses.	
ECTS credit points and grades	6 ECTS credit points The grade is determined by the weighted average of the grades of the written test and the lab courses. The weights are 50% for the written exam and 25% for each lab course.	
Frequency	annually, in summer semester	
Workload	180 working hours	
Duration	1 semester	

Module number	**Module name**	**Lecturer in charge**
ET-12 04 05 RES-WK-31	Grid Integration, System Performance and Supply Quality (*Netzintegration, Systemverhalten und Versorgungsqualität*)	Prof. Dr.-Ing. P. Schegner
Contents and intended learning outcome	Contents: - all areas of quality of supply, i.e. service reliability, power quality and service quality in electrical power supply as well as - the stress from transient operation processes. Intended learning outcome: The students are able to assess the connection of consumer and generator installations regarding their effect on power quality. They know the methods to assess the service reliability of electrical energy supply and evaluate the calculation results. They are familiar with transient operation processes and their effects.	
Modes of teaching and learning	3 SWS lecture, 2 SWS tutorial, 1 SWS lab course and self-study	
Prerequisites	Competences acquired in modules such as ET-12 08 01 Fundamentals of Electrical Power Systems and ET-12 04 04 Operating of Electrical Power Systems	
Usability	The module is an elective module within the specialization area of Electrical Power Engineering for the *Diplom* programme in Electrical Engineering as well as an elective module within the *Diplom* programme in Renewable Energy Systems.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The assessment consists of two written exams of 120 minutes (PL1) and of 90 minutes (PL2) as well as of a lab course (PL3). If less than 20 students take part in the module, the written exams might be replaced by oral exams.	
ECTS credit points and grades	7 ECTS credit points The grade is determined by the weighted average of the grades of the three elements of assessment: M= 0,5*PL1+0,25*PL2+0,25*PL3	
Frequency	Annually, in summer semester	
Workload	210 working hours	
Duration	1 semester	

Module number	**Module name**	**Lecturer in charge**
ET-12 04 06 RES-WE-04	Planning of Electrical Power Systems (*Planung elektrischer Energieversorgungssysteme*)	Prof. Dr.-Ing. P. Schegner
Contents and intended learning outcome	Contents: - mathematical methods for calculating the stress of individual equipment within electrical power systems and - the principles of planning electro technical installations and distribution networks. Intended learning outcome: The students are able to calculate and assess holistically, steady and transient stress. They have mastered all important procedures and methods to dimension respectively select the equipment with regard to their voltage and current stresses and other criteria. The students know the basic standards for the planning.	
Modes of teaching and learning	4 SWS lecture, 3 SWS tutorial and self-study	
Prerequisites	Competences acquired in modules such as ET-12 08 01 Fundamentals of Electrical Power Systems and ET-12 04 04 Operating of Electrical Power Systems.	
Usability	The module is an elective module within the specialization area of Electrical Power Engineering for the *Diplom* programme in Electrical Engineering as well as an elective module within the *Diplom* programme in Renewable Energy Systems.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The assessment consists of two written exams of 120 minutes each.	
ECTS credit points and grades	7 ECTS credit points The grade is determined by the arithmetic mean of the grades of both written exams.	
Frequency	annually, in summer semester	
Workload	210 working hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 04 07 RES-WE-05	High Voltage Engineering (*Vertiefung Hochspannungs-technik*)	Prof. Dr.-Ing. S. Großmann
Contents and learning goals	The module contains selected topics from - High voltage engineering - Insulation technology - Lightning protection Qualification: After successful completion of the module, the students will be able to evaluate the function, design and rating of electrical equipment. Furthermore the students will learn simplified methods to dimension and test electrical equipment.	
Class type	5 SWS lecture, 1 SWS lab course and self-study	
Prerequisites	Competences acquired in modules such as ET-12 04 02 High Voltage and High Current Engineering	
Type of module	The module is an elective module within the specialization area of Electrical Power Engineering for the *Diplom* programme in Electrical Engineering.	
Requirements for ECTS credit points	The credit points are earned if the module assessment is passed. The assessment consists of a lab course and an oral exam of 30 minutes.	
ECTS credit points and grades	7 ECTS credit points The grade for this module consists to 70% of the grade of the oral exam and to 30% of the lab course grade.	
Frequency	annually in the summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	**Module name**	**Lecturer in charge**
ET-12 04 08 RES-WE-03	Protection and Control of Electrical Power Systems (*Schutz- und Leittechnik in elektrischen Energieversorgungssystemen*)	Prof. Dr.-Ing. P. Schegner
Contents and intended learning outcome	Contents: - the construction and operation of the protection and control systems in electrical power systems and - the essential criteria of the selective protection technology and related algorithms. Intended learning outcome: After completing this module, the students will be able to evaluate the interfaces the process and the subsystems of the secondary equipment. They can evaluate criteria for detection of errors in electrical energy supply systems with respect to their suitability and accuracy. They can understand the basic principles of numerical protection devices and can comprehend and critically evaluate the methods and algorithms of the selective protection technology. Students are able to independently design protection systems and determine the necessary parameter settings.	
Modes of teaching and learning	3 SWS lecture, 2 SWS tutorial, 1 SWS lab course and self-study	
Prerequisites	Competences acquired in modules such as ET-12 04 05 System Performance and Quality of Supply of Electrical Power Systems and ET-12 04 06 Planning of Electrical Power Systems	
Usability	The module is an elective module within the specialization area of Electrical Power Engineering for the *Diplom* programme in Electrical Engineering as well as an elective module within the *Diplom* programme in Renewable Energy Systems.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The assessment consists of two written exams (of 120 minutes and of 90 minutes) and of a lab course.	
ECTS credit points and grades	7 ECTS credit points The grade is determined by the weighted average of the grades of the three elements of assessment. The weights are 4/9 for the 120 minutes exam, 2/9 for the 90 minutes exam and 3/9 for the lab course.	
Frequency	annually, in winter semester	
Workload	210 working hours	
Duration	1 semester	

Module number	**Module name**	**Lecturer in charge**
ET-12 04 09 RES-WE-06	Stress of Electrical Equipment (*Beanspruchung elektrischer Betriebsmittel*)	Prof. Dr.-Ing. S. Großmann
Contents and learning goals	The module contains - Basics of the design and operational mode of electrical equipment with high current load in electrical power engineering Qualification: By completing the module successfully, the students will be able to rate, evaluate and test components of systems with high current load. They will be enabled to do scientific research on the subject.	
Class type	3 SWS lecture, 1 SWS project, 2 SWS lab course and self-study	
Prerequisites	Competences equivalent to those which can be gained in the modules ET-12 04 02 High voltage and high current engineering and ET-12 04 07 High voltage engineering	
Usability	The module is an elective module within the specialization area of Electrical Power Engineering for the *Diplom* programme in Electrical Engineering as well as an elective module within the *Diplom* programme in Renewable Energy Systems.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The assessment consists of an oral individual exam of 30 minutes (PL1), one project (PL2), and a lab course (PL3).	
ECTS credit points and grades	7 ECTS credit points The grade for this module (M) is determined by the weighted average of the 3 assessments: M=(2PL1+PL2+PL3)/4	
Frequency	Annually, in the winter semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 04 10	Experimental High Voltage Engineering (*Experimentelle Hochspannungs-technik*)	Prof. Dr.-Ing. S. Großmann
Contents and learning goals	The module contains - High voltage test technique - Measurement technique - Scientific methods for planning experiments and their statistical evaluation. Qualification: After successful completion of the module, the students will be able to plan and perform scientific experiments as well as to evaluate them statistically. The students will gain HV-related and methodical knowledge for scientific research on the subject.	
Class type	4 SWS lecture, 2 SWS lab course and self-study	
Prerequisites	Competences equivalent to those which can be gained in the modules ET-12 04 02 High voltage and high current engineering and ET-12 04 07 High voltage engineering	
Usability	The module is an elective module within the specialization area of Electrical Power Engineering for the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The assessment consists of a lab course and an individual oral exam of 30 minutes.	
ECTS credit points and grades	7 credit points The grade for this module is determined by the weighted average of the lab course and the oral exam. The oral exam is weighted as 70% of the module grade and the lab course as 30%.	
Frequency	annually in the winter semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 04 11	Seminar for Graduate Students Electrical Power Engineering (*Oberseminar Elektrische Energieversorgung*)	Prof. Dr.-Ing. P. Schegner
Contents and objectives	Contents: - special issues and questions of the electrical energy supply, high voltage and high current engineering and - methods of scientific and project-based working. Intended learning outcome: The students are able to apply skills independently, individually and in teams to solve a task. They will document the steps, present and discuss the results. This will help them expand knowledge and skills.	
Modes of teaching and learning	2 SWS seminar and self-study	
Prerequisites	Competences that are provided by modules such as ET-12 04 01 Electrical Power Engineering, ET-12 04 03 Fundamentals of Electrical Power Systems, ET-12 04 04 Operating of Electrical Power Systems and ET-12 04 06 Planning of Electrical Power Systems	
Usability	The module is an elective module within the specialization area of Electrical Power Engineering for the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The assessment consists of an assignement and the correspond-ing presentation of 30 minutes.	
ECTS credit points and grades	4 ECTS credit points The module grade consists to 2/3 of the grade of the as-signement and to 1/3 of the grade of the presentation.	
Frequency	annually in winter semester	
Workload	120 working hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 05 02	Advanced Seminar „Electronic Systems and Technology“ *(Hauptseminar Geräte- und Mikro-technik)*	Prof. Dr.-Ing. habil. J. Lienig
Contents and objectives	This module covers the steps of an engineering process based on annually announced assignments by participating institutes. - Passing early engineering phases of a product, a technology or a fabrication process - Detailed specification of assignment task - Team assignments - Documentation of engineering process - Research of current-state applications - Individual research of theoretical fundamentals for solution finding - Creation of conceptual solution variants including their documentation - Presentation of the solution concept Intended learning outcomes: Students completing this module are qualified to apply techniques, methods and principles for early engineering phases of a product, a technology or a fabrication process. This is accomplished by project- and team-oriented solving of complex tasks in recent research.	
Modes of teaching and learning	2 SWS project and self-study	
Prerequisites	Some specific expertise is required, which can for example be aquired by completing the modules ET-12 08 01 Fundamentals of Electrical Engineering, ET-02 06 04 01 Physics, ET-12 01 01 Microcomputer Technology, ET-12 05 01 ElectronicSystems Design and ET-12 06 10 Project Electronics Technolgy	
Usability	This module is a compulsory module for the specialization area of Electronic Systems and Technolgy within the *Diplom* programme in Electrical Engineering. It provides the knowledge necessary for passing module examinations of the elective studies.	
Requirements for the award of ECTS credit points	The credit points are obtained by passing the module assessment. This assessment comprises a project of 40 hours of work.	
ECTS credit points and grades	4 ECTS credit points The module grade is determined by the weighted average of the grades for the project documentation (contributes by 2/3) and the seminar talk (contributes by 1/3).	
Frequency	Annually, during winter semester	
Workload	120 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 05 03	System Design *(Gerätetechnik)*	Prof. Dr.-Ing. habil. J. Lienig
Contents and objectives	This module covers **1 Design process and concepts** *(Entwicklungsprozess ausgehend vom Lösungskonzept)* - Design analysis and optimization with proof of functional correctness - Design reports and documentation - Presentation of design solution **2 Introduction on Sensors** *(Einführung in die Sensorik)* - Sensor and measuring technology - Sensors for thermal, mechanical, magnetical and optical applications **3 Optical Systems** *(Technische Optik)* - Wave optics and geometrical optic - Materials and elements - Fibre-optic guides, electro-optical and electro-micro-optical-mechanical elements and systems - Light engineering, digital and analog light processing, adaptive optics, optical devices Intended learning outcomes: Students completing this module are qualified to apply techniques and methods of system engineering in a creative manner, in particular for sensor and optical devices.	
Modes of teaching and learning	3 SWS lectures, 2 SWS tutorial, 2 SWS lab course, and self-study	
Prerequisites	Some specific expertise is required, which can for example be aquired by completing the module ET-12 05 02 Advanced Seminar Electronic Systems and Technology.	
Usability	This module is a compulsory module for the specialization area of Electronic Systems and Technolgy within the *Diplom* programme in Electrical Engineering. It provides the knowledge necessary for passing module examinations of the elective studies.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. This assessment consists of a written exam (180 minutes) covering the subjects of sensors and optics, and a project (40 hours of work) on design process and concepts. Both examinations must be passed.	
ECTS credit points and grades	8 ECTS credit points The module grade is determined by the weighted average of both elements of the module assessment, for which the written exam contributes by 2/3 and the project by 1/3.	
Frequency	annually, during summer semester	
Workload	240 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 05 04	Design Methodologies *(Konstruktion)*	PD Dr.-Ing. T. Nagel
Contents and objectives	This module covers **1 Fundamentals of Design** *(Grundlagen der Konstruktion)* - Basics of system engineering - Standards for measures, tolerances, fittings, material load capacities - Mechanical connecting components - Mechanical functional components - Mechanical devices **2 Computer-Aided Design** *(CAD-Konstruktion)* – Method of constructing CAD models – Modelling assembly constraints – Parametric and adaptive construction – Construction of variants – Deformation and load simulation Intended learning outcomes: Students completing this module are qualified to design components and devices, dimension components and assemble them properly. They are capable to provide documentation of the design process conforming to standards while using modern CAD tools.	
Modes of teaching and learning	2 SWS lectures, 4 SWS tutorial, and self-study	
Prerequisites	Comptences acquired in modules such as ET-12 04 01 Electronic Systems Design	
Usability	This module is a compulsory module for the specialization area of Electronic Systems and Technolgy within the *Diplom* programme in Electrical Engineering. It provides the knowledge necessary for passing module examinations of the elective studies.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. This assessment comprises a written examination (120 minutes) on fundamentals of design and the tutorial assignments. Both elements of assessment must be passed.	
ECTS credit points and grades	6 ECTS credit points The module grade is determined by the arithmetic mean of both elements of assessment, i.e. the written examination and the tutorial assignments.	
Frequency	Annually, starts in winter semesters	
Workload	180 hours	
Duration	2 semesters	

Module number	**Module name**	**Lecturer in charge**
ET-12 05 05	Physical Design and Physical Design Automation *(Rechnergestützter Entwurf)*	Prof. Dr.-Ing. habil. J. Lienig
Contents and objectives	This module covers - Terms and concepts of physical design and physical design automation - Related design phases - The library concept - Layout interfaces - Goals and constraints for physical design - Commercial physical design tools Intended learning outcomes: Students completing this module are qualified in the methodology of physical design and physical design automation. They are furthermore capable of handling a layout process using commercial design tools.	
Modes of teaching and learning	2 SWS lectures, 1 SWS lab course, and self-study	
Prerequisites	Some specific expertise is required, which can for example be aquired by completing the modules ET-12 05 01 Electronic Systems Design and ET-12 05 02 Advanced Seminar „Electronic Systems and Technology“	
Usability	This module is a compulsory module for the specialization area of Electronic Systems and Technolgy within the *Diplom* programme in Electrical Engineering. It provides the knowledge necessary for passing module examinations of the elective studies.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. This assessment comprises a team assignment and an oral examination (of 30 minutes for each team member); both elements of assessment must be passed.	
ECTS credit points and grades	4 ECTS credit points The module grade is determined by the weighted average of both elements of assessment, for which the assignment contributes by 40% and the oral examination by 60%.	
Frequency	annually, during summer semester	
Workload	120 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 05 06	Product and Precision Device Engineering (*Entwicklung feinwerktechnischer Produkte*)	PD Dr.-Ing. T. Nagel
Contents and objectives	This module covers **1 Fundamentals of Product Engineering** *(Grundlagen der Produktentwicklung)* - Systematic solving of production tasks - Methods of product engineering - Structural engineering process - Creativity techniques for finding solutions - Fault avoidance during product development - Scope of duties for product engineers **2 Design of Precision Devices** *(Baugruppenentwicklung)* - Planning, construction and fabrication of a precision-mechancis drive mechanism - Finding of solution variants - Dimension and devise of an optimal solution - Creation of the set of drawings - Fabrication of parts and assembly of the device group - Initiation of the device group and verification of functionality Intended learning outcomes: Students completing this module are qualified to design innovative solutions of precision devices. They are capable of applying the concepts of product engineering and provide sets of drawings.	
Modes of teaching and learning	2 SWS lectures, 4 SWS lab course, and self-study	
Prerequisites	Some specific expertise is required, which can for example be aquired by completing the modules ET-12 05 01 Electronic Systems Design and ET-12 05 04Design Methodologies.	
Usability	This module is an elective module for the specialization area of Electronic Systems and Technolgy within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are obtained by passing the module assessment. This assessment consists of a written examination (of 90 minutes) and an assigment. In case of up to 5 examinees, the written exam can be replaced by an oral individual exam of 30 min. Both elements of assessment must be passed.	
ECTS credit points and grades	7 ECTS credit points The module grade is determined by the arithmetic mean of both elements of assessment, i.e. the examination and the assignment.	
Frequency	annually, during summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 05 07	Simulation Methodologies in System Design *(Simulation in der Gerätetechnik)*	Prof. Dr.-Ing. habil. J. Lienig
Contents and objectives	Content: Finite Element Method (FEM): 1. Fundamentals of modelling for the different physical domains of device technology using the example of structural mechanics, heat and electromagnetic fields, 2. generalized process steps for the creation of theoretically sound FEM models Thermal design: 1. Fundamentals of heat transport, 2. Thermal calculations and models Optimization: - Method of model creation and simulation, considering the holistic system-simulation approach for system design - Model experiments for the construction process (analysis, nominal value optimization, probabilistic optimization, multi-criteria optimization) Objectives: Students completing this module will obtain qualified fundamentals for systematic application of FEM tools. They understand the key concept of holistic system simulation for the design process. They are capable of finding robust and cost-effective solutions in system-design processes by applying system simulations while accounting for ubiquitous parameter variations and functional behaviour.	
Modes of teaching and learning	2 SWS lectures, 4 SWS tutorial, and self-study	
Prerequisites	Competences that can be acquired by completing the module MT-12 05 01 Electronic Systems Design.	
Usability	This module is an elective module for the specialization area of Electronic Systems and Technolgy within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are obtained by passing the module assessment. This assessment consists of individual tutorial assignments.	
ECTS credit points and grades	7 ECTS credit point The module grade is determined by the grade obtained for the tutorial assignments.	
Frequency	annually, during summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 05 08	Electromechanical Design (*Gerätekonstruktion*)	PD Dr.-Ing. T. Nagel
Contents and objectives	Content: **1. Methodologies for Electromechanical Design** (Präzisionsgeräte-technik) with focus on: - Method of development - Construction guidelines and principles derived from technology and nature - Constructive guidelines for system design - Fundamentals for precision gears - Accuracy parameters for drive systems - Examples on development of precise-mechanics devices **2. Actuators** (*Aktorik*) with focus on: - Composition of drive systems - Properties of different small-drive systems and actuators - Servomotors for system design - Innovative actuators Objectives: Students completing this module will obtain qualified knowledge to develop and design modern precise-mechanics devices under consideration of general construction guidelines, design guidelines and failure-detection principles. They are furthermore familiar with relevant principles of actuators and their constructive mechanic. In combination with the knowledge of specific actuator properties, the students can chose actuators appropriately for different applications and requirements.	
Modes of teaching and learning	4 SWS lectures, 2 SWS tutorial, and self-study	
Prerequisites	Some specific expertise is required, which can for example be aquired by completing the module ET-12 05 01 Electronic Systems Design	
Usability	This module is an elective module for the specialization area of Electronic Systems and Technolgy within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are obtained by passing the module assess-ment. This assessment comprises a written exam of 180 minutes (PL1) and tutorial assignments (PL2). Both elements of assessment must be passed.	
ECTS credit points and grades	7 ECTS credit points The module grade M is calculated as follows: M = (2PL1 + PL2)/3	
Frequency	annually, during the winter semester	
Workload	210 hours	
Duration	1 semester	

Module number	**Module name**	**Lecturer in charge**
ET-12 05 09	Electronic Design Automation *(Entwurfsautomatisierung)*	Prof. Dr.-Ing. habil. J. Lienig
Contents and objectives	This module covers - Relevance of electronic design automation (EDA) - Design styles, design steps, layout design, geometrical fundamentals, etc. - Floorplanning - Partitioning and placement algorithms - Routing algorithms - Methods for compaction and verification - Trends in EDA Intended learning outcomes: Students completing this module have obtained knowledge of algorithms which are used in modern design tools for physical design automation (going from netlist to the final layout). They are thus capable of writing design modules on their own or adapting commercial design tools for specific tasks.	
Modes of teaching and learning	2 SWS lectures, 2 SWS tutorial, 2 SWS seminar, and self-study	
Prerequisites	Some specific expertise is required, which can for example be aquired by completing the module ET-12 05 05 Physical Design and Physical Design Automation.	
Usability	This module is an elective module for the specialization areas of Electronic Systems and Technolgy as well as Microelectronics within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are obtained by passing the module assessment. This assessment comprises an oral examination of 30 minutes and tutorial assignments. Both elements of assessment must be passed.	
ECTS credit points and grades	7 ECTS credit points The module grade is determined by the weighted average of both elements of assessment, for which the tutorial assignments contribute by 40% and the oral examination by 60%.	
Frequency	annually, during winter semester	
Workload	210 hours	
Duration	1 semester	

Module number	**Module name**	**Lecturer in charge**

ET-12 05 10	Seminar for Graduate Students „System design“ (*Oberseminar Gerätetechnik*)	Prof. Dr.-Ing. habil. J. Lienig
Contents and objectives	This module covers - specific topics and trends in system design and - methods of scientific and project-based engineering Intended learning outcomes: Students completing this module are qualified to apply skills and techniques self-employed and in teams to complete specific tasks. They can create the documentation of process steps and can present and discuss the results.	
Modes of teaching and learning	2 SWS seminar and self-study	
Prerequisites	Some specific expertise is required, which can for example be aquired by completing the modules ET-12 05 04 Design Methodologies, ET-12 05 03 System Design, and ET-12 05 05 Physical Design and Physical Design Automation.	
Usability	This module is an elective module for the specialization area of Electronic Systems and Technolgy within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are obtained by passing the module assessment. This assessment consists of an assignment and a related presentation of 30 minutes, which is graded as a separate examination.	
ECTS credit points and grades	4 ECTS credit points The module grade is determined by the weighted average of both elements of module assessment, for which the assignment contributes by 2/3 and the presentation by 1/3.	
Frequency	Annually, during winter semester	
Workload	120 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 05 11	FEM – Probabilistic Simulation and Design Optimization (*FEM – Probabilistische Simulation und Optimierung*)	Prof. Dr.-Ing. habil. J. Lienig
Contents and objectives	This module covers **1 Finite Element Method (FEM)** *(Finite Elemente Methode)* - Fundamental theory of FEM for application in varying physical domains - Basic process steps for the creation of theoretical substantiated FEM models - Parametrization of FEM models based on script languages **2 Probabilist Simulation of Systems** *(Probabilistische Systemsimulation mit FEM)* - Method of model creation and probabilistic simulation, considering a holistic system-simulation approach - Model experiments for the construction process (analysis of variants, probabilistic simulation, probabilistic optimization) - Solution finding as robust multi-objective optimization - Trends for system simulations Intended learning outcomes: Students completing this module will obtain qualified fundamentals for systematic application of FEM tools. They understand the key concept of holistic system simulation for the design process and have the required skills and knowledge to find robust solutions by applying system simulations while accounting for ubiquitous parameter variations and functional behaviour.	
Modes of teaching and learning	2 SWS lectures, 4 SWS tutorial, and self-study	
Prerequisites	Some specific expertise is required, which can for example be aquired by completing the module ET-12 05 01 Electronic Systems Design.	
Usability	This module is an elective module for the specialization area of Microelectronics within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are obtained by passing the module assessment. This assessment consists of individual tutorial assignments.	
ECTS credit points and grades	7 ECTS credit points The module grade is determined by the grade obtained for the tutorial assignments.	
Frequency	Annually, during summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 06 01	Technologies for Electronic Packaging and Assembly (*Technologien der Elektronik*)	Prof. Dr.-Ing. habil. Dr. h.c. Karlheinz Bock
Contents and objectives	This module covers **1 Electronic Packaging (*Aufbau- und Verbindungstechnik der Elektronik*)** - trends in electronic packaging - packaging of semiconductor devices - assembly technologies for semiconductor devices - thin-film technologies for electronic circuits - thick-film technologies for electronic circuits - printed circuit board technologies - surface finish technologies for electronic components - packaging for optoelectronics **2 Assembly Technologies (*Montagetechnologien der Elektronik*)** - packaging of electronic components - package types for SMD and THT - fine-pitch-assembly - theory on assembly precision - special technologies for component assembly - technologies for system integration Intended learning outcomes: Students completing this module gain knowledge as well as practical experience for the assembly of electronic components and the manufacturing process of printed circuit boards. The students are qualified to apply the fundamentals on joining technologies like bonding, soldering and adhesive bonding as well as structuring technologies for circuit boards including packaging and assembly of electronic components. They are familiar with the technological steps and the necessary equipment.	
Modes of teaching and learning	4 SWS lectures, 2 SWS lab course, and self-study	
Prerequisites	Competences acquired in modules such as ET-12 06 10 Project Electronics Technology and ET-12 05 01 Electronic Systems Design.	
Usability	This module is a compulsory module for students specializing in the field of Electronic Systems and Technolgy within the *Diplom* degree programme in Electrical Engineering. This lecture is required for passing the module assessments of the elective modules.	

Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The assessment consists of two written exams (90 min. each) and a lab course. All elements of assessment must be passed.
ECTS credit points and grades	6 ECTS credit points The grade of the module is the arithmetic mean of all elements of assessment.
Frequency	annually, starting in the winter semester
Workload	180 hours
Duration	2 semesters

Module number	Module name	Lecturer in charge
ET-12 06 02	Electronic Packaging (*Aufbau- und Verbindungstechnik der Elektronik*)	Prof. Dr.-Ing. habil. Dr. h.c. Karlheinz Bock
Contents and objectives	This module covers Electronic Packaging: - trends in electronic packaging - packaging of semiconductor devices - assembly technologies for semiconductor devices - thin-film technologies for electronic circuits - thick-film technologies for electronic circuits - printed circuit board technologies - surface finish technologies for electronic components - packaging for optoelectronics Intended learning outcomes: Students completing this module gain knowledge as well as practical experience for the assembly of electronic components and the manufacturing process of printed circuit boards. The students are qualified to apply the fundamentals on joining technologies like bonding, soldering and adhesive bonding as well as structuring technologies for circuit boards including packaging and assembly of electronic components. They are familiar with the technological steps and the necessary equipment.	
Modes of teaching and learning	2 SWS lecture, 2 SWS lab course, and self-study	
Prerequisites	Competences acquired in modules such as ET-12 06 10 Project Electronics Technology and ET-12 05 01 Electronic Systems Design.	
Usability	This module is a compulsory module for students specializing in the field of Microelectronics within the *Diplom* programme in Electrical Engineering. This module is required for passing the assessments of the elective modules.	
Requirements for the award of ECTS credit points	The credit points are acquired if the module assessment is passed. The module assessment consists of a written exam (of 90 min) and a lab course; both have to be passed.	
ECTS credit points and grades	4 ECTS credit points The module grade is determined by the weighted average of both elements of module assessment, for which the written exam contributes by 2/3 and the lab course by 1/3.	
Frequency	annually, starting in the winter semester	
Workload	120 hours	

Duration	2 semesters

Module number	**Module name**	**Lecturer in charge**
ET-12 06 03	Quality Assurance (*Qualitätssicherung*)	Dr.-Ing. habil. H. Wohlrabe
Contents and objectives	The modulus includes methods for the application of quality assurance especially in electronics production - Description of quality characteristics and their distribution and parameters - Quality standards - Statistical tests of quality data - Construction and usage of quality control charts - Machine and process capability analysis - Analysis of reliability data - Regression analysis	
Modes of teaching and learning	2 SWS lecture, 1 SWS exercises and self-study	
Prerequisites	Skills in mathematics, particularly in linear algebra, analysis, ordinary differential equations, theory of probability and mathematical statistics, are necessary.	
Usability	The module is a compulsory module in the specialization area of Electronic Systems and Technolgy within the *Diplom* programme in Electrical Engineering	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The module assessment consists of a written exam of 180 minutes.	
ECTS credit points and grades	4 ECTS credit points The module grade is the grade for the written exam.	
Frequency	Annually, in the summer semester	
Workload	120 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 06 05	Board Level Reliability of Electronic products (*Funktionsmaterialien der Aufbau- und Verbindungs-technik der Elektronik*)	Prof. Dr.-Ing. habil. H.-J. Albrecht
Contents and objectives	**1. Package constructions, materials, modules, assembly demands** Students that design and learn to specify electronic products as a way to meet their performance and reliability objectives despite pressure to deliver quickly technology solutions. The collected product design faces new challenges in: the need for further miniaturization; the use of higher speed signals; the introduction of new materials and device technologies; the information in globalization of the supply chain; and the exposure to harsher lifecycle environments associated with the penetration of electronics into a growing range of applications, many of which demand portability and in the future power electronics. The lectures are available to ensure that a product will meet its reliability goals, and to achieve this efficiently and economically aspects. **2. Materials and reliability** Design for reliability, demands on materials, interconnect materials /glues, solders, substrates, packages; Assembly parameters, design for manufacturing, design for reliability, stress consumption, stress free assemblies, goals for lifetime require-ments. At the end the students will have a lab tour at Siemens AG Berlin in the Energy Sector.	
Modes of teaching and learning	4 SWS lecture, 2 SWS lab course and self-study	
Prerequisites	Competences in terms of materials and basics in electronic assemblies as well as knowledge of industrial requirements for save processes and products, life cycle requirements	
Usability	The module is an elective module in the specialization area of Electronic Systems and Technolgy within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are aquired if the module exam is passed. The module exam consists of a written exam of 120 minutes.	
ECTS credit points and grades	7 ECTS credit points The grade is the grade for the written exam.	
Frequency	annually in the summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 06 06	Computer-Aided Electronics Manufacturing (*Rechnergestützte Elektronik-fertigung*)	PD Dr.-Ing. G. Weigert
Contents and objectives	This module includes two parts (2 SWS lecture and 1 SWS tutorial each) **1. Production control and planning (*Fertigungsplanung und -steuerung*)** **2. Statistical methods (*Statistische Verfahren*)** The module gives a scientific introduction to the methods of analysis and optimization of production processes, particularly in electronic industry. Mathematical methods are applied for optimal design of manufacturing processes as well as product quality assurance. The most important areas are: - Models for description of manufacturing systems and of quality characteristics of products - Performance evaluation and scheduling of manufacturing and test processes - Fundamentals of Discrete Event Simulation (DES) - Application of various statistical analysis and optimization methods; e.g. Design of Experiments (DoE)	
Modes of teaching and learning	4 SWS lecture, 2 SWS tutorial and self-study	
Prerequisites	Skills in mathematics are recommended, particularly in linear algebra, analysis, ordinary differential equations, theory of probability and mathematical statistics.	
Usability	The module is an elective module in the specialization area of Electronic Systems and Technolgy within the *Diplom* programme in Electrical Engineering	
Requirements for the award of ECTS credit points	The credit points are aquired if the module assessment is passed. The module assessment consists of a written exam of 180 minutes.	
ECTS credit points and grades	7 ECTS credit points The module grade is the grade for the written exam.	
Frequency	Annually in the summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 06 07	Hybrid Integration (*Hybridintegration*)	Prof. Dr.-Ing. habil. Dr. h.c. Karlheinz Bock
Contents and objectives	This module includes two parts **1. Hybrid technique** (*Hybridtechnik*, 2 SWS lecture and 2 SWS lab course) - Technologies for the Hybrid technique, - thin film- and thick film technologies, - substrates and pastes, - thermal processes, - single layer and multilayer techniques, - design rules, hybridisation, components, housing - printing, sintering, laser application and trimming - packaging techniques, - functional test, and **2. Micro und nano integration** (*Mikro- und Nano-Integration*, 2 SWS lecture) - Micro and nano integration of electronic components, - nano scaling und nano materials, - processes and tools for the nano structuring, - photonic und nano systems, 3D integration The module provides skills in the fields of thin film and thick film technologies, hybrid integration and packaging of such components. The knowledge of micro and nano integration qualifies the students for the solving of innovative tasks in the electronic packaging technology. The students become able to estimate and choose such technologies.	
Modes of teaching and learning	4 SWS lecture, 2 SWS lab courses and self-study	
Prerequisites	Competences in the field of electronic packaging technologies as acquired in the module ET-12 06 01 Technologies for Electronic Packaging and Assembly	
Usability	The module is an elective module of the specialization area of Electronic Systems and Technolgy of the *Diplom* programme in Electrical Engineering	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The module assessment consists of a written exam of 150 minutes and a lab course; both have to be passed.	
ECTS credit points and grades	7 ECTS credit points The module grade is the weighted average for the written exam (2/3) and the lab course (1/3).	

Frequency	annually, in the winter semester
Workload	210 hours
Duration	1 semester

Module number	Module name	Lecturer in charge
ET-12 06 08	Nondestructive Testing *(Zerstörungsfreie Prüfung)*	Prof. Dr.-Ing. habil. Dr. h.c. Karlheinz Bock
Contents and objectives	This module covers **1 Non-destructive testing of electronic devices (*Zerstörungsfreie Prüfung elektronischer Baugruppen*)** including: • imaging techniques • storage of digital images • image pre-processing, image segmentation • attribute extraction, data classification and **2 Micro and ano non-destructive testing methods (*Zerstörungsfreie Prüfung elektronischer Baugruppen*)** including: • acoustic methods • imaging scanning probe methods • X-ray techniques • magnetic techniques • thermography and thermal wave microscopy. Intended learning outcomes: Students completing this module acquire knowledge and competences about function, design and use of non-destructive testing methods, particularly to characterise electronic components and devices.	
Modes of teaching and learning	4 SWS lectures, 2 SWS lab course and self-study	
Prerequisites	Some specific expertise is required, which can for example be aquired by completing the modules ET-12 0806 Measurement and Sensor Techniques and ET-12 06 01 Technologies for Electronic Packaging and Assembly.	
Usability	The module is an elective module of the specialization area of Electronic Systems and Technology of the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are aquired if the module assessment is passed. The assessment consists of a written exam of 180 minutes and of a lab course. Both elements of assessment have to be passed.	

ECTS credit points and grades	7 ECTS credit points The module grade is determined by the weighted average of both elements of module assessment, for which the written exam contributes by 2/3 and the lab course by 1/3.
Frequency	Annually in the winter semester
Workload	210 hours
Duration	1 semester

Module number	Module name	Lecturer in charge
ET-12 06 09	Seminar for Graduate Students in Electronic Packaging (*Oberseminar Aufbau- und Verbindungstechnik*)	Prof. Dr.-Ing. habil. Dr. h.c. Karlheinz Bock
Contents and objectives	This module covers - trends and special issues in electronic packaging - methodology for scientific and project based engineering Intended learning outcomes: Students completing this module gain the skill and capability to solve specific problems autonomously, alone or in a team. They master the documentation of the workflow and have the ability to present and discuss their results.	
Modes of teaching and learning	2 SWS seminar, and self-study	
Prerequisites	Competences acquired in modules such as ET-12 06 10 Project Electronics Technology, ET-12 06 01 Technologies for Electronic Packaging and Assembly, and ET-12 06 07 Hybrid integration is recommended.	
Usability	The module is an elective module of the specialization area of Electronic Systems and Technology within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are acquired if the module assessment is passed. The module assessment consists of an oral presentation of 30 min.	
ECTS credit points and grades	4 ECTS credit points The grade of the module is the grade of the oral presentation.	
Frequency	Annually, during the winter semester	
Workload	120 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 06 10	Project Electronics Technology (*Projekt Elektronik-Technologie*)	Prof. Dr.-Ing. habil. T. Zerna
Contents and objectives	The content of the module is - computer aided design of printed circuit boards - manufacturing of printed circuit boards - parameter optimization for technological processes - technologies of assembling electronic modules - testing and initial operation of electronic modules - simulation of the quality behaviour of manufacturing processes - Qualification purposes The students acquire basic knowledge, competences and practical skills about designing substrates, about assembling and testing electronic modules as well as about parallel processes of quality management. In addition they will gain social, rhetorical and presentation competences as a result of the team oriented and self-organized lab work based on the division of labour.	
Modes of teaching and learning	4 SWS lab course and self-study	
Prerequisites	Competences acquired in modules such as ET-12 08 01 Fundamentals of Electrical Engineering, ET-13 00 01 Materials and Technical Mechanics and ET-02 06 04 01 Physics.	
Usability	The module is a compulsory module within the basic studies of the *Diplom* programme in Electrical Engineering. It provides the prerequisites for passing the module assessments of the specialization areas.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The module assessment consists of an assignment and its presentation (90 min.) by the team.	
ECTS credit points and grades	3 ECTS credit points The grade is the arithmetic mean of the assignments and its presentation.	
Frequency	Annually in winter semester	
Workload	90 working hours	
Duration	1 semester	

Module number	**Module name**	**Lecturer in charge**
ET-12 07 01	Biomedical Engineering (*Biomedizinische Technik*)	Prof. Dr.-Ing. habil. H. Malberg
Contents and objectives	The module contains the basics of biomedical engineering for diagnosis and therapy, particularly - the relevant physical, physiological and biochemical phenomena - the basic principles and the design of biomedical devices, - the diagnostic biosignal recording and processing - the automatic processing of diagnostic signals and information, - the therapeutic basic principles in clinical applications - the principles of organ assist systems, - biomaterials and biocompatibility, and - bionics Outcome: The students gain general knowledge about biomedical engineering and the complex interactions between the organism and engineering. They acquire the necessary qualifications to design devices for measuring physiological quantities. Furthermore, they are able to project automatic devices for diagnostic and organ assist systems and know the most import and therapeutic procedures in clinical practice. They can transfer biological/physiological basics to technical components and work flows.	
Modes of teaching and learning	3 SWS lecture, 2 SWS seminar, and self-study	
Prerequisites	Competences acquired in modules such as ET-12 08 01 Fundamentals of Electrical Engineering and ET-12 05 01 Electronic Systems Design	
Usability	This module is a compulsory module for the specialization area of Electronic Systems and Technolgy within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The assessment consists of a written exam of 120 minutes.	
ECTS credit points and grades	6 ECTS credit points The module grade is the grade of the written exam.	
Frequency	annually, starting in the winter semester	
Workload	180 hours	
Duration	2 semesters	

Module number	Module name	Lecturer in charge
ET-12 07 02	Medical and physiological principles (*Medizinisch-physiologische Grundlagen*)	Prof. Dr.-Ing. habil. H. Malberg
Contents and objectives	The module contains the **1. Basics in Medicine and Physiology (*Grundlagen der Physiologie und Medizin*)** - the structure and function of cells, organs and organ systems, - the electro- and neurophysiologic basics, - the cardiovascular system, - the auto regulation and regulatory circuits of the organism, - the main pathophysiological phenomena, and - the clinical workflow **2. Measuring of Physiological *Signals* (*Messung physiologischer Signale*)** - detection of electrical and nonelectrical physiological values, - medical sensoring, and - artifacts and noise processing **3. Biomedical Engineering in Clinical Practice (*Biomedizinische Technik in Kliniken*)** - Application of biomedical devices in clinics of the medical faculty "Carl Gustav Carus" at the TU Dresden - special technical effects in the clinical environment **4. Medical Terminology *(Medizinische Terminologie)*** - basics of the interdisciplinary medical language in anatomy, physiology and biomedical engineering Intended learning outcomes: The students know the technical relevant processes of life, the basic physiological processes and pathomechanisms, and the main principles in diagnosis and therapy by biomedical engineering. Moreover, they know the features of the interface between organism and engineering. They know medical and biomedical terminology and are qualified for the interdisciplinary cooperation between physicians and engineers.	
Modes of teaching and learning	4 SWS lecture, 1 SWS tutorial, 1 SWS lab course, and self-study	
Prerequisites	Competences acquired in modules such as ET-02 06 04 01 Physics and ET-12 07 01 Biomedical Engineering.	
Usability	The module is an elective module of the specialization area of Electronic Systems and Technology within the *Diplom* programme in Electrical Engineering.	

Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The module assessment consists of an individual oral exam of 20 minutes.
ECTS credit points and grades	7 ECTS credit points The module grade is the grade of the oral exam.
Frequency	annually, during summer semester
Workload	210 hours
Duration	1 semester

Module number	Module name	Lecturer in charge
ET-12 07 03	Biomedical Devices (*Biomedizinisch-technische Systeme*)	Prof. Dr.-Ing. habil. H. Malberg
Contents and objectives	The module contains **1. Diagnostical and Therapeutical Systems** *(Diagnostische und therapeutische Systeme)* the design and function of devices in the cardiovascular medicine, for sensory organs, the musculoskeletal system, the genitor-urinary system, the digestion and the centrals and peripheral nervous system. **2. Biosignal Processing (***Biosignalverarbeitung)* the basics of automatic processing of physiological signals, the conception of sensors and electrodes, the artifact preprocessing and special structures auf novel data processing including diagnosis and decision support. Intended learning outcomes: The students gain knowledge to assess diagnostical and therapeutical procedures and work flows in the clinical environment. They are able to solve given diagnostic and therapeutic problems by biomedical engineering. Furthermore they are able to design and to program biosignal processing algorithms.	
Modes of teaching and learning	3 SWS lecture, 2 SWS seminar, 1 SWS lab course, and self-study	
Prerequisites	Some specific expertise is required, which can for example be aquired by completing the modules ET-02 06 04 01 Physics and ET-12 07 01 Biomedical Engineering.	
Usability	The module is an elective module of the specialization area of Electronic Systems and Technology within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The module assessment consists of a written exam of 90 minutes, and a lab course; both have to be passed.	
ECTS credit points and grades	7 ECTS credit points The module grade is generated by the weighted average of both elements of assessment, for which the written exam contributes by ¾, and the lab course by ¼.	
Frequency	annually, in the winter semester	
Workload	210 hours	
Duration	1 semester	

Module number	**Module name**	**Lecturer in charge**
ET-12 07 04	Co-operative Systems in Biomedical Engineering *(Kooperative Systeme in der BMT)*	PD Dr.-Ing. U. Morgenstern
Contents and objectives	This module covers *1. Modelling and Simulation in Biomedical Engineering (Modelle in der Biomedizinischen Technik)* - the model as a description of biological and technical system part interactions - stage work levels of modelling - application of simulation systems as a biomedical engineering tool: goal, kind, range, and profoundness of modelling, specific BME user chraracteristics for simulation systems (e.g. MATLAB / SIMULINK),discussed by means of examples - signal models of cerebral autoregulation - process models and simulation: historical development and quality criteria, e.g. electronic pacemaker technology and mechanical ventilation / respiratory system - parameter identification with Matlab / Simulink software *2. Electronic Pacemaker Technology (Herzschrittmachertechnik)* - therapeutic conception, functionality, pacemaker code - construction and application of electronic pacemakers - frequency adaptive systems, telemonitoring, safety *3. Mechanical Ventilation Technology (Beatmungstechnik)* - drive and control principles of mechanical ventilation (mode, shape, and pattern) - ventilation monitoring and effectivity evaluation. Intended learning outcomes: Students completing this module are able to solve interdisciplinary modelling and simulation tasks in biomedical engineering. They are qualified to use methodological modelling and simulation tools for solving problems also with the help of analogies, and to assess the results by defined quality criteria.	
Modes of teaching and learning	4 SWS lecture, 1 SWS seminar, 1 SWS lab course, and self-study	
Prerequisites	Some specific expertise is required, which can for example be aquired by completing the modules ET-02 06 04 01 Physics and ET-12 07 01 Biomedical Engineering.	
Usability	The module is an elective module of the specialization area of Electronic Systems and Technology within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The module assessment consists of a written exam (90 minutes) and a lab course. Both elements of assessment have to be passed.	
ECTS credit points and grades	7 ECTS credit points The module grade is determined by the weighted average of both elements of module assessment, for which the written exam contributes by ¾ and the lab course reports by ¼.	
Frequency	annually, during winter semester	
Workload	210 hours	

Duration	1 semester

Module number	**Module name**	**Lecturer in charge**
ET-12 07 05	Medical Imaging (*Medizinische Bildgebung*)	PD Dr.-Ing. U. Morgenstern
Contents and objectives	This module covers **1. Imaging Modalities: Principles and Devices (*Bildgebende Verfahren und Geräte in der Medizin*)** - physical principles and modalities in medical diagnosis process (X-ray diagnosis, CT, MRI, PET, SPECT, US, multi-modal data fusion, visualisation) - quality assessment of diagnostic information as a basis for medical decision process and therapeutic procedures **2. Medical Image Processing and Autostereoscopic Visualisation (*Medizinische Bildverarbeitung und autostereoskopische Visualisierung*)** - mathematical algorithms for medical image processing and visualisation of spatial data (image processing chain) - data format and volume data models - autostereoscopic presentation and 3D interaction - handling of real multidimensional medical data and training with images by various software systems (computed tomography, MATLAB / Image Processing Toolbox (Mathworks Corp.), AMIRA (Visage Imaging GmbH)) Intended learning outcomes: Students completing this module are capable of applying the concepts of medical imaging for processing of real patient data with several software systems. They are qualified to design innovative solutions of imaging devices and principles and to use interactive presentation, navigation, and visualisation tools in biomedical engineering field.	
Modes of teaching and learning	3 SWS lecture, 1 SWS seminar, 2 SWS lab course, and self-study	
Prerequisites	Some specific expertise is required, which can for example be aquired by completing the modules ET-02 06 04 01 Physics and ET-12 07 01 Biomedical Engineering.	
Usability	The module is an elective module of the specialization area of Electronic Systems and Technology within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The assessment consists of a written exam (90 minutes) and a lab course; both must be passed.	
ECTS credit points and grades	7 ECTS credit points The module grade is determined by the weighted average of both elements of module assessment, for which the written exam contributes by 2/3 and the lab course reports by 1/3.	
Frequency	annually, during summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 07 06	Seminar for Graduate Students in Biomedical Engineering (*Oberseminar Biomedizinische Technik*)	Prof. Dr.-Ing. habil. H. Malberg
Contents and objectives	The module contains 1. special topics and trends in diagnostic and therapeutic device technologies, and 2. the scientific and management methods of engineering Intended learning outcomes: The students are able to solve interdisciplinary tasks in biomedical engineering independently or in a working team. They know the main procedures of engineering and are able to present and to discuss their results.	
Modes of teaching and learning	2 SWS seminar, 1 presentation, and self-study	
Prerequisites	Some specific expertise is required, which can for example be aquired by completing the modules ET-02 06 04 01 Physics and ET-12 07 01 Biomedical Engineering.	
Usability	The module is an elective module of the specialization area of Electronic Systems and Technology within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessement is passed. The assessment consists of an assignment and a presentation of 30 minutes as an individual exam.	
ECTS credit points and grades	4 ECTS credit points The module grade consists to 2/3 of the grade of the assignment and to 1/3 of the grade of the presentation.	
Frequency	annually, during winter semester	
Workload	120 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 08 07	Introduction to the Theory of Nonlinear Systems (*Einführung in die Theorie nichtlinearer Systeme*)	Prof. Dr. phil. nat. habil. R. Tetzlaff
Contents	The module contents: 1. phenomena and analysis of nonlinear systems (including chaotic systems) 2. specialization in the theory and application of "Cellular Neural Networks". Outcomes: After completing the module the students know the stability analysis by linearization and by applying Lyapunov functions, as well as the Volterra analysis of nonlinear transmission systems. Students know the properties of Cellular Neural Networks (CNN) and are able to realize binary information processing by means of these networks. The participants have an understanding of the structure CNN-based computers and are able to simulate the behavior of such networks numerically.	
Modes of teaching and learning	4 SWS lecture, 2 SWS tutorial and self-study	
Prerequisites	Competences acquired in modules such as ET-01 04 01 Principles of Algebra and Analysis, ET-01 04 02 Multivariable Calculus, ET-12 08 01 Fundamentals of Electrical Engineering, ET-12 08 02 Electric and Magnetic Fields, and ET-12 09 01 Systems Theory	
Usability	The module is an elective module of the specialization area of Communications and Information Technology within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessement is passed. The assessment consists of two written exams of 120 minutes each.	
ECTS credit points and grades	7 ECTS credit points The module grade is determined by the arithmetic mean of the grades of the two written exams.	
Frequency	annually, starting in the summer semester	
Workload	210 hours	
Duration	2 semester	

Module number	Module name	Lecturer in charge
ET-12 08 08	Circuit Simulation and System Identification (*Schaltungssimulation und System-identifikation*)	Prof. Dr. phil. nat. habil. R. Tetzlaff
Contents and objectives	The module contents: the mathematical basics of system identification and its practical application, basic system properties, important modeling approaches, methods for parameter identification and essential aspects of signal selection and data conditioning as well as adaptation of model parameters with appropriate algorithms. Outcomes: The students can select suitable model approaches based on theoretical considerations (linear/nonlinear, time/frequency domain). They are aware of simplifications made and consider specific boundary conditions for the applied methods. Students are able to define and analyze the set of data available for the identification and to evaluate it in terms of suitability. The students master the application of common methods for system identification and are able to evaluate the result.	
Modes of teaching and learning	2 SWS lecture, 2 SWS tutorial and self-study	
Prerequisites	Competences acquired in modules such as ET-01 04 01 Principles of Algebra and Analysis, ET-01 04 02 Multivariable Calculus, ET-01 04 03 Special Chapters of Mathematics, ET-12 09 01 Systems Theory, and ET-Digital Signal Processing and Hardware-Implementation (1st semester of module)	
Usability	The module is an elective module of the specialization area of Communications and Information Technology within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessement is passed. The assessment consists of a written exam of 150 minutes.	
ECTS credit points and grades	7 credit points The module grade is the grade of the written exam.	
Frequency	annually, in the summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET- 12 08 12	Integrated Analogue Circuits (*Integrierte Analogschaltungen*)	Prof. Dr.-Ing. habil. U. Jörges
Contents and objectives	Integrated analogue circuits, such as reference sources, translinear circuits, transconductance amplifiers, mixers, analogue switchs, switched capacitor circuits, current conveyors and others. Students learn the fundamental properties of devices and circuits, such as temperature dependency, nonlinearities, noise and matching. They learn important functionally blocks of integrated analogue systems. Students can analyse symbolically, dimension and design analogue circuits.	
Modes of teaching and learning	4 SWS lectures, 2 SWS tutorials and self-study	
Prerequisites	Competences acquired in modules such as ET-12 08 04 Circuit Design	
Usability	This module is a compulsory module of the specialization areas of Microelectronics as well as Communications and Information Technology within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of credit points	The credit points are earned if the module assessment is passed. The module assessment consists of a written exam of 120 minutes.	
ECTS credit points and grades	4 ECTS credit points The module grade is the grade of the exam.	
Frequency	annually, during the winter semester	
Workload	120 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 08 13	Physics of Selected Devices (*Physik ausgewählter Bauelemente*)	Prof. Dr.-Ing. habil. M. Schröter
Contents and objectives	The module contains the courses: - *Numerical simulation of devices* (winter semester) and - *Modeling for circuit design* (summer semester). The module includes: - Design, operation and electrical properties of micro- and nanoelectronic devices for integrated circuits. Outcomes: The students are capable of - describing the behavior of components on the basis of important physical models, - implementing numerical solution methods for physical models, - applying Computer-aided tools for the numerical simulation of micro- and nanoelectronic devices, - constructing equivalent circuits, - developing compact models based on realistic devices and fit model parameter from measurements.	
Modes of teaching and learning	2 SWS lecture, 2 SWS tutorial, 2 SWS lab course and self-study	
Prerequisites	Competences acquired in modules such as ET-12 08 11 Microelectronic Technologies and Devices	
Usability	The module is a compulsory module within the Microelectronics programme work towards the *Diplom* in Electrical Engineering. It provides the foundations for the elective modules.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The module assessment consists of a graded assignment (winter semester) and of a graded written exam of 150 min duration. Both elements of assessment must be passed. Note: It is possible to obtain credit points in exceptional cases (Erasmus students) only for the graded assignment. This rule applies only to the winter semester!	
ECTS credit points and grades	6 ECTS credit points The grade is determined by the weighted average of the grades of both elements of assessment. The grade of the assignment is weighted with 3/10 (winter semester) and the grade of the written exam with 7/10 (summer semester) for the module grade. Note: Credit points in exceptional cases (applies to non-degree students only): 2	
Frequency	annually, starting in winter semester	
Workload	180 hours	
Duration	2 semester	

Module number	Module name	Lecturer in charge
ET-12 08 14	Characterization and Modeling of Electronic Devices (*Charakterisierung und Modellierung elektronischer Bauelemente*)	Prof. Dr.-Ing. habil. M. Schröter
Contents and objectives	The module contains the course *Characterization and modeling of electronic devices* (in German) along with a student lab. The module includes: - Current topics and trends in the field of experimental characterization and modeling of micro- and nanoelectronic components, including model parameter determination. After completing this module, students are capable of - understanding the basic operation of selected advanced transistors, their most important practical characteristics, and associated compact models for high-frequency circuit design; - applying advanced methodologies for model parameter extraction under industrial conditions; - understanding industrially relevant measurement methods for device characterization and analyzing/interpreting test results.	
Modes of teaching and learning	2 SWS lecture, 2 SWS tutorial, 2 SWS student lab and self-study	
Prerequisites	Competences acquired in modules such as ET-12 08 13 Physics of selected devices	
Usability	The module is an elective module within the Microelectronics programme work towards the *Diplom* in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The module assessment consists of a graded assignment.	
ECTS credit points and grades	7 ECTS credit points The grade is the grade of the assignment.	
Frequency	annually in the summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 08 15	Advanced Seminar: Micro- and Nanoelectronics (*Hauptseminar Mikro- und Nanoelektronik*)	Prof. Dr.-Ing. habil. M. Schröter
Contents and objectives	The module contains the advanced seminar *micro- and nano-electronics*. The module includes: - Topics of micro- and nanoelectronics and the methodology of scientific and project-based work organization. Outcomes: The students are capable of - solving tasks in teams or independently (conception and documentation) in the field of micro- and nanoelectronics, - presenting and defending their own work, - acquiring new topics from literature.	
Modes of teaching and learning	2 SWS seminar and self-study	
Prerequisites	Competences acquired in, e.g. the modules ET-12 08 11 Microe-lectronic Technologies and Devices and ET-12 08 12 Integrated Analogue Circuits	
Usability	The module is a compulsory module within the Microelectronics programmework towards the *Diplom* in Electrical Engineering. It provides the foundations for the electice modules.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The module assessment consists of a project of overall 40 hours.	
ECTS credit points and grades	4 ECTS credit points The module grade is determined by the weighted average of the grade of the project and the grade of the colloquium (oral exam). The grade of the project is weighted with 2/3 and the grade of the colloquium with 1/3 for the module grade.	
Frequency	annually in the summer semester	
Workload	120 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET- 12 08 16	Radio Frequency Integrated Circuits	Prof. Dr. sc. techn. habil. F. Ellinger
Contents and objectives	Radio frequency integrated circuits for mobile communications, such as low noise amplifiers, power amplifiers, mixers and oscillators with active and passive devices based on present-day technologies as well as architectures of radio frequency systems. Students learn the methods of the design of analogue radio frequency integrated circuits. They know the fundamental circuits and the architectures of the systems and they can analyse and optimise these circuits. The students know the complete design cycle using the program CADENCE. Students are prepared for industrial and scientific jobs.	
Modes of teaching and learning	3 SWS lecture, 1 SWS tutorial, 2 SWS lab course and self-study The lecture is given in English.	
Prerequisites	Competences acquired in modules such as ET-12 08 04 Circuit Design	
Usability	This module is an elective module of the specialization areas of Microelectronics as well as of Communications and Information Technology within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The module assessment consists of a written exam of 120 minutes.	
ECTS credit points and grades	7 ECTS credit points The module grade is the grade of the written exam.	
Frequency	annually, during the summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET- 12 08 17	Integrated Circuits for Broad-band Optical Communications	Prof. Dr. sc. techn. habil. F. Ellinger
Contents and objectives	Integrated circuits for optical broadband communications, such as transimpedance amplifiers, detector circuits, laser drivers, multiplexers, frequency dividers, oscillators, phase locked loops, synthesizesr and data recovery circuits. Students learn the methods of the design of fast integrated circuits and systems for optical broadband communications. They are able to analyse and optimise these circuits. The students know the complete design cycle using the program CADENCE.	
Modes of teaching and learning	3 SWS lecture, 1 SWS tutorial, 2 SWS lab course and self-study The lecture is given in English.	
Prerequisites	Competences acquired in modules such as ET-12 08 04 Circuit Design	
Usability	This module is an elective module of the specialization areas of Microelectronics as well as of Communications and Information Technology within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The module assessment consists of a written exam of 120 minutes.	
ECTS credit points and grades	7 ECTS credit points The module grade is the grade of the written exam.	
Frequency	Annually, during the winter semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 08 18	Integrated Circuit Design (*Schaltkreis- und Systementwurf*)	Prof. Dr.-Ing. habil. C. Mayr
Contents and objectives	Content of the module: Basics and methods necessary for an Application-Apecific Integrated Circuit (ASIC) design project. Each step of the design process from algorithmic specification to synthesis strategies (CDFG-Control Data Flow Graph, Scheduling, Allocation) will be explained on the example of a processor for solving 2nd order differential equations. After transformation of the CDFG into the data path, we will discuss variations in terms of area, speed and power consumption and introduce structural modifications, e.g. functional or structural pipelining, resource- and bus sharing. For one data path the according Register-Transfer- Sequences (RTL) as well as the Random-, Microprogram- and Data Path control units will be described and verified through simulation. Furthermore, the students will learn about the basics of the C-like hardware description language VERILOG used to simulate the circuit at system-, behavioral-, RT- and logic level. In a final project, each student will design an individual ASIC utilizing the Cadence Design Framwork and a modern Designflow running on modern SUN workstations.	
Modes of teaching and learning	2 SWS lecture, 1 SWS tutorial, 2 SWS lab course and self-study	
Prerequisites	Competences acquired in modules such as ET-12 08 01 Fundamentals of Electrical Engineering, ET-01 04 01 Principles of Algebra and Analysis, ET-01 04 02 Multivariable Calculus, ET-12 08 11 Microelectronic Technologies and Devices, ET-12 08 04 Circuit Design and ET-12 09 01 Systems Theory	
Usability	This module is a compulsory module of the specialization areas of Microelectronics as well as of Communications and Information Technology within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of credit points	The credit points are earned if the module assessment is passed. The module assessment consists of a project report of 40 hours.	
Credit points and grades	7 ECTS credit points The module grade is the grade of the project report.	
Frequency	annually, beginning in winter semester	
Workload	210 hours	
Duration	2 semesters	

Module number	Module name	Lecturer in charge
ET-12 08 19	VLSI Processor Design (*VLSI-Prozessorentwurf*)	Prof. Dr.-Ing. habil. C. Mayr
Contents and objectives	Content of the module: - Basics, concepts and methods for designing complex digital VLSI-systems - Architectures for highly integrated digital processing systems, with emphasis on user-specific signal processing systems - Methods for the efficient transfer of architectural concepts in the highly integrated implementation of a digital system. - Specification and abstract modelling of the system, conversion into a Register-Transfer-Level (RTL) description, automated circuit synthesis and physical implementation (place & route, layout synthesis), delivering the data for the manufacture of the chip. - Verification of the design on all levels of abstraction (behaviour, implementation) via simulation (functional verification) - Proof of the equivalence of transformation steps via formal verification, i.e. by checking compliance with design rules (signoff-verification) - Training in working together as a design team (division of tasks, definition of interfaces, schedule planning and time management) Objectives: After completion of this module, the students will be able to carry out a complete implementation and verification of a VLSI-System (e.g. a processor with a complexity comparable to an 8051) using industrial design software (Synopsys, Cadence).	
Modes of teaching and learning	2 SWS lecture, 2 SWS tutorial, 2 SWS lab course and self-study	
Prerequisites	Competences acquired in modules such as ET-12 08 01 Fundamentals of Electrical Engineering, ET-12 08 02 Electric and Magnetic Fields, ET-01 04 03 Special Chapters of Mathematics, ET-12 08 11 Microelectronic Technologies and Devices, and ET-12 08 04 Circuit Design	
Usability	This module is an elective module of the specialization areas of Microelectronics as well as of Communications and Information Technology within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of credit points	The credit points are earned if the module assessment is passed. The module assessment consists of a project report of 30 hours and an oral presentation.	
Credit points and grades	7 ECTS credit points The module grade is the weighted average of the grade of the project report (66%) and the grade of the oral presentation (33%).	
Frequency	annually, in winter semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 08 20	Laser Sensor Technology (*Lasersensorik*)	Prof. Dr.-Ing. habil. J. Czarske
Contents and objectives	The module deals with the basic principles and the realisation of laser sensors in practice. - Laser measurement technology (laser technology, biophotonics, fiber optic measurement systems, optical information technology) - Mechatronic laser sensors - Experimental investigation and application of laser sensors Intended learning outcomes: Students will acquire skills to describe the physical principle and the technical design of laser sensors and to assess them. They will be able to handle the basic approaches and methods for the system design of modern laser sensors.	
Modes of teaching and learning	4 SWS lecture, 1 SWS tutorial, 1 SWS lab course and self-study	
Prerequisites	Competences acquired in modules such as ET-02 06 04 01 Physics, ET-12 09 01 Systems Theory, ET-12 02 01 Electromagnetic Theory, and ET-12 08 06 Measurement and Sensor Techniques	
Usability	This module is an elective module of the specialization areas of Automation, Measurement and Control as well as of Communications and Information Technology within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The assessment consists of an individual oral exam of 40 min duration and a lab course.	
ECTS credit points and grades	7 ECTS credit points The module grade is determined by the weighted average of both elements of module assessment, for which the oral exam contributes by 6/7 and the lab course by 1/7.	
Frequency	annually, during the summer semester	
Workload	210 hours	
Duration	1 Semester	

Module number	Module name	Lecturer in charge
ET-12 08 21	Photonic Measurement System Techniques (*Photonische Messsystemtechnik*)	Prof. Dr.-Ing. habil. J. Czarske
Contents and objectives	Contents are the basic principles, the theoretical description and the realisation of photonic measurement systems in practice. - Digital holography and image processing - Laser measuring systems for fluid technology - Experimental investigation of photonic systems - Imaging methods Intended learning outcomes: The students are able to implement laser-optical measuring systems and to measure physical quantities by applying these.	
Modes of teaching and learning	4 SWS lecture, 1 SWS tutorial, 1 SWS project and self-study	
Prerequisites	Competences acquired in modules such as ET-02 06 04 01 Physics, and ET-12 08 06 Measurement and Sensor Techniques	
Usability	This module is an elective module of the specialization areas of Communications and Information Technology as well as of Automation, Measurement and Control within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The assessment consists of an individual oral exam of 40 min and a project of 20 hours.	
ECTS credit points and grades	7 ECTS credit points The module grade is determined by the weighted average of both elements of module assessment, for which the oral exam contributes by 6/7 and the project by 1/7.	
Frequency	annually, in the winter semester	
Workload	210 hours	
Duration	1 Semester	

Module number	**Module name**	**Lecturer in charge**
ET-12 08 22	Seminar for Graduate Students on Measurement System Technology (*Oberseminar Messsystemtechnik*)	Prof. Dr.-Ing. habil. J. Czarske
Contents and objectives	Content: - Current trends and issues of measurement system technology - Methods of scientific and project-based working as well the presentation of results Objectives: The students are capable of solving a given task independently, individually, and in teams. They master the documentation of the work and the methods used, and are capable of presenting and discussing the results.	
Modes of teaching and learning	2 SWS seminar and self-study	
Prerequisites	Required are competences that can be acquired in modules such as ET-12 08 06 Measurement and Sensor Techniques. Further, competences are recommended that can be acquired in modules on Sensor Technology, Photonic Measurement System Techniques and Signal Processing	
Usability	The module is an elective module of the specialization area of Automation, Measurement and Control within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessement is passed. The module assessment consists of an assignment and a presentation of 30 minutes.	
ECTS credit points and grades	4 ECTS credit points The module grade consists to 2/3 of the grade for the assignment and to 1/3 of the grade for the presentation.	
Frequency	annually, in the winter semester	
Workload	120 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 08 23	Computer Aided Integrated Circuit Design (*Rechnergestützer Schaltkreisentwurf*)	Prof. Dr.-Ing. habil. C. Mayr
Contents and objectives	Content of the module: 1. Integrated Circuit Design Basics and methods necessary for an Application-Specific Integrated Circuit (ASIC) design project. Each step of the design process from algorithmic specification to synthesis strategies (CDFG-Control Data Flow Graph, Scheduling, Allocation) will be explained. For one data path the according Register-Transfer-Level-Sequences (RTL) as well as the Random-, Microprogram- and Data Path control units will be described and verified through simulation. 2. Physical Design Designmethodology for layout generation of Integrated Circuits, MCMs and PCBs. Detailed step-by-step description of the computer assisted layout generation from a netlist description to the final layout. After completion of this module, the students will have knowledge about the basics of the C-like hardware description language VERILOG used to design and to simulate the circuit at system-, behavioral-, RT- and logic level verification of a VLSI-System. Furthermore, the students will be able to use modern design tools for the physical layout implementation.	
Modes of teaching and learning	4 SWS lecture, 1 SWS tutorial, 2 SWS lab course and self-study	
Prerequisites	Competences acquired in modules such as ET-12 08 01 Fundamentals of Electrical Engineering, ET-12 08 02 Electric and magnetic Fields, and ET-12 05 01 Electronic Systems Design	
Usability	This module is a compulsory module of the specialization area of Microelectronics within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of credit points	The credit points are earned if the module assessment is passed. The module assessment consists of a design project of 50 hours and an oral presentation of 20 minutes per person. Both elements of assessment must be passed.	
Credit points and grades	8 ECTS credit points The module grade is the weighted average of the grade of the project report (66%) and the grade of the oral presentation (33%).	
Frequency	Annually Module starts in the winter semester.	
Workload	240 hours	
Duration	2 semesters	

Module number	**Module name**	**Lecturer in charge**
ET-12 08 25	Seminar for Graduate Students: Micro- and Nanoelectronics (*Oberseminar Mikro- und Nanoelektronik*)	Prof. Dr.-Ing. habil. M. Schröter
Contents and objectives	The module includes: - Special issues and trends in the field of modeling of micro- and nanoelectronic components - Methods of scientific and engineering project-based activities Outcomes: The students are capable of solving a given task independently, individually, and in teams. They master the documentation of the work methods, can present and discuss the results.	
Modes of teaching and learning	2 SWS seminar and self-study	
Prerequisites	Competences acquired in modules such as ET-12 08 13 Physics of selected devices	
Usability	This is an optional module within the Microelectronics programmework towards the *Diplom* in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The assessment consists of a graded assignment and a graded presentation of 30 minutes duration as a single test.	
ECTS credit points and grades	4 ECTS credit points The module grade is derived from the grades of the assignment and of the presentation; the assignment contributes by 2/3 and the presentation by 1/3.	
Frequency	annually in the winter semester	
Workload	120 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 09 02	Signal Theory (*Signaltheorie*)	Prof. Dr.-Ing. habil. E. Jorswieck
Contents and objectives	The module content includes: analysis of continuous time and discrete time signals in the time and frequency domain. A second focus is the description of stochastic signals as realisations of stochastic processes and its processing by static and dynamic systems. Learning outcomes: The students master the fundamental principles and the practical application of methods of signal processing in the time domain and in the frequency domain. They are familiar with the relationship between the processing of continuous time and discrete time signals. They know the different forms of spectral analysis and are able to decide which forms are applicable under which conditions. In particular, they understand how short time spectral analysis works and the specifics concerning its application. The students are able to describe stochastic signals as realisations of stochastic processes. They are capable of calculating the behaviour of deterministic and stochastic systems that are processing stochastic processes.	
Modes of teaching and learning	4 SWS lecture, 2 SWS tutorial and self-study	
Prerequisites	Competences acquired in modules such as ET-01 04 01 Principles of Algebra and Analysis, ET-01 04 02 Multivariable Calculus, ET-01 04 03 Special Chapters of Mathematics, ET-12 08 01 Fundamentals of Electrical Engineering, ET-12 08 02 Electric and Magnetic Fields, ET-12 08 03 Dynamic Networks, ET-12 09 01 Systems Theory or equivalent	
Usability	The module is a compulsory module for the specialization area of Communications and Information Technology within the *Diplom* programme in Electrical Engineering. It lays the foundations for other modules in the elective area of study.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The module assessment consists of 2 written exams of 120 minutes and 90 minutes.	
ECTS credit points and grades	7 ECTS credit points The module grade is the arithmetic mean of the grades of the 2 written exams.	
Frequency	annually, in the winter semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 09 03	Intelligent Audio Signal Processing (*Intelligente Audiosignalverarbeitung*)	Jun.-Prof. Dr.-Ing. P. Birkholz
Contents and objectives	The module content includes: methods for the signal analysis and modeling, as well as the construction of feature spaces and the numerical classification for audio signal processing. Associated algorithms will be implemented on digital signal processing units. Learning outcomes: Successful students know the signal processing algorithms that are specifically used in the processing of audio signals. They have in-depth knowledge of analysis and parametric modeling of acoustic signals, of the coding of audio signals, of sound shaping, and of source separation. They understand the procedures of numerical classification and its application to audio signals. They are able to apply their knowledge to the design of acoustic human-machine interfaces and to employ audio signal processing algorithms using digital signal processors (DSPs).	
Modes of teaching and learning	4 SWS lecture, 1 SWS tutorial, 1 SWS lab course and self-study	
Prerequisites	Competences acquired in modules such as ET-12 09 02 Signal Theory	
Usability	The module is an elective module for the specialization area of Communications and Information Technology within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The module assessment is a written exam of 150 minutes and a lab course.	
ECTS credit points and grades	7 ECTS credit points The module grade is the weighted mean of the grades of both elements of assessment, for which the written exam contributes by 4/5 and the grade for the lab course by 1/5.	
Frequency	Annually, in the summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 09 04	Speech Technology (*Sprachtechnologie*)	Jun.-Prof. Dr.-Ing. P. Birkholz
Contents and objectives	The module content includes: The algorithms and methods required for the lingual human-machine interaction (speech recognition and speech synthesis). Learning outcomes: Successful students master the latest technologies being used in speech recognition and speech synthesis. They know the basic concepts of linguistics and the hierarchical semiotic system and the structures of natural language. They are able to define it by means of formal languages and grammars and employ this knowledge in the development of speech recognition systems. Furthermore, they know the structure of speech synthesis systems and the algorithms used in linguistic-phonetic and acoustic-phonetic implementations. They know how to adapt these systems to meet specific demands such as multilingual or multimodal interaction.	
Modes of teaching and learning	4 SWS lecture, 2 SWS lab course, and self-study	
Prerequisites	Competences acquired in modules such as ET-12 09 02 Signal Theory, ET-12 09 03 Intelligent Audio Signal Processing, or equivalent	
Usability	The module is an elective module for the specialization area of Communications and Information Technology within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The module assessment consists of 2 written exams of 90 minutes each and a lab course.	
ECTS credit points and grades	7 ECTS credit points The module grade is the weighted mean of the grades of the 3 elements of assessment, for which the 2 written exams contribute by 2/5 each and the grade for the lab course by 1/5.	
Frequency	Annually, in the winter semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 09 05	Electro-Acoustics (*Elektroakustik*)	Prof. Dr.-Ing. habil. E. Altinsoy
Contents and objectives	The module content includes: in-depth knowledge of electro-acoustics with an emphasis on the evaluation of audio systems as well as the active control of sound and vibration. Learning outcomes: The students are able to integratively apply their knowledge in the various disciplines of electrical engineering/mechanics/acoustics to complex structures (nonlinear, time dependent, with distributed parameters). A typical example is the rating of sound systems using objective measurements. The students are proficient in the development of new measurement methods, which employ test signals as well as music for the rating of the electro-acoustic system. They understand the relationship between measured physical symptoms and physical causes and their impact on the perceived sound quality. They have learned advanced methods for modeling and analysis of electrical, mechanical and acoustic systems and the systematic design of measurement and control instrumentation, which are implemented using digital signal processors.	
Modes of teaching and learning	4 SWS lecture, 2 SWS lab course and self-study	
Prerequisites	Competences acquired in modules such as ET-12 09 02 Signal Theory, ET-12 09 06 Acoustics , or equivalent	
Usability	The module is an elective module for the specialization area of Communications and Information Technology within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The module assessment consists of 2 written exams of 90 minutes each and a lab course.	
ECTS credit points and grades	7 ECTS credit points The module grade is the weighted mean of the grades of the 3 elements of assessment, for which the 2 written exams contribute by 2/5 each and the grade for the lab course by 1/5.	
Frequency	annually, beginning in the summer semester	
Workload	210 hours	
Duration	2 semesters	

Module number	Module name	Lecturer in charge
ET-12 09 06	Acoustics (*Akustik*)	Prof. Dr.-Ing. habil. E. Altinsoy
Contents and objectives	This module gives an introduction to the fundamentals of acoustics with focus on the physics and perception of sound and vibration, application of their theories and models. Students learn basic principles of sound wave generation and propagation, electroacoustic and electromechanic transducers, room and building acoustics to design silent machines, to handle simple room acoustical problems and develop solutions across all areas of sound recording, transmission and reproduction. Example solutions for common industrial noise control problems and environmental acoustic regulations will be introduced and discussed in tutorials. Graduates from acoustic courses are employed in automotive, household, medical-technology and multimedia industries.	
Modes of teaching and learning	2 SWS lecture, 2 SWS tutorials and self-study	
Prerequisites	Basic knowledge in physics, mathematics and electrical engineering	
Usability	The module is a compulsory module for the specialization area of Communications and Information Technology within the *Diplom* programme in Electrical Engineering. It provides the foundations for other modules in the elective area of study.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The module assessment consists of a written exam of 180 minutes.	
ECTS credit points and grades	4 ECTS-credit points The module grade is the grade of the written exam.	
Frequency	annually, in the summer semester	
Workload	120 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 09 07	Technical Acoustics / Vehicle Acoustics (*Technische Akustik / Fahrzeug-akustik*)	Prof. Dr.-Ing. habil. E. Altinsoy
Contents and objectives	The design and quality of vehicle interior sound becomes increassingly important in the development process of new vehicles. The physical behaviour of vibration and sound generation (also transmission) ranked first in the design process. This module provides the theoretical and practical foundation for technical acoustics with focus on vehicle acoustics and includes a lab course on the sound and vibration measurement technique. Generation, transmission and damping of air- and structure-borne sound, transfer path analysis and synthesis, manipulation of the vehicle interior and exterior sound will be introduced. The lab course includes examples in the following areas: - technical acoustics - electromechanic and electroacoustic systems	
Modes of teaching and learning	2 SWS lecture, 2 SWS tutorial, 2 SWS lab course and self-study	
Prerequisites	Basic knowledge that can be acquired in modules such as ET-12 08 06 Measurement and Sensor Techniques and ET-12 09 06 Acoustics.	
Usability	The module is an elective module for the specialization area of Communications and Information Technology within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The module assessment consists of a lab course and an oral exam of 30 minutes.	
ECTS credit points and grades	7 ECTS-credit points The module grade results from the arithmetic mean of both elements of assessment.	
Frequency	annually, in the winter semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 09 08	Room Acoustics/Virtual Reality (*Raumakustik / Virtuelle Realität*)	Prof. Dr.-Ing. habil. E. Altinsoy
Contents and objectives	This module provides the theoretical and practical foundation for room acoustics (first part) and interface design for virtual reality applications (second part). 1)The first part of the module (room acoustics) includes the theory of sound fields in enclosed spaces, geometrical acoustics, sound absorbers, electroacoustic systems in rooms and design of lecture halls, concert halls, opera houses, etc. 2) The aim of the second part of the module is to present the advanced concepts for generation of real-time interactive auditory, haptic, and visual virtual environments. Nowadays, such kinds of systems play a pronounced role in scientific and industrial research & development and, thus, become more and more important as tools for automotive industry (e.g. driving simulators, prototyping of engineering designs, restyling, ergonomics, etc.), telecommunication industry, architecture, and entertainment industry. Students learn audio recording and reproduction technologies (binaural techn., stereophony, surround sound, VBAP, ambisonics, wave field synthesis), implementation of room acoustical models, sound synthesis techniques, haptic and visual reproduction technologies. Furthermore, students will be exposed to the process of creating virtual environments, by developing some small VR applications (auditory/haptic/visual) as members of a small team.	
Modes of teaching and learning	4 SWS lecture, 2 SWS lab course and self-study	
Prerequisites	Basic knowledge in system theory and signal processing	
Usability	The module is an elective module for the specialization area of Communications and Information Technology within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The module assessment consists of a lab course and an oral exam of 55 minutes.	
ECTS credit points and grades	7 ECTS credits points The module grade consists to 6/7 of the exam grade and to 1/7 of the lab course grade.	
Frequency	annually, in the summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 09 09	Psychoacoustics / Sound Design (*Psychoakustik / Sound Design*)	Prof. Dr.-Ing. habil. E. Altinsoy
Contents and objectives	This module gives an introduction to: 1.Psychoacoustics: Psychoacoustics is concerned with the relationships between the physical characteristics of sounds and their perceptual attributes. The aim of this module is to give students an understanding on the theory and practice of psychophysics, including the various aspects of psycho-acoustics, such as sensitivity, masking, loudness, sharpness, pitch, timbre and roughness. In this module various binaural models and the aspects of the binaural hearing will be introduced. 2. Sound design Each perceived sound in product use is a carrier of information. Each sound has a meaning to its listener, and as such each sound is perceived as a sign. The humming sound inside a car is mostly associated with, e.g., sportiness. This module outlines basic principles of sign theory and gives guidelines to how human perception of a product is affected by product sounds. Intended learning outcomes: Students learn to construct signals, which evoke – if they are heard – specific physical, affective or psychomotor reactions. They are qualified for the product development, e.g., in the automotive, hearing aid, household appliance or telecommunication industry and in medical engineering companies.	
Modes of teaching and learning	4 SWS lecture, 2 SWS tutorial and self-study	
Prerequisites	Basic knowledge that can be acquired in modules such as ET-12 08 06 Measurement and Sensor Techniques and ET-12 09 06 Acoustics.	
Usability	The module is an elective module for the specialization area of Communications and Information Technology within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The module assessment consists of a written exam of 90 minutes and a project of 30 working hours.	
ECTS credit points and grades	7 ECTS credits The module grade results from the arithmetic mean of both elements of assessment.	
Frequency	annually, in the winter semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 10 01	Information Theory (*Informationstheorie*)	Prof. Dr.-Ing. E. Jorswieck
Contents and objectives	Content of this module: - basic information theoretic measures - source coding - channel coding - coding theorem - rate-distortion theory Intended learning outcomes: Students are able to master the basic principles of Information Theory. They are familiar with the calculation and the meaning of entropy as well as the mutual information for discrete and statistical random variables. Furthermore, students know the source coding and channel coding theorems and are able to apply the results from these coding theorems for a practical system design. They are able to construct source codes as well as channel codes and are further able to indicate procedures for decoding. Various performance metrics for the evaluation of the performance of information systems e.g. the ergodic capacity or the outage capacity are used and interpreted confidently.	
Modes of teaching and learning	2 SWS lecture, 2 SWS tutorial and self-study	
Prerequisites	Basic knowledge which can be acquired in modules such as ET-01 04 01 Principles of Algebra and Analysis, ET-01 04 02 Multivariable Calculus, ET-01 04 03 Special Chapters in Mathematics, and ET-12 09 01 Systems Theory.	
Usability	This module is a compulsory module for the specialization area of Communications and Information Technology within the *Diplom* programme in Electrical Engineering.It provides various tools necessary to pass the exams of the elective modules.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The module assessmen consists of a written exam of 120 min.	
ECTS credit points and grades	4 ECTS credit points The grade of the written exam is the grade for the module.	
Frequency	annually, during the summer semester	
Workload	120 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 10 02	Advanced Seminar Communication Systems (*Hauptseminar Kommunikationssysteme*)	Prof. Dr.-Ing. Frank Fitzek
Contents and objectives	This module encompasses new topics and issues regarding communications and network engineering combined with the methodology of scientific and project based operations. Intended learning outcome: After completing this module, students will be able to apply their skills autonomously, individually or within a team to specific tasks. In doing so, single steps of the procedures should be documented comprehensibly. Students are expected to present and discuss their results. Moreover, students can work in teams to develop their concepts, which they will then realize and defend.	
Modes of teaching and learning	2 SWS project and self-study	
Prerequisites	Competences regarding communications engineering, metrology, sensor technology, and signal processing	
Usability	This module is a compulsory module for the specialization area of Communications and Information Technology within the *Diplom* programme in Electrical Engineering.It provides various tools necessary to pass the exams of the elective modules.	
Requirements for the award of ECTS credit points	The credit points are earned if the module exam is passed successfully. The module exam consists of a project work of 40 hours.	
ECTS credit points and grades	4 ECTS credit points The module grade consists to 2/3 of the documentation of the project and to 1/3 of the colloquium.	
Frequency	annually, during the summer semester	
Workload	120 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 10 03	RF Engineering (*Hoch- und Höchstfrequenz-technik*)	Prof. Dr.-Ing. D. Plettemeier
Contents and objectives	The modules content comprises: the physical basics of devices and circuits as well as RF systems and radio transmission systems. This includes theory and praxis of RF wave guides (micro strip lines, hollow wave guides and optical fibers), their associated circuit components and circuits as well as their characterization through scattering parameters. Qualification objectives: Students will have the ability to evaluate RF connections and design wave guides. They are trained in handling RF equivalent circuits and description of n-ports by scattering parameters. Students can certainly apply the basics of wave radiation, propagation and reflection and have basic knowledge of signal transmission over various wave guides.	
Modes of teaching and learning	2 SWS lecture, 2 SWS tutorial and self-study	
Prerequisites	Competences acquired in modules such as ET-12 02 01 Electro-magnetic Theory (1st semester of the module), ET-12 10 24 Communications and ET-12 09 01 Systems Theory	
Usability	This module is a compulsory module for the specialization area of Communications and Information Technology within the *Diplom* programme in Electrical Engineering. It provides various tools necessary to pass the exams of the elective modules.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The assessment is a written exam of 180 minutes.	
ECTS credit points and grades	4 ECTS credit points The module grade is the grade of the written exam.	
Frequency	annually, in the summer semester	
Workload	120 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 10 04	Communication Networks, Basic Module (*Kommunikationsnetze, Basis-modul*)	Prof. Dr.-Ing. Frank Fitzek
Contents and objectives	Content: The principles of message routing in communication networks, the architecture of communication networks in wire-bound, wireless and optical technology and the communication protocols of the OSI model. Media access methods, multiplexing techniques and the transmission technology ATM are introduced. Objectives: The students master circuit switching and packet switching methods, layered protocols and they can evaluate static and statistical multiplexing methods. The students are acquainted with TCP/IP and CSMA/CD exemplary. They know fundamental methods for network design.	
Modes of teaching and learning	2 SWS lecture, 2 SWS tutorial and self-study	
Prerequisites	Mathematics (e.g. Calculus for functions with several variables, probabilistic theory) as well as competences acquired in modules such as ET-12 10 24 Communications and ET-12 09 01 Systems Theory	
Usability	This module is a compulsory module for the specialization area of Communications and Information Technology within the *Diplom* programme in Electrical Engineering. It provides various tools necessary to pass the exams of the elective modules.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The assessment is a written exam of 150 minutes.	
ECTS credit points and grades	4 ECTS credit points The module grade is the grade of the written exam.	
Frequency	annually, in the summer semester	
Workload	120 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 10 05	Communication Networks, Advanced I (*Kommunikationsnetze, Aufbaumodul*)	Prof. Dr.-Ing. Frank Fitzek
Contents and objectives	Content: • The planning process for communication networks with transport, service and cost modelling and principles for the dimensioning and routing in communication networks, including their implementation in algorithmic or heuristic optimization approaches • Integrated packet networks with selected basics of networking technologies and protocols for LAN, MAN and WAN Objectives: Having succeessfully completed this module, the students have a sound knowledge of planning, dimensioning and optimization of integrated communication networks. They understand the procedures and protocol structures that are used for efficient, flexible and reliable operation of these networks and have an overview of currently used technologies and their trends. The students are familiar with the basic technologies for integrated communication networks. They understand the system structures and processes and are able to evaluate and apply these. They master the most important networking technologies, their operating principles and protocols and are able to apply these to new problems.	
Modes of teaching and learning	4 SWS lecture, 2 SWS tutorial and self-study	
Prerequisites	Competences acquired in modules such as ET-12 10 24 Communications and ET-12 10 04 Communication Networks, Basic Module	
Usability	This module is an elective module for the specialization area of Communications and Information Technology within the *Diplom* programme in Electrical Engineering as well as an elective module within the Diplom programme in Information Systems Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The assessment consists of a written exam (120 minutes) and an oral exam (30 minutes). If less than 15 students take part in the module, the written exam can be replaced by an oral exam of 30 min.	
ECTS credit points and grades	7 ECTS credit points The module grade is the arithmetic mean of the grades for both elements of assessment.	
Frequency	annually, in the summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 10 19	Optimization in modern Communication Systems *(Optimierung in modernen Kommunikationssystemen)*	Prof. Dr.-Ing. E. Jorswieck
Contents and objectives	Content: The foundations of optimization in communication systems and modern methods of signal processing for communication in radio systems Ojectives: The students are familiar with optimization problems that occur in communication technology as well as with modern approaches and methods of information theory and signal processing. The students have the mathematical knowledge necessary for classifying these problems and master both analytical methods as well as numerical methods for the solution thereof. They are able to apply these to different scenarios and are thus able to develop optimal and efficient strategies for current problems in modern communication systems.	
Modes of teaching and learning	4 SWS lecture, 2 SWS tutorial, and self-study The language of instruction can be either German or English. At the beginning of the teaching period, the lecturer announces whether the module will be taught in English or German.	
Prerequisites	Knowledge in systems theory and information theory, in algebraic and analytic fundamentals, and in communications	
Usability	This module is an elective module for the specialization area of Communications and Information Technology within the *Diplom* programme in Electrical Engineering as well as for the specialization area of Communication Technology within the *Diplom* programme in Information Systems Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The assessment consists of two written exams (120 minutes each).	
ECTS credit points and grades	7 ECTS credit points The module grade is the arithmetic mean of the grades for both elements of assessment.	
Frequency	annually, in the winter semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 10 20	Communication Networks, Advanced II (*Kommunikationsnetze, Vertiefungsmodul*)	Prof. Dr.-Ing. Frank Fitzek
Contents and objectives	Content: • Tools for analyzing the performance of communication systems, in particular the analytical and simulative approach, and the exemplary realization by implementation • Future communication systems, their planning, analysis and structure • Approaches to project-based work, incl. work-structuring and presentation of the results (in writing and oral) in front of an expert public Objectives: Having successfully completed this module, the students have a thorough understanding of the modelling and performance analysis of communication networks and their protocols. They are able to chose and apply appropriate methods of investigation for various problems. The students have learned to look at their tasks in a professional manner, to structure their project in terms of work and time, and to present their results in a public-oriented manner.	
Modes of teaching and learning	4 SWS lecture, 2 SWS tutorial, and self-study The language of instruction can be either German or English. At the beginning of the teaching period, the lecturer announces whether the module will be taught in English or German.	
Prerequisites	Competences acquired in modules such as ET-12 10 24 Communications and ET-12 10 04 Communication Networks, Basic Module	
Usability	This module is an elective module for the specialization area of Communications and Information Technology within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The assessment consists of a written exam (120 minutes) and a project (30 hours). If less than 15 students take part in the module, the written exam can be replaced by an oral exam of 30 min.	
ECTS credit points and grades	7 ECTS credit points The module grade is the arithmetic mean of the grades for both elements of assessment.	
Frequency	annually, in the winter semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 10 08	Statistics (*Statistik*)	Prof. Dr.-Ing. Frank Fitzek
Contents and objectives	Content: • Theoretical and practical fundamentals and methods of descriptive statistics (moments and calculation rules; important specific probability distributions, limit theorems) • Estimation and testing of the assessing statistics (point and interval estimates, hypothesis tests, analysis of statistical correlations) Objectives: The students are able to carry out scientific investigations of mass phenomena based on combinatorics and probability theory. By doing so, they obtain information on the basic population of the considered objects or processes from concrete samples, taking probabilistic models into account. They are able to find the necessary statistical models and lead them to an analytical treatment. The students are able to determine sample function, to estimate statistical parameters, confidence and prediction intervals, to test hypotheses on distribution parameters or laws using statistical methods and to identify stochastic correlations between several parameters.	
Modes of teaching and learning	4 SWS lecture, 2 SWS tutorial, and self-study	
Prerequisites	Competences acquired in modules such as ET-01 04 01 Principles of Algebra and Analysis, ET-01 04 02 Multivariable Calculus, ET-01 04 03 Special Chapters of Mathematics and ET-12 09 01 Systems Theory	
Usability	This module is an elective module for the specialization area of Communications and Information Technology within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The assessment consists of two written exams (135 minutes each).	
ECTS credit points and grades	7 ECTS credit points The module grade is the arithmetic mean of the grades for both elements of assessment.	
Frequency	Annually The module starts in the summer semester.	
Workload	210 hours	
Duration	2 semesters	

Module number	Module name	Lecturer in charge
ET-12 10 09	Network Information Theory (*Netzwerk-Informationstheorie*)	Prof. Dr.-Ing. E. Jorswieck
Contents and objectives	This module comprises: Elements of the multi-user information theory, meaning capacity regions and attainable rate regions of multiple access channels, broadcast channels, relay channels, interference channels with coding theorems and converse Intended learning outcome: After completing this module, students are familiar with the elements of the network information theory and the basic results regarding capacity regions und attainable rate regions. Students further obtain information theoretical and mathematical tools to prove coding theorems. Amongst these coding theorems are superposition coding, Gelfand-Pinkser coding, dirty-paper coding, successive-interference-cancellation, Han-Kobayashi-coding, backward-decoding and many more. Furthermore, students will know the current status of technology – e.g. the capacity region of the multi-antenna broadcast channel – as well as unsolved issues regarding network information theory and its difficulties. They further apply their gained knowledge and the functional interpretation of system designs of future mobile communication systems, for cellular systems (multiple access and broadcast channel), relay and multi-hop systems as well as ad hoc networks to specific tasks. Moreover, they confidently deploy various performance metrics, are familiar with the stochastic description of wireless networks, and can evaluate average and outage-performances.	
Modes of teaching and learning	4 SWS lecture, 2 SWS tutorial and self-study	
Prerequisites	Competences provided by modules such as ET-12 10 01 Information Theory and ET-12 10 02 Advanced Seminar Communications Engineering	
Usability	This module is a compulsory module for the specialization area of Communications and Information Technology within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The assessment consists of a written exam of 150 min.	
ECTS credit points and grades	7 ECTS credit points The module grade is the grade of the written exam.	
Frequency	annually, in the summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 10 12	Antennas and Propagation (*Antennen und Wellenausbreitung*)	Prof. Dr.-Ing. D. Plettemeier
Contents and objectives	The content of this module is: Basic concepts of antenna theory and electromagnetic wave propagation. Objectives: The students are familiar with the calculation of linear- and aperture radiators and know the basic principles and methods for the calculation of wave fields. The students know the application of Green's theorems and approach. They are familiar with equivalent circuits of the input impedance and the design of matching networks. The students are capable of approximating radiation characteristics of phased antenna array as well as designing reflector antennas and compact high gain antennas (e.g. Cassegrain and Gregory systems). They will be able to evaluate characterize and measure antenna performance.	
Modes of teaching and learning	4 SWS lectures, 2 SWS tutorials and self-study	
Prerequisites	Competences acquired in modules such as ET-12 10 03 RF engineering, ET-12 10 24 Communications and ET-12 09 01 Systems Theory	
Usability	This module is an elective module for the specialization area of Communications and Information Technology within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The module assessment consists of an oral exam of 45 minutes.	
ECTS credit points and grades	7 ECTS credit points The module grade is the grade of the oral exam.	
Frequency	annually, in the summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 10 13	RF Systems (*Hochfrequenzsysteme*)	Prof. Dr.-Ing. D. Plettemeier
Contents and objectives	The module content: The operation and the physical basics of modern RF and wireless systems. Objectives: The students are familiar with ground- and satellite-based radio navigation and positioning systems. Communication satellite links can be described at system level. Basic understanding of satellite technology, antenna systems and phenomena of wave propagation (free space propagation, atmospheric absorption, plasma frequency, reflection and scattering, Doppler effect, etc.) are taught. The students are familiar with the different radar techniques (e.g. pulse-radar, pulse Doppler radar, FMCW radar and secondary radar, MTI principle, chirp) and with the system description and signal processing. They have obtained knowledge regarding the functionality and methods of the signal processing of radar imaging techniques (e.g. SAR principles).	
Modes of teaching and learning	4 SWS lecture, 2 SWS tutorial and self-study	
Prerequisites	Competences acquired in modules such as ET-12 10 03 RF Engineering, ET-12 10 24 Communications and ET-12 09 01 Systems Theory	
Usability	This module is an elective module for the specialization area of Communications and Information Technology within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The module assessment is an individual oral exam of 45 minutes.	
ECTS credit points and grades	7 ECTS credit points The module grade is the grade of the oral exam.	
Frequency	annually, in the summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 10 14	Optical Communications (*Optische Nachrichtentechnik*)	Prof. Dr.-Ing. D. Plettemeier
Contents and objectives	The module comprises: the design and the development of optical transmission systems Intended learning outcomes: The students are proficient with the physical basics of different types of optical waveguides (planar wave guides, single mode and multi mode fiber) and the transmission properties in linear and nonlinear regime. Further important points are optical connection and measurement methods, passive optical components (couplers, isolators, interferometers) as well as optical transmission systems from the system theoretical point of view. Here, recent and future synchronous and asynchronous optical networks operating in time and wavelength division multiplex are focused. The students know the different system approaches (e.g. optical packet switching, dynamically switched optical networks) and the network technologies needed for that (modulation formats, signal regeneration, compensation of transmission impairments).	
Modes of teaching and learning	4 SWS lectures, 2 SWS tutorials and self-study	
Prerequisites	Competences acquired in modules such as ET-12 10 03 RF Engineering, ET-12 10 24 Communications and ET-12 09 01 Systems Theory	
Usability	This module is an elective module for the specialization area of Communications and Information Technology within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The module assessment consists of an oral exam of 45 minutes.	
ECTS credit points and grades	7 ECTS credit points The module grade is the grade of the oral exam.	
Frequency	annually, in the summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 10 15	Basics Mobile Communications Systems (*Grundlagen Mobile Nachrichtensysteme*)	Prof. Dr.-Ing. Dr. h.c. G. Fettweis
Contents and objectives	Having completed the module, the students know and understand the basic structure of cellular mobile communications systems (system and protocol architectures, radio network planning and optimization, capacity calculation). They are able to analyze und to solve problems of radio network planning. They know the phenomena of the mobile radio channel (Doppler effect, multipath propagation), master the basic principles of digital signal transmission over frequency-selective and time-variant transmission channels and are able to analyze, to describe mathematically and to work out solutions for real-word data transmission problems.	
Modes of teaching and learning	4 SWS lecture, 2 SWS tutorial and self-study	
Prerequisites	Competences acquired in modules such as ET-01 04 01 Principles of Algebra and Analysis, ET-01 04 02 Multivariable Calculus, ET-01 04 03 Special Chapters of Mathematics, ET-12 10 24 Communications and ET-12 09 01 Systems Theory	
Usability	The module is an elective module in the specialization area of Communications and Information Technology within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of credit points	The credit points are earned if the module assessment is passed. The assessment consists of a written exam of 180 minutes.	
ECTS credit points and grades	7 ECTS credit points The module grade is the grade of the exam.	
Frequency	annually in the summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 10 16	Digital Signal Processing and Hardware Implementation (*Digitale Signalverarbeitung und Hardwareimplementierung*)	Prof. Dr.-Ing. Dr. h.c. G. Fettweis
Contents and objectives	Having completed the module, the students master processes for software implementation of digital signal processing algorithms on different hardware platforms and can evaluate them with respect to various criteria. The students know methods for hardware and software realization of communications engineering problems as well as design and optimization methods for digital signal processing systems. They are able to design and optimize signal processing systems in the field of communications by taking into account the mutual influence of the hardware and software (HW / SW co-design).	
Modes of teaching and learning	2 SWS lectures, 2 SWS tutorial, 2 SWS lab course and self-study The module can be taught in English.	
Prerequisites	Competences acquired in modules such as ET-01 04 01 Principles of Algebra and Analysis, ET-01 04 02 Multivariable Calculus, ET-01 04 03 Special Chapters of Mathematics, ET-12 10 24 Communications and ET-12 09 01 Systems Theory	
Usability	The module is an elective module in the specialization area of Communications and Information Technology within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of credit points	The credit points are earned if the module assessment is passed. The module assessment consists of two exams. Exam 1 is a written exam of 120 minutes if the number of participants exceeds 16. With up to 16 participants, the written exam will be replaced by an oral exam as an individual exam of 20 minutes. The type of exam will be announced at the end of the registration period at the faculty. Exam 2 is a lab report.	
ECTS credit points and grades	7 ECTS credit points The module grade results from the arithmetic mean of the grades of both elements of assessment.	
Frequency	annually, beginning in the summer semester	
Workload	210 hours	
Duration	2 semesters	

Module number	Module name	Lecturer in charge
ET-12 10 17	Upgrade Mobile Communications Systems (*Vertiefung Mobile Nachrichtensysteme*)	Prof. Dr.-Ing. Dr. h.c. G. Fettweis
Contents and objectives	Having completed this module, the students are able to understand the concepts of modern mobile systems and to contribute creatively to solve radio transmission problems under mobile communications conditions. The students have a deeper understanding of the problems in mobile communications (signal transmission via disturbed frequency-variant and time-variant communication channels), have the knowledge and skills to analyze theoretically these problems, to develop and implement practical solutions.	
Modes of teaching and learning	The module includes lectures, tutorials and lab courses in the amount of 6 SWS and self-study. The courses are to be chosen from the catalogue "*Vertiefung Mobile Nachrichtensysteme*" (Upgrade Mobile Communication Systems) in the given amount. The module can be taught in English.	
Prerequisites	Competences acquired in modules such as ET-01 04 01 Principles of Algebra and Analysis, ET-01 04 02 Multivariable Calculus, ET-01 04 03 Special Chapters of Mathematics, ET-12 10 24 Communications and ET-12 09 01 Systems Theory	
Usability	The module is an elective module in the specialization area of Communications and Information Technology within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of credit points	The credit points are earned if the module assessment is passed. The module assessment is a written exam of 150 minutes if the number of participants exceeds 20. With up to 20 participants, the written exam will be replaced by an oral exam as an individual exam of 40 minutes.	
ECTS credit points and grades	7 ECTS credit points The module grade is the grade of the exam.	
Frequency	annually in the winter semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 10 18	Digital Signal Processing Systems (*Digitale Signalverarbeitungssysteme*)	Prof. Dr.-Ing. Dr. h.c. G. Fettweis
Contents and objectives	Having completed the module, the students have the mathematical knowledge necessary for describing and analyzing discrete-time systems (e.g., fundamentals of time-discrete systems and spectral analysis of time, signal sampling and reconstruction, digital filtering, quantization, multirate systems, adaptive filtering), and can use this knowledge in the design and implementation of digital signal processing systems. The students are able to simulate signal processing modules and to implement them with the help of digital signal processors (DSPs).	
Modes of teaching and learning	3 SWS lecture, 1 SWS tutorial, 2 SWS lab course and self-study	
Prerequisites	Competences acquired in modules such as ET-01 04 01 Principles of Algebra and Analysis, ET-01 04 02 Multivariable Calculus, ET-01 04 03 Special Chapters of Mathematics, ET-12 10 24 Communications and ET-12 09 01 Systems Theory	
Usability	The module is an elective module in the specialization area of Communications and Information Technology within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of credit points	The credit points are earned if the module assessment is passed. The module assessment consists of a written exam of 120 minutes and a lab report.	
ECTS credit points and grades	7 ECTS credit point The module grade results from the weighted grades of the elements of assessment; the written exam contributes by 2/3 and the lab report by 1/3.	
Frequency	annually in the winter semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 10 21	Network Coding: Theory and Practice (*Netzwerkkodierung in Theorie und Praxis*)	Prof. Dr.-Ing. Frank Fitzek
Contents and objectives	Content: • Theoretical fundamentals of network coding (NC) • Evaluation of NC's performance in present and future communications systems Objectives: The students are able to cope with the joint treatment of coding and routing in networks. They know both the classic NC in wire-bound and the extension to the wireless case. They are familiar with current research topics in the fields of modulation and coding in networks as well as modern methods for data storage and secure data transmission, such as network coded modulation, lattice codes, compute-and-forward, distributed data storage and secure network coding. They know the performance of NC systems and are familiar with the simulation as well as the implementation of NC on simple communication systems.	
Modes of teaching and learning	4 SWS lecture, 2 SWS tutorial, and self-study The language of instruction can be either German or English. At the beginning of the teaching period, the lecturer announces whether the module will be taught in English or German.	
Prerequisites	Competences acquired on modules such as Information Theory, Systems Theory, Communications and Communication Networks/basic module	
Usability	This module is an elective module for the specialization area of Communications and Information Technology within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The assessment consists of two written exams (120 minutes each). If less than 15 students take part in the module, the written exams can be replaced by oral exams (30 min. each).	
ECTS credit points and grades	7 ECTS credit points The module grade is the arithmetic mean of the grades for both elements of assessment.	
Frequency	Annually, in the summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 10 22	Cooperative Communications (*Kooperative Kommunikation*)	Prof. Dr.-Ing. Eduarf Jorswieck
Contents and objectives	Content: • Modern methods of resource allocation in radio systems • Their application to cooperative communication systems Objectives: The knowledge of approaches and methods of game theory makes it possible to analyse conflict situations such as occur in resource allocation in radio systems. The students are familiar with the fundamental mathematical tools of the game theory and master their application in cooperative and non-cooperative systems in the field of mobile communication. They are familiar with example systems and the corresponding analytical and simulative approach, as well as the exemplary realisation by means of implementation on practical systems.	
Modes of teaching and learning	4 SWS lecture, 2 SWS tutorial, and self-study The language of instruction can be either German or English. At the beginning of the teaching period, the lecturer announces whether the module will be taught in English or German.	
Prerequisites	Competences acquired on modules such as Information Theory, Systems Theory and Communications	
Usability	This module is an elective module for the specialization area of Communications and Information Technology within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The assessment consists of two written exams (120 minutes each). If less than 15 students take part in the module, the written exams can be replaced by oral exams (30 min. each).	
ECTS credit points and grades	7 ECTS credit points The module grade is the arithmetic mean of the grades for both elements of assessment.	
Frequency	Annually, in the summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 10 23	Seminar for Graduate Students on Information Technology (*Oberseminar Informationstechnik*)	
Contents and objectives	Content: - Current trends and issues of Information Technology in various applications - Methods of scientic and project-based working as well as the presentation of results Objectives: The students are capable of solving a given task independently, individually, and in teams. They master the documentation of the work and the methods used, and are capable of presenting and discussing the results.	
Modes of teaching and learning	2 SWS seminar and self-study	
Prerequisites	Competences acquired in modules such as ET-12 09 02 Signal Theory, ET-12 10 01 Information Theory, ET-12 08 18 Integrated Circuit Design and ET-12 09 06 Acoustics	
Usability	The module is an elective module of the specialization area of Communications and Information Technology within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessement is passed. The module assessment consists of an assignment and a presentation of 30 minutes.	
ECTS credit points and grades	4 ECTS credit points The module grade consists to 2/3 of the grade for the assignment and to 1/3 of the grade for the presentation.	
Frequency	annually, in the winter semester	
Workload	120 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 11 01	Solid-state and Nano Electronics (*Festkörper- und Nanoelektronik*)	Prof. Dr.-Ing. habil. G. Gerlach
Contents and objectives	The module comprises: - **Solid-state electronics** with electronic functions based on di-, piezo-, pyro- and ferroelectricity, magnetic effects, electronic effects of plasmons and electron emission, - **Nanotechnology and nanoelectronics** of nanoelectronic devices (effects in nanodots and nanowires as well as effects taking place at very small numbers of charge carriers). Intended learning outcome: After successfully passing the module, students are able - to bring physically caused material effects to bear, - to apply probability-based theoretical basics of these effects, - to evaluate these effects, and - to use electronic and ionic effects for up-to-date electron devices.	
Modes of teaching and learning	4 SWS lecture, 2 SWS tutorial, self-study	
Prerequisites	Competences acquired in modules such as ET-01 04 01 Principles of Algebra and Analysis, ET-01 04 02 Multivariable Calculus, ET-01 04 03 Special Chapters in Mathematics, ET-13 00 01 Materials Science and Engineering Mechanics, and ET-12 12 01 Microsystems and Semiconductor Technology	
Usability	The module is an elective module in the specialization area of Microelectronics within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. This assessment consists of an oral exam of 30 minutes (up to 8 students) or of a written exam of 90 minutes (at least 9 students).	
ECTS credit points and grades	7 ECTS credit points The module grade is either the grade of the oral or of the written exam.	
Frequency	annually, in the summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	**Module name**	**Lecturer in charge**
ET-12 11 02	Theoretical Acoustics (*Theoretische Akustik*)	Prof. Dr. rer. nat. et Ing. habil. E. Kühnicke
Contents and objectives	The module content: 1. Sound field modeling - Reflection and refraction of plane waves at angular incidence, - Integral forms and Green's functions - Integral transform methods for the solution of the boundary value problem in solids, non-idealized boundary conditions, sound fields of point sources (of any orientation monopole and dipole tensor sources) in plates - Fundamental principles of sound-field simulation in complex geometries - Calculation of the sound field for extended transducers: harmonic and transient fields 2. New wave acoustic measurement methods 3. Signal processing with MatLab Outcomes: On completion of the module, students will master methods for solving partial differential equations. They are familiar with the calculation of the fields of point sources (Green's functions) in half-spaces and disks. Based on this, they are familiar with the modeling of the fields of extended sources in layered media with nonparallel and curved interfaces. On completion of the module, students have gained knowledge of signal processing and are capable of using sound field calculations in order to evaluate measured signals correctly under consideration of wave acoustics. Further, students are capable of gaining information about the parameters of an object from these signals.	
Modes of teaching and learning	3 SWS lecture, 3 SWS tutorial and self-study	
Prerequisites	Competences acquired in modules such as ET-01 04 01 Principles of Algebra and Analysis, ET-01 04 02 Multivariable Calculus, ET-01 04 03 Special Chapters in Mathematics, and ET-02 06 04 01 Physics	
Usability	The module is an elective module in the specialization area of Microelectronics within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. This assessement is a written exam of 90 minutes.	
ECTS credit points and grades	7 ECTS credit points The module grade is the grade of the written exam.	
Frequency	annually, in the winter semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 11 03	Ultrasound (*Ultraschall*)	Prof. Dr. rer. nat. et Ing. habil. E. Kühnicke
Contents and objectives	The module content: **1. Fundamentals of ultrasound** - Geometrical considerations on refraction and reflection - Fundamentals of wave propagation in fluids and solids: wave equation, equation of motion, vector equations, potentials, Hooke's law, reflection, refraction, mode conversion . and **2. Ultrasonic sensors / ultrasonic measuring technology** - Application of ultrasound for nondestructive testing and medical diagnostics - Pulse-echo method, signal processing, imaging techniques, microscopy - Doppler measurement, acoustic emission testing, SAW, new wave acoustic measurement methods - Transducers – single element probe, TR-probe, arrays, construction, equipment, electronics Outcomes: On completion of the module, students are capable of handling the fundamentals of ultrasonic excitation and wave propagation in solid. Further, for the ultrasound measurement, they know typical measurement methods and imaging techniques. They will be able to work in the field of nondestructive testing, ultrasonic measurement techniques and medical diagnostic ultrasound. They have a complex knowledge of ultrasonic measurements in liquids, solids, tissues, and can choose appropriate methods and can test and develop adapted measuring set-up.	
Modes of teaching and learning	4 SWS lecture, 1 SWS tutorial, 1 SWS lab course and self-study	
Prerequisites	Competences acquired in modules such as ET-01 04 01 Principles of Algebra and Analysis, ET-01 04 02 Multivariable Calculus, ET-01 04 03 Special Chapters in Mathematics, and ET-02 06 04 01 Physics	
Usability	The module is an elective module in the specialization area of Microelectronics within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. This assessment is a written exam of 120 minutes.	
ECTS credit points and grades	7 ECTS credit points The module grade is the grade of the written exam.	
Frequency	annually, in the summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 11 04	Sensors and Sensor Systems (*Sensoren und Sensorsysteme*)	Prof. Dr.-Ing. habil. G. Gerlach
Contents and objectives	The module comprises: - Physical effects connecting diverse measurands of sensors with electronic sensor quantities - Properties of sensors (material properties, transducer mechanisms, fabrication technology, construction of sensors, application requirements), - Design, application and operation of sensors Intended learning outcome: After successfully passing the module students are able - to apply physical basics of sensors, - to connect coupling effects and interferences caused by material properties, fabrication and application, - to estimate the impact of effects upon the sensor behaviour and to compare it with other influences, and - to use sensors for diverse applications.	
Modes of teaching and learning	Lectures, tutorials, and lab work with at least 6 SWS, chosen from a catalogue of courses (typically 4 SWS lecture, 1 SWS tutorial, 1 SWS lab course); self-study	
Prerequisites	Competences acquired in modules such as ET-01 04 01 Principles of Algebra and Analysis, ET-01 04 02 Multivariable Calculus, ET-01 04 03 Special Chapters in Mathematics, and ET-12 12 01 Microsystems and Semiconductor Technology	
Usability	The module is an elective module in the specialization area of Microelectronics within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The module assessment consists of a written exam of 150 minutes and a lab course. Both elements of assessment have to be passed successfully.	
ECTS credit points and grades	7 ECTS credit points The module grade is calculated from the weighted average of both the grade of the written exam (2/3) and the grade of the lab course (1/3).	
Frequency	annually, in the winter semester	
Workload	210 hours	
Duration	1 semester	

Module number	**Module name**	**Lecturer in charge**
ET-12 12 01	Microsystems and Semiconductor Technology (*Mikrosystem- und Halbleitertechnologie*)	Prof. Dr.-Ing. habil. W.-J. Fischer
Contents and objectives	The module includes: - Fundamentals of microsystems technology - Micro-structuring technologies (manufacturing of complex, miniaturized systems) - Materials for semiconductor and micro technology - Sensory applications (basic material, semiconductor technologies, micro technology) Outcomes: On completion of the module, the students have the ability to specifically select the materials of the semiconductor and micro technology for micro sensor and micro actuator applications, to determine their functional parameters and to use the associated semiconductor technologies for structuring and system configuration.	
Modes of teaching and learning	8 SWS lecture, 1 SWS seminar, 3 SWS lab course and self-study	
Prerequisites	Basic knowledge acquired in modules such as ET-12 08 01 Fundamentals of Electrical Engineering, ET-13 00 01 Materials Science and Engineering Mechanics, and ET-12 08 11 Microelectronic Technologies and Devices	
Usability	The module is is a compulsory module in the specialization area of Microelectronics within the *Diplom* programme in Electrical Engineering. It provides various tools necessary for passing the assessments of the elective modules.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The module assessment consists of two individual oral exams, each 35 minutes in duration. Both exams must be passed.	
ECTS credit points and grades	12 ECTS credit points The grade of the module is determined by the arithmetic mean of the grades of both oral exams.	
Frequency	annually, starting in winter semester	
Workload	360 working hours	
Duration	2 semesters	

Module number	Module name	Lecturer in charge
ET-12 12 02	Design of Microsystems (*Entwurf von Mikrosystemen*)	Prof. Dr.-Ing. habil. U. Marschner
Contents and objectives	The module includes: - Design of microsystems with modeling and simulation of techniques and processes (electrical devices, sensors and actuators as well as complete systems) - Electromechanical networks with mechanical, magnetic, fluidic (acoustic) and coupled systems (circuit-oriented representation, interaction) - Combination of network modelling with the method of finite element modeling (complete systems consisting of electrical and non electrical components) Outcomes: The students have competences: - to describe the basic model of technological processes - in effective design and descriptive analysis of the dynamic behavior of electro-mechanical, magnetic and fluidic systems - about the function and modeling electromechanical transducers - in operation and applications of FEM and FDM methods - in complete system description using HDL languages	
Modes of teaching and learning	4 SWS lecture, 2 SWS seminar, 1 SWS lab course and self-study	
Prerequisites	Basic knowledge of Materials and Technical Mechanics and Physics	
Usability	The module is an elective module in the specialization area of Microelectronics within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The module assessment is a written exam of 150 minutes.	
ECTS credit points and grades	7 ECTS credit points The grade of the module is the grade of the written exam.	
Frequency	annually, in the summer semester	
Workload	210 working hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 12 03	Applied Thin-Film and Solar Technology (*Angwandte Dünnschicht- und Solartechnik*)	Prof. Dr. rer. nat. J. W. Bartha
Contents and objectives	The module includes: - the production of electronic devices and solar cells by the vacuum-based generation of thin films Objectives: Having successfully completed this module, the students are familiar with: - the kineatic theory of gases - the generation of vacuum and vacuum measurement - the dimensioning of vacuum plants The students are capable of: - applying processes of thin film technology - using interactions between materials and the characteristics of the film - differentiating between the various types of solar cells and their manufacturing technologies - mastering the methods of process control - characterizing failure mechanisms of the devices	
Modes of teaching and learning	6 SWS lecture and self-study	
Prerequisites	Knowledge of Materials, Technical Mechanics and Physics	
Usability	The module is an elective module in the specialization area of Microelectronics within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The module assessment is an individual oral exam of 45 minutes.	
ECTS credit points and grades	7 ECTS credit points The grade of the module is the grade of the oral exam.	
Frequency	annually, in the summer semester	
Workload	210 working hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 12 04	Memory Technology (*Speichertechnology*)	Prof. Dr.-Ing. T. Mikolajick
Contents and objectives	This module covers memory concepts in the market and in research respectively development stage: - Magnetic memories - Optival memories - Semiconductor memories (SRAM, DRAM, nonvolatile Memories (EPROM, EEPROM, Flash)) - Innovative semiconductor memories (e.g. ferroelectric, magnetoresistive, resisitive, organic, and single molecule memories) Objectives: After completion of the module the students have the competences to optimize and develop new generations of existing memory concepts. Based on the physical effects they will also be able to develop new memory concepts. Furthermore, the students are able to evaluate the areas of application for the memory concept and are aware of their limitation.	
Modes of teaching and learning	3 SWS lecture, 2 SWS seminar, and self-study The module is at least partially taught in English.	
Prerequisites	Competences acquired in modules such as ET-12 08 11 Microelectronic Technologies and Devices and ET-12 08 13 Physics of Selected Devices	
Usability	The module is an elective module in the specialization area of Microelectronics within the *Diplom* programmes in Electrical Engineering and Information Systems Engineering as well as within the Master's programme in Nanoelectronic Systems.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The module assessment is an individual oral exam of 25 minutes.	
ECTS credit points and grades	7 ECTS credit points The grade of the module is the grade of the oral exam.	
Frequency	Annually The module starts in the summer semester.	
Workload	210 working hours	
Duration	2 semesters	

Module number	Module name	Lecturer in charge
ET-12 12 05	Characterization of Microstructures (*Charakterisierung von Mikrostrukturen*)	Prof. Dr. rer. nat. J. W. Bartha
Contents and objectives	The module consists of: - Testing and assignment of micro and nanostructures of semiconductor devices and integrated circuits using semiconductor measurement techniques. - Layer and substrate characterization by physical microanalysis. Objectives for qualification: The students are capable of - generating and detecting photon and high energy particle based radiation - using the interaction between photons or particles and solids - applying micro analytical techniques for the characterization of materials - determining geometrical and electrical parameters of micro devices	
Modes of teaching and learning	6 SWS lecture, 1 SWS lab course and self-study	
Prerequisites	Competences acquired in modules such as ET-13 00 01 Materials Science and Engineering Mechanics, and ET-02 06 04 01 Physics	
Usability	The module is an elective module of the specialization area of Microelectronics within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The module assessment consists of an individual oral examination with a duration of 45 min.	
ECTS credit points and grades	7 ECTS credit points The grade of the module is the grade of the oral exam.	
Frequency	annually, each winter semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 12 06	New Actuators and Actuator Systems (*Neue Aktoren und Aktorsysteme*)	Prof. Dr.-Ing. A. RIchter
Contents and objectives	Content: - Unconventional actuators (Systematics of actuatoric effects, the physical basis of these effects, operating principles, design and dimensioning guidelines, application examples and relevant application fields) - microfluidics (Fluid properties, fluid dynamics, phenomena of fluid manipulation, basic elements and basic operations, platform technologies, analytical methods) Objectives: The students are able to select appropriate actuator principles for specific tasks, to define the necessary interfaces for the system implementation and to dimension the actuator elements appropriately. They are able to recognize the unique physical characteristics of the fluid motion in microstructures and are able to apply technologies and analysis methods for microfluidic systems.	
Modes of teaching and learning	4 SWS lecture, 1 SWS tutorial, 1 SWS lab course, and self-study	
Prerequisites	Competences acquired in modules such as ET-12 08 06 Measurement and Sensor Techniques, ET-12 12 01 Microsystems and Semiconductor Technology and ET-12 12 02 Design of Microsystems	
Usability	The module is an elective module of the specialization area of Microelectronics within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The module assessment consists of an individual oral exam (30 min.), a presentation and a lab course.	
ECTS credit points and grades	7 ECTS credit points The grade of the module is the weigthed mean of the grades for the different elements of assessment: the grade for the oral exam contributes by 50%, the grade for the presentation and for the lab course contribute by 25% each.	
Frequency	annually, each winter semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 12 07	Innovative Concepts for Active Nanoelectronic Devices (*Innovative Konzepte für aktive nanoelektronische Bauelemente*)	Prof. Dr.-Ing. T. Mikolajick
Contents and objectives	Content: - Technology of nanoelectronic devices - (Generation of electronic devices in nm-dimensions) - Modelling of nanoelectronic devices Objectives: The students are able to - to design innovative concepts for active nanoelectronic devices - to understand physical effects and transport mechanisms - to develop analytical descriptions of physical mechanisms in nanostructured devices - to recognize concrete embodiments of devices that are currrently in the research or development stage as well as the respective technological, material science and electrical conditions	
Modes of teaching and learning	4 SWS lecture, 2 SWS tutorial, and self-study	
Prerequisites	Competences acquired in modules such as ET-12 08 13 Physics of Selected Devices	
Usability	The module is an elective module in the specialization area of Microelectronics within the *Diplom* programme in Electrical Engineering and within the Master's programme in Nanoelectronic Systems.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The module assessment is an individual oral exam of 25 minutes, an assignment and a presentation.	
ECTS credit points and grades	7 ECTS credit points The grade of the module is the arithmetic mean of the grades for the different elements of assessment.	
Frequency	annually, in the winter semester.	
Workload	210 working hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 12 08	Advanced Seminar Microelectronics (*Oberseminar Mikroelektronik*)	Prof. Dr. rer. nat. J. W. Bartha
Contents and objectives	The module consists of: - Specific topics and trends in microelectronics and - Methods of scientific and project based engineering work. Objectives for qualification: The students are capable of applying their skills and expertise to solve specific problems individually or within a team. They master the documentation of their workflow and cope with the presentation of their results.	
Modes of teaching and learning	2 SWS seminar and self-study	
Prerequisites	Competences acquired in modules such as ET-13 00 01 Materials Science and Engineering Mechanics, and ET-02 06 04 01 Physics	
Usability	The module is an elective module of the specialization area of Microelectronics within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed successfully. The assessment consists of an assignment and a presentation of 30 minutes.	
ECTS credit points and grades	4 ECTS credit points The module grade is derived from the grade for the assignment (2/3) as well as the grade for the presentation (1/3).	
Frequency	annually, each winter semester	
Workload	120 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 13 01	Control of Continuous-Time Processes (*Regelungstechnik*)	Prof. Dr.-Ing. habil. K. Röbenack
Contents and objectives	Content: Basic principles of control of linear systems with focus on frequency domain methods, state-space methods and sampled-data control. Objectives: The students • understand the basic structure of rules and control systems. They are able to mathematically describe linear continuous-time systems (mainly in the frequency range) and to analyse these with regard to their stability. Further, they are able to systematically design single-loop linear controllers. • understand the solutions of state-space models in time and frequency domains, are familiar with the concepts of controllability and observability and are able to check these properties for given systems. They are also capable of designing state controller and state observer and understand the basics of sampled-data control.	
Modes of teaching and learning	5 SWS lecture, 2 SWS tutorial, 2 SWS lab course and self-study	
Prerequisites	Competences acquired in modules such as ET-12 09 01 Systems Theory	
Usability	This module is a compulsory module within the specialization area of Automation, Measurement, and Control in the *Diplom* degree programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The assessment consists of two written exams of 120 minutes each (P1 and P2) as well as a lab course (P3).	
ECTS credit points and grades	9 ECTS credit points The module grade is calculated from the weighted average of the grades of the written exams and the grade of the lab course. PL1 and PL2 contribute by 2/5 each, P3 by 1/5.	
Frequency	Annually The module starts in the winter semester.	
Workload	270 hours	
Duration	2 semesters	

Module number	**Module name**	**Lecturer in charge**
ET-12 13 10	Nonlinear Systems und Process Identification (*Nichtlineare Systeme und Prozessidentifikation*)	Prof. Dr.-Ing. habil. K. Röbenack
Contents and objectives	Content: The module includes • Design and analysis of nonlinear control systems, such as sliding mode control, backstepping and • Identification of parameters from measurement data, for example, by using classes of static, discrete-time and continuous-time models Objectives: The students are able to work with nonlinear control systems, mathematically analyze such systems and dimension simple controller for nonlinear systems. They are able to identify the parameters from measurement data for particular classes of static, discrete-time and continuous-time models.	
Modes of teaching and learning	4 SWS lecture, 2 SWS tutorial, and self-study	
Prerequisites	Competences acquired in modules such as ET-12 09 01 Systems Theory	
Usability	This module is an elective module within the specialization area of Automation, Measurement, and Control in the *Diplom* degree programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The assessment consists of two written exams of 120 minutes each.	
ECTS credit points and grades	7 ECTS credit points The module grade is determined by the arithmetic mean of both exams.	
Frequency	annually, in the summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	**Module name**	**Lecturer in charge**
ET-12 13 11	Nonlinear Control Systems, Advanced (*Nichtlineare Regelungs-systeme – Vertiefung*)	Prof. Dr.-Ing. habil. Klaus Röbenack
Contents and objectives	Content: • Mathematical tools of nonlinear systems (e.g. differential geometry) • System theoretical elements of complex control systems (e. g. spatially distributed systems) Objectives: The students are capable of analyzing complex control systems and dimension nonlinear control systems. They are able to model, identify, analyze, control and regulate complex control systems (e.g. spatially distributed systems) by means of mathematical and system theoretical correlations.	
Modes of teaching and learning	4 SWS lecture, 1 SWS project, and self-study	
Prerequisites	Competences acquired in modules such as ET-12 09 01 Systems Theory and ET-12 13 01 Control of Continuous-Time Processes	
Usability	This module is an elective module within the specialization area of Automation, Measurement, and Control in the *Diplom* degree programme in Electrical Engineering as well as an elective module in the *Diplom* programme of Information Systems Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The assessment consists of two written exams of 90 minutes each.	
ECTS credit points and grades	7 ECTS credit points The module grade is determined by the arithmetic mean of both exams.	
Frequency	Annually The module starts in the summer semester.	
Workload	210 hours	
Duration	2 semesters	

Module number	**Module name**	**Lecturer in charge**
ET-12 13 12	Optimal and Robust Multivariable Control Systems (*Optimale, robuste und Mehrgrößenregelung*)	Prof. Dr.-Ing. habil. K. Röbenack
Contents and objectives	Content: 1. Analysis and design of optimal and / or robust control 2. Design of control concepts for multivariable systems or systems with model uncertainties Objectives: The students create optimal or robust controls and regulations (controller design). They are able to develop control concepts for multivariable systems or systems with model uncertainties, e.g. for the simultaneous influencing or decoupling of several sizes.	
Methods of teaching and learning	4 SWS lecture, 1 SWS project, and self-study	
Prerequisites	Competences acquired in modules such as ET-12 13 01 Control of Continuous-Time Processes	
Usability	This module is an elective module within the specialization area of Automation, Measurement and Control in the *Diplom* degree programme in Electrical Engineering as well as an elective module in the *Diplom* programme in Information Systems Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The assessment consists of two written exams of 90 minutes.	
ECTS credit points and grades	7 ECTS credit points The module grade is determined by the arithmetic mean of both exams.	
Frequency	Annually The module starts in the summer semester.	
Workload	210 hours	
Duration	2 semesters	

Module number	Module name	Lecturer in charge
ET-12 13 13	Seminar for Graduate Students on Control Theory (*Oberseminar Regelungs- und Steuerungstheorie*)	Prof. Dr.-Ing. habil. K. Röbenack
Contents and objectives	The content of the module includes: - Classical and modern concepts of control theory Objectives: After completing this module, students are capable of familiarising themselves with papers on Control Theory as well as Systems Theory, of presenting their hereby acquired knowledge as well as testing their knowledge in examples of use.	
Modes of teaching and learning	2 SWS seminar and self-study	
Prerequisites	Competences acquired in modules such as ET-12 13 01 Control of Continuous-Time Processes, ET-12 13 10 Nonlinear Systems und Process Identification	
Usability	The module is an elective module of the specialization area of Automation, Measurement and Control within the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessement is passed. The module assessment consists of an assignment and a presentation of 30 minutes.	
ECTS credit points and grades	4 ECTS credit points The module grade consists to 2/3 of the grade for the assignment and to 1/3 of the grade for the presentation.	
Frequency	annually, in the winter semester	
Workload	120 hours	
Duration	1 semester	