ECTS – Information Brochure on the Bachelor / Master Degree Programme WS 2021/2022

Department of Electrical Engineering and Information Technology

Bachelor Programme
Electrical Engineering/ Information Technology

Master Programme
Electrical Engineering/ Information Technology

Master Programme
Mechatronics

Ernst-Abbe-Hochschule Jena
University of Applied Sciences

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I.1 Basics about Studying

I.1.1 The academic year

The academic year is divided into two equal semesters – the summer semester and the winter semester. Actual dates may vary according to events at the time. The dates given here serve as a guideline only. Information on the current semester length can be obtained from the Admission and Registrar's Office (Studentensekretariat) and the UAS Jena website.

Winter semester:

Winter semester:	October to March
Examination period:	February
free period:	March

Summer semester:

Summer semester:	April to September
Examination period:	July to the begin of August
free period:	August to the end of September

Holidays:

Christmas holidays:	two weeks before the end of December (including Christmas Eve and New Year's Eve)
Easter:	Good Friday and Easter Monday
German Labour Day:	1 May
Ascension Day:	May (40 days after Easter/varied)
Pentecost:	May (Whit Monday)
German Unity Day:	3. October
Reformation Day:	31. October

Orientation for people interested in studying at the UAS Jena:

University Information Day:	April of every year
Trial study days:	April of every year
Girl's Day:	March/April of every year
Introductory days for first semester students:	at the beginning of the winter semester
Orientation for secondary school classes: Courses	by appointment with the Advisors on Study (see: Important contacts)

I.1.2 Important addresses

Note: For current office hours, see the UAS Jena website (Internet: www.eah-jena.de), the current UAS Jena Study Guide or the information boards of the respective offices.

Department offices:

Each Department (in German: Fachbereich) has a general administration office (in German: Sekretariat).

Business Administration:	Phone: +49 (0)3641 205-550, bw@eah-jena.de
Electrical and Information Engineering:	Phone: +49 (0)3641 205-700, et@eah-jena.de
Fundamental Sciences:	Phone: +49 (0)3641 205-500, gw@eah-jena.de
Mechanical Engineering:	Phone: +49 (0)3641 205-300, mb@eah-jena.de
Medical Engineering and Biotechnology:	Phone: +49 (0)3641 205-600,

	mt@eah-jena.de
SciTec (Precision-Optics-Materials-Environment):	Phone: +49 (0)3641 205-400 Phone: +49 (0)3641 205-350, SciTec@eah-jena.de
Social Work:	Phone: +49 (0)3641 205-800, sw@eah-jena.de
Industrial Engineering:	Phone: +49 (0)3641 205-900, wi@eah-jena.de
Health and Care:	Phone: +49 (0)3641 205-850, gp@eah-jena.de

Central Student Advisory Service (in German: Zentrale Studienberatung)
Bldg. 1, ground floor, room 13 (01.00.13)
Phone: +49 (0)3641 205-122
E-Mail: studienberatung@eah-jena.de

Student secretariat (your first drop-in centre for information) (in German: Servicezentrum Studium und Studienberatung
Bldg. 1, ground floor, room 10 (01.00.10)
Phone: +49 (0)3641 205-232 and -233
E-Mail: studierendensekretariat@eah-jena.de

International Office: (in German: Akademisches Auslandsamt)
Bldg. 1, ground floor, room 12 (01.00.12)
Phone: +49 (0)3641 205-135
E-Mail: auslandsamt@eah-jena.de

Master Service:
Bldg. 1, ground floor, Raum 10 (01.00.11)
Phone: +49 (03641) 205-151; -156
E-Mail: master@eah-jena.de

Career Service:
Bldg. 1 ground floor, room 09 (01.00.09)
Phone: +49 (03641) 205-787
E-Mail: career-service@eah-jena.de

Thoska-Office:
Bldg. 1, ground floor, room 17 (01.00.17)
Phone: +49 (03641) 205-266
E-Mail: thoska@eah-jena.de

Examination offices of the departments:
Each Department (in German: Fachbereich) has an examination office (in German: Prüfungsamt).

Business Administration and Mechanical Engineering:	Phone: +49 (0)3641 205-580 E-Mail: PA-I@eah-jena.de
Social Work and Health & Care:	Phone: +49 (0)3641 205-808 E-Mail: PA-II@eah-jena.de
Electrical Engineering/, Information Engineering, Medical Engineering and Biotechnology, SciTec:	Phone: +49 (0)3641 205-236 E-Mail: PA-III@eah-jena.de
Industrial Engineering:	Phone: +49 (0)3641 205-921 and -928 E-Mail: PA-IV@eah-jena.de

Work placement offices of the departments:
Each Department (in German: Fachbereich) has a work placement office (in German: Praktikantenamt).

All engineering courses:	Mr. Schlegel Phone: +49 (0)3641 205-485 E-Mail: Praktikantenamt-Technik@eah-jena.de
Social Work:	Mr. Scharffenberg Phone: +49 (0)3641 205-805 E-Mail: peter.scharffenberg@eah-jena.de
Business Administration:	Mrs. Baumgart Phone: +49 (0)3641 205-566 E-Mail: gabriele.baumgart@eah-jena.de
Industrial Engineering:	Mrs. Sommerwerk Phone: +49 (0)3641 205-921 bzw. -928 E-Mail: PA-IV@eah-jena.de
Health and Care	Mrs. Wille Phone: +49 (0)3641 205-834 E-Mail: praxisamt-gp@eah-jena.de

Academic sports office:	(in German: Hochschulsport) Bldg. 3, 1st floor, room 11 (03.00.11) Phone: +49 (0)3641 205-254 E-Mail: hochschulsport@eah-jena.de

Library (in German: Bibliothek)**:**

lending service, enquiries, info:	Bldg. 5, ground floor, room 47 (05.00.47) Phone: +49 (0)3641 205-280 E-Mail: bibliothek@eah-jena.de Internet: http://www.eah-jena.de/bib

Appointments for the Patent Information and Patent Enquiry Offices and the university archives should be made via telephone. A **free-of-charge "inventor guidance service"** provided by Jena patent lawyers is held on the third Tuesday of every month in the UAS Jena library. For appointments, please call: +49 (0)3641 205-270.

I.2 Information on Bachelor and Master Degree programmes

I.2.1 What is ECTS?

In Bologna in 1999, 29 European countries signed what is known as the „Bologna Declaration“. The aim was the creation of an "European area of higher education" by 2010. To reach this goal, common academic quality standards have to be established throughout Europe. These standards primarily address

- the adoption of a two-tier system of easily readable and comparable degrees (**Bachelor, Master**),
- the establishment of a system of **modules and credits (ECTS Credits)**,
- promoting the mobility of students (**Diploma Supplement**) as well as of teaching and research staff,
- quality assurance in study and teaching (**evaluation and accreditation**).

One prerequisite for the establishment of a European area of higher education is the European Credit Transfer and Accumulation System (ECTS). This European system for the crediting, transfer and accumulation of students' academic achievements is helpful, for example, when a student switches to another university or – with regard to lifelong learning – when someone starts an additional course of study at home or abroad.

The ECTS system is based on three principles:

1. Information (about the courses attended and outcomes achieved),
2. Learning Agreement (arranged between the institution concerned and the student), and
3. Assignment of ECTS credits (to display the student's workload).

I.2.2 ECTS coordinators

For information about the ECTS, you may contact the Programme Coordinator (Associate Dean/ Studiendekan) or the Departmental Advisor (Studienfachberater) of your study course, or the head of the International Office.

I.2.3 Bachelor

Bachelor degree programmes represent the basic academic course of study and culminate in a university degree that qualifies the graduate to enter a profession. A Bachelor programme lasts three to four years and is designed to enable the student to apply scientific methods in the given key study area and systematically create a basis for subsequent entry into professional life. It also equips students with non-subject-specific knowledge and capabilities. Graduating from a Bachelor degree course is a prerequisite for admission to a Master degree programme.

I.2.4 Master

Master degree programmes are based on a previously completed course of study (e.g., Bachelor). They usually take one to two years and broaden and deepen the knowledge acquired in a Bachelor degree course. Master degree courses can be either “research-oriented” or “application-oriented”, or a combination of both. Furthermore a distinction between “consecutive” (depending on a constitutive Bachelor degree course) and “non-consecutive” Master degree programmes is possible. In addition to this “qualifying” Master degree courses will also be offered at universities. They require additional professional experience (one to five years). Independent scientific work and research under supervision are the focus of a Master degree course. A Master degree is required in order to start a PhD-programme.

I.2.5 Modules

Bachelor and Master degree programmes have a modular structure, they are unitised. The modular system refers to an organisational principle, according to which courses consist of clearly defined teaching and learning units, both in terms of content and time. Modules are the building blocks of a course or several courses of study.
A module is described in respect to quality (by way of a module description) and quantity (by way of ECTS credits). An examination is course-related and takes place at the end of the module. Students achieve specific qualifications (subject specific and non-subject specific knowledge) which combine to

make up the overall qualification for a profession. In general a module takes place during the course of one semester, although in exceptional, well-grounded cases it may last for up to three semesters.

A module may take place in any of the given forms:

In a **lecture** a lecturer teaches a specific subject. Basically it is of a theoretical nature, and a discussion with the students is rarely possible.

In **seminars** the knowledge gained in a lecture is deepened, they are usually held among small groups. Students are required to take part in a dialogue. New subject matter on particular topics can be dealt with in seminars.

In a **practice session** the theoretical knowledge imparted in the lecture is reinforced with the aid of practical assignments. Students are required to participate actively in these units.

Laboratory practice sessions are periods of subject-specific practical training in a lab, workshop or computer pool. Special working methods are practised under authentic working conditions.

There are various ways of concluding a module:

The most common method of completing a module is a **written examination**. The duration of the exam varies from 60 to 180 minutes. The examination questions usually relate to the content of the relevant module only and must be answered within the given amount of time.

In **oral examinations** students must answer questions on the subject matter of the given module. The duration of the exams varies but is generally shorter than a written examination.

In addition to these, there are various **alternative examinations** in the form of written tests (generally 60 minutes long), presentations, assignments, seminar/term papers or reports.

I.2.6 ECTS credits

The competences acquired within a module (including subject-related knowledge as well as key general skills) are examined and rated in terms of both **grades (best: 1; lowest: 5)** and credit points (**ECTS credits**). ECTS credits are based on the workload, i.e. the time spent by an average student in successfully attending a module, including private study time. One ECTS credit stands for approximately 25-30 hours of work load.

Under the ECTS, 60 credits measure the work load of a full-time student in a complete academic year; accordingly, 30 credits are allocated for one semester, as a rule.

A student will get ECTS credits for any one module only after he or she has passed the examination for that module with a grade between 1 and 4 and thus proved to have achieved the required learning objectives. As grading systems vary greatly between European countries, problems of mutual recognition arise frequently. Therefore, an ECTS grading scale has been established in addition to national grades and ECTS credits. (For more information: „Ordnung zur Berechnung von ECTS-Graden an der Ernst-Abbe-Hochschule Jena“)

I.2.7 Diploma Supplement

Starting in 2005, all graduates from the UAS Jena receive a Diploma Supplement (DS) free of charge. This is a supplement to the Diploma degree certificate, in English and/or German, which provides a detailed description of the qualifications obtained during the degree programme and of the structure of the German higher education system. The DS is internationally harmonised and is aimed to facilitate the mutual recognition of qualifications across national borders.

I.2.8 Evaluation and accreditation

Quality assurance is a mandatory constituent of the new study programmes offered by institutions of higher education. Measures include (1) internal evaluation of the teaching sessions by the students,

and (2) regular appraisal of the new study programmes by external accreditation agencies and awarding of a quality seal by the accreditation council.

I.3 The study programmes in the department of Electrical Engineering and Information Technology

I.3.1 Contact

For any specific questions on the degree programmes at the department of Electrical Engineering and Information Technology please contact:

Academic adviser	Prof. Dr.-Ing. Johannes Trabert Phone: +49 (0)3641 205-706 E-Mail: Johannes.Trabert@eah-jena.de
Head of course EE/IE Specialisation AE	Prof. Dr. Jörg Müller Phone: +49 (0)3641 205-702 E-Mail: Joerg.Mueller@eah-jena.de
Head of course EE/IE Specialisation CMT	Prof. Dr. Jürgen Kampe Phone: +49 (0)3641 205-788 E-Mail: Juergen.Kampe@eah-jena.de
Head of course EE/IE Specialisation CE	Prof. Prof. Oliver Jack Phone: +49 (0)3641 205-715 E-Mail: Oliver.Jack@eah-jena.de
Head of course MA ET/IT	Prof. Dr. Frank Giesecke Phone: +49 (0)3641 205-764 E-Mail: Frank.Giesecke@eah-jena.de
Head of course MA ME	Prof. Dr.-Ing. Jörg Müller Tel.: (03641) 205-702 E-Mail: Joerg.Mueller@eah-jena.de

I.3.2 Module descriptions

In this chapter all offered modules (classified by module number) are described in detail. You can find the respective module number in the following overviews.
The first overview shows the modules of the Combined Field of Basics for all four Bachelor Courses, separately listed the modules from 4th to 7th semester for the Bachelor Programme EE/IT with it's specialisations: Automation Engineering and Robotics (AER), Communication- and Circuit Technology (CCT), Computer Engineering and Artificial Intelligence (CEAI). At the end you will find the overview of module descriptions for the Master Programmes Electrical Engineering and Information Technology (EE/IT) and Mechatronics (ME).

Combined Field of Basics for all specialisations (1st – 3rd semester, all bachelor programmes):

Module-No.	Module name	Module part	Semester	Programme
ET.1.101	Mathmatics 1		1	EE/IT
ET.1.102	Mathmatics 2		1	EE/IT
ET.1.103	Electrical Engineering 1		1	EE/IT
ET.1.104.1	Computer Engineering (ET.1.104)	Basic of programming	1	EE/IT
ET.1.104.2		Algorithms and data structures	2	EE/IT
ET.1.105.1	Physics (ET.1.105)	Physics 1	1	EE/IT
ET.1.105.2		Physics 2	2	EE/IT
ET.1.106.1	Technical English (ET.1.106)	Technical English 1	1	EE/IT
ET.1.106.2		Technical English 2	2	EE/IT
ET.1.202	Mathmatics 3		2	EE/IT
ET.1.203	Electrical Engineering 2		2	EE/IT
ET.1.201.1	Electronic Components (ET.1.201)	Electronic Components 1	2	EE/IT
ET.1.201.2		Electronic Components 2	3	EE/IT
ET.1.301	Circuit Design		3	EE/IT
ET.1.302	Theory of Signals and Systems		3	EE/IT
ET.1.303.1	Measurement Techniques (ET.1.303)	Measurement Techniques 1	3	EE/IT
ET.1.304	Automatic Control		3	EE/IT
ET.1.305	Digital Systems		3	EE/IT

Legend for the module code: ET.Y.XXX.Z
ET = Department of EE/IT
Y = Module level (1= bachelor level, 2= master level)
XXX = basic module code
Z = Module part (necessary for modules with 2 semester duration, 1 = first part, 2 = second part)

Bachelorprogramme Electrical Engineering /Information Engineering (4th – 7th Semester)
- Specialisation Automation Engineering and Robotics -

Module-No.	Module name	Module part	Semester	Programme
ET.1.411	Digital Signal Processing		4	EE/IE – Sp.: AER
ET.1.303.2	Measurement Techniques (ET.1.303)	Measurement Techniques 2	4	EE/IE – Sp.: AER
ET.1.401	Microprocessor Technology		4	EE/IE – Sp.: AER
ET.1.402.1	Analogue Circuit Design (ET.1.402)		4	EE/IE – Sp.: AER
ET.1.402.2			5	EE/IE – Sp.: AER
ET.1.404	Electrical Drives		4	EE/IE – Sp.: AER
ET.1.405.1	Control Systems (ET.1.405)	Control Systems/ PLC	4	EE/IE – Sp.: AER
ET.1.405.3		Robotic Systems	5	EE/IE – Sp.: AER
ET.1.406	Image Processing		4	EE/IE – Sp.: AER
ET.1.501	Non-Technical Elective Module		5	EE/IE – Sp.: AER
ET.1.502	Modelling/Simulation		5	EE/IE – Sp.: AER
ET.1.503	Automation Systems		5	EE/IE – Sp.: AER
ET.1.504.1	Process Communication (ET.1.504)	Fieldbus	5	EE/IE – Sp.: AER
ET.1.504.2		Local Area Networks	6	EE/IE – Sp.: AER
ET.1.407	Optoelectronics		6	EE/IE – Sp.: AER
ET.1.601	Digital Control Systems		6	EE/IE – Sp.: AER
ET.1.607	Mobile Robotics		6	EE/IE – Sp.: AER
ET.1.900	Elective Modules		5 / 6	EE/IE – Sp.: AER
ET.1.901	Filter Design		5	EE/IE – Sp.: AER
ET.1.902	Signal Prozessors		5	EE/IE – Sp.: AER
ET.1.903	Power Electronics		5	EE/IE – Sp.: AER
ET.1.904	Immersive Media Technology		6	EE/IE – Sp.: AER
ET.1.905	Selected Sections on Analogue Circuitry		6	EE/IE – Sp.: AER
ET.1.906	Autonomous model vehicles		5	EE/IE – Sp.: AER
ET.1.908	Motion Control		5	EE/IE – Sp.: AER
ET.1.911	Sensor Technology		6	EE/IE – Sp.: AER
ET.1.912	Stochastics		5	EE/IE – Sp.: AER
ET.1.605	Micro Computer Design		6	EE/IE – Sp.: AER
ET.1.914	Intercultural Engineering Project Autonomous Systems		5	EE/IE – Sp.: AER
ET.1.701	Industrial Placement		7	EE/IE – Sp.: AER
ET.1.702	Bachelor Thesis		7	EE/IE – Sp.: AER
ET.1.703	Colloquium		7	EE/IE – Sp.: AER

Bachelorprogramme Electrical Engineering /Information Engineering (4th – 7th Semester)
- Specialisation Communication and Circuit Technology-

Module-No.	Module name	Module part	Semester	Programme
ET.1.411	Digital Signal Processing		4	EE/IE – Sp.: CCT
ET.1.303.2	Measurement Techniques (ET.1.303)	Measurement Techniques 2	4	EE/IE – Sp.: CCT
ET.1.401	Microprocessor Technology		4	EE/IE – Sp.: CCT
ET.1.402.1	Analogue Circuit Design (ET.1.402)		4	EE/IE – Sp.: CCT
ET.1.402.2			5	EE/IE – Sp.: CCT
ET.1.609	Hardware Description		4	EE/IE – Sp.: CCT
ET.1.611	Electronic Design/PCB		4	EE/IE – Sp.: CCT
ET.1.507	Communication Networks		4	EE/IE – Sp.: CCT
ET.1.915	Integrated Circuits		5	EE/IE – Sp.: CCT
ET.1.506.1	Radio Frequency Technique (ET.1.506)		5	EE/IE – Sp.: CCT
ET.1.506.2			6	EE/IE – Sp.: CCT
ET.1.602	Transmission Technique		5	EE/IE – Sp.: CCT
ET.1.501	Non-Technical Elective Module		5	EE/IE – Sp.: CCT
ET.1.910	Analog and Mixed-Signal System Modelling		6	EE/IE – Sp.: CCT
ET.1.406	Image Processing		6	EE/IE – Sp.: CCT
ET.1.407	Optoelectronics		6	EE/IE – Sp.: CCT
ET.1.900	Elective Modules		5 / 6	EE/IE – Sp.: CCT
ET.1.901	Filter Design		5	EE/IE – Sp.: CCT
ET.1.902	Signal Prozessors		5	EE/IE – Sp.: CCT
ET.1.903	Power Electronics		5	EE/IE – Sp.: CCT
ET.1.904	Immersive Media Technology		6	EE/IE – Sp.: CCT
ET.1.905	Selected Sections on Analogue Circuitry		6	EE/IE – Sp.: CCT
ET.1.906	Autonomous model vehicles		5	EE/IE – Sp.: CCT
ET.1.908	Motion Control		5	EE/IE – Sp.: CCT
ET.1.911	Sensor Technology		6	EE/IE – Sp.: CCT
ET.1.912	Stochastics		5	EE/IE – Sp.: CCT
ET.1.605	Micro Computer Design		6	EE/IE – Sp.: CCT
ET.1.914	Intercultural Engineering Project Autonomous Systems		5	EE/IE – Sp.: CCT
ET.1.701	Industrial Placement		7	EE/IE – Sp.: CCT
ET.1.702	Bachelor Thesis		7	EE/IE – Sp.: CCT
ET.1.703	Colloquium		7	EE/IE – Sp.: CCT

Bachelor programme Electrical Engineering /Information Engineering (4th – 7th Semester)
- Specialisation Computer Engineering and Artificial Intelligence -

Module-No.	Module name	Module part	Semester	Programme
ET.1.411	Digital Signal Processing		4	EE/IE – Sp.: CEAI
ET.1.303.2	Measurement Techniques (ET.1.303)	Measurement Techniques 2	4	EE/IE – Sp.: CEAI
ET.1.401	Microprocessor Technology		4	EE/IE – Sp.: CEAI
ET.1.402.1	Analogue Circuit Design (ET.1.402)		4	EE/IE – Sp.: CEAI
ET.1.402.2			5	EE/IE – Sp.: CEAI
ET.1.608	Introduction to Machine Learning		4	EE/IE – Sp.: CEAI
ET.1.406	Image Processing		4	EE/IE – Sp.: CEAI
ET.1.410	Software-Engineering		4	EE/IE – Sp.: CEAI
ET.1.501	Non-Technical Elective Module*)		5	EE/IE – Sp.: CEAI
ET.1.508	Mobile Computing		5	EE/IE – Sp.: CEAI
ET.1.505	Computer Graphics		5	EE/IE – Sp.: CEAI
ET.1.509.1	Operating Systems (ET.1.509)	Operating Systems	5	EE/IE – Sp.: CEAI
ET.1.509.2		Real-Time Operating Systems	6	EE/IE – Sp.: CEAI
ET.1.609	Hardware Description		6	EE/IE – Sp.: CEAI
ET.1.610	Machine Learning for Visual Computing		6	EE/IE – Sp.: CEAI
ET.1.504.1	Process Communication (ET.1.504)	Fieldbus	6	EE/IE – Sp.: CEAI
ET.1.504.2		LAN	6	EE/IE – Sp.: CEAI
ET.1.900	Technical Elective Modules **)		5 / 6	EE/IE – Sp.: CEAI
ET.1.901	Filter Design		5	EE/IE – Sp.: CEAI
ET.1.902	Signal Processors		5	EE/IE – Sp.: CEAI
ET.1.903	Power Electronics		5	EE/IE – Sp.: CEAI
ET.1.904	Immersive Media Technology		6	EE/IE – Sp.: CEAI
ET.1.905	Selected Sections on Analogue Circuitry		6	EE/IE – Sp.: CEAI
ET.1.906	Autonomous model vehicles		5	EE/IE – Sp.: CEAI
ET.1.908	Motion Control		5	EE/IE – Sp.: CEAI
ET.1.911	Sensor Technology		6	EE/IE – Sp.: CEAI
ET.1.912	Stochastics		5	EE/IE – Sp.: CEAI
ET.1.605	Microcomputer Design		6	EE/IE – Sp.: CEAI
ET.1.914	Intercultural Engineering Project Autonomous Systems		5	EE/IE – Sp.: CEAI
ET.1.701	Industrial Placement		7	EE/IE – Sp.: CEAI
ET.1.702	Bachelor Thesis		7	EE/IE – Sp.: CEAI
ET.1.703	Colloquium		7	EE/IE – Sp.: CEAI

Master programme Electrical Engineering /Information Engineering

Module-No.	Module name	Module part				Semester	Programme
ET.2.106	Electromagnetic Fields					1	Ma EE/IE
ET.2.202	Design of Electronic Systems					2	Ma EE/IE
ET.2.209	Technical elective modules**)					1/2	Ma EE/IE
ET.2.110	Nontechnical elective module*)					1	Ma EE/IE
ET.2.113		English for Specific Purposes				1	Ma EE/IE
M-GM-UF1.2.1		Formation Management				1	Ma EE/IE
M-GM-UF1.2.2		Project Management				1	Ma EE/IE
ET.2.209	Technical elective modules:	linked Profil (AER, CCT, CEAI, SE)					Ma EE/IE
ET.2.224	Intelligent Systems	x		x		2	Ma EE/IE
ET.2.211	Advanced Control Systems	x				2	Ma EE/IE
ET.2.120	Optimal Control	x				1	Ma EE/IE
ET.2.233	Applied RF- and Microwave Engineering		x			1	Ma EE/IE
ET.2.232	Augmented Reality/Virtual Reality	x		x		2	Ma EE/IE
ET.2.102	Software Engineering			x		1	Ma EE/IE
ET.2.101	Theoretical Information Science			x		2	Ma EE/IE
ET.2.230	Processor Design			x		2	Ma EE/IE
ET.2.212	Embedded Systems		x			1	Ma EE/IE
ET.2.107	Servo Drive Systems and Components	x				1	Ma EE/IE
ET.2.220	Optical and optoelectronic sensors				x	2	Ma EE/IE
ET.2.218	Optoelectronics II					2	Ma EE/IE
ET.2.221	Integration of mixed-signal circuits		x			2	Ma EE/IE
ET.2.104	Reliability Theory				x	1	Ma EE/IE
ET.2.105	Analoge Design		x			1	Ma EE/IE
ME.2.203.1	Actuators	x				2	Ma EE/IE
ME.2.203.2	Simulation of electromechanical Systems	x				2	Ma EE/IE
ET.2.122	Space Travel Systems				x	1	Ma EE/IE
ET.2.280	Autonomous Missions					1	Ma EE/IE
ME.2.105	3D Robot Vision	x				1	Ma EE/IE
ET.2.225	Data Sciene	x		x		1	Ma EE/IE
ET.2.200	Numerical Mathematics/Optimization					2	Ma EE/IE
ET.2.201	Satellite communication		x		x	2	Ma EE/IE
ET.2.234	Optoelectronic systems				x	1	Ma EE/IE
ET.2.121	Design of Spaceborne Electronics				x	2	Ma EE/IE
ET.2.300	Complex Lab Session					2/3	Ma EE/IE
ET.2.301	Master Thesis					3	Ma EE/IE
ET.2.302	Colloquium					3	Ma EE/IE

Master programme Mechatronics

Module-No.	Module name	Module part	Semester	Programme
ME.2.102	Mechatronics		1	Ma ME
ET.2.115	3D Robot Vision		1	Ma ME
ET.2.120	Optimal Control and Regulate		1	Ma ME
ME.2.107	Nontechnical elective module*)		1	Ma ME
ET.2.113	Nontechnical elective module*)	English for Specific Purposes	1	Ma ME
M-GM-UF1.2.1		Formation Management	1	Ma ME
M-GM-UF1.2.2		Project Management	1	Ma ME
ET.2.211	Complex Controls		2	Ma ME
ET.2.200	Numerical Mathematics / Optimization		2	Ma ME
ME.2.203	Actuators and Simulation of Electromechanical Systems	Actuators	2	Ma ME
		Simulation of Electromechanical Systems		
ME.2.109	Mechatronics Project		2/3	Ma ME
ME.2.108	Technical elective modules**)		1/2	Ma ME
ME.2.206	Experimental modal analysis		2	Ma ME
ET.2.104	Reliability Theory		1	Ma ME
ET.2.220	Optical and Optoelectronical Sensors		2	Ma ME
ET.2.224	Intelligent systems		2	Ma ME
ET.2.225	Data Science		1	Ma ME
ET.2.232	Augmented Reality/Virtual Reality		2	Ma ME
ET.2.107	Servo Drive Systems and Components		1	Ma ME
ME.2.301	Masterarbeit		3	Ma ME
ME.2.302	Kolloquium		3	Ma ME

Legend for the module code: ET.Y.XXX.Z
ET = Department of EE/IT
Y = Module level (1= bachelor level, 2= master level)
XXX = basic module code
Z = Module part (necessary for modules with 2 semester duration, 1 = first part, 2 = second part)

*) The offered nontechnical elective modules will be published by a written announcement each semester.
**) The offered technical elective modules will be published by a written announcement each semester.

Module number	**ET.1.101**
Module name	**Mathematics 1**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Module coordinator	Prof. Dr. Elizabeth Ribe
Compulsory/ optional/ elective	Compulsory
Learning objectives	After successful completion of this module, students are capable of… - solving equations and inequations (with fractions, powers, roots, absolute values, logarithms, summations and products) using elementary algebra rules. - specifying the solution set of equations and inequations as intervals or sets. - performing basic operations on vectors. - determine characteristics of vectors (magnitude, linear independence, parallelism, etc.). - calculate vector products (dot product, cross product, scalar triple product). - using vector products in order to determine characteristics of vectors (angle between vectors, parallelism, linear independence, etc.). - setting up various forms of equations for planes and lines. - examining the positions of points, lines, and planes to one another. - performing basic operations on matrices. - determining various characteristics of matrices (dimensions, type, rank, determinant, invertibility, etc.). - determining all solutions of a linear system of equations using Gaussian elimination. - determining all of a matrix's eigenvalues and eigenvectors. - switching between the rectangular, polar, and exponential forms of complex numbers. - identifying various characteristics of complex numbers (magnitude, argument, imaginary part, real part, complex conjugate). - performing calculations on complex numbers involving addition, multiplication, division, powers, and roots. - representing complex numbers in the Cartesian complex plane and Polar complex plane.
Module content	- Elemental Algebra - Vectors in the 2- and 3 dimensions - Linear equations - Matrices - Determinants and eigenvalue problem
Course type	2L - 2E - 0S - 0P (Lecture, Exercises, Seminar, practical course)
Learning Material	Exercises with solutions, worksheets
Recommended literature	- Papula: MathemaCEAI für Ingenieure Bd. 1-3 - Papula , Mathematische Formelsammlung
Method(s) of instruction/ media being used	Lecture / Exercise
Level/ category	1 (Bachelor=1, Master=2)
Summer/ Winter	winter term
Term	1st term
Recommended requirements	Entrance qualification for Universities of Applied Sciences
Assessment	exam 90 min
Assessment modalities	PL – exam during audit period(graded)
ECTS credits	6
Workload	180h of total work load, thereof 60 h presence time 120 h self study 45 h lectures

	45 Exercises 30 h exam preperation
Usability of this module	Mathematics 3 Numerical Mathematics / Optimization
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

Module number	**ET.1.102**
Module name	**Mathematics 2**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Module coordinator	Prof. Dr. Henning Kempka
Compulsory/ optional/ elective	Compulsory
Learning objectives	Confidence in dealing with methods of differential calculus and integration in one variable to solve practical problems. After succesfull participation at the module MathemaCEAI 2 the students are able to apply the methods which are taught in the areas which are content of the module. Further, they posess the Abbility to sucessfully apply the mathematical procedures on physical and engineering problems.
Module content	Sequences and limits Series and Potential series Elementary Functions - Terms; general properties of functions of one variable - Exponential-, Logarithm- and trigonometric functions - Polynomials and rational functions Onedimensional differential calculus - Continuity of functions - Derivative and its properties, derivation rules - Applications of differential calculus (Taylor's formula, limits on the Bernoulli de l'Hospital, Newton's method) Integral Calculus - Definite and indefinite integral, fundamental theorem of differential and integral calculus - Integration rules; applications of the definite integral - Improper integral and the Gamma function
Course type	4L - 2E - 0S - 0P (Lecture, Exercises, Seminar, practical course)
Learning Material	Exercises with solutions, worksheets
Recommended literature	- Papula,MathemaCEAI für Ingenieure und Naturwissenschaftler, Bd.1-3 - Papula , Mathematische Formelsammlung - Bartsch , Mathematische Formeln
Method(s) of instruction/ media being used	Lecture, supplemented by exercises
Level/ category	1 (Bachelor=1, Master=2)
Summer/ Winter	winter term
Term	1st term
Recommended requirements	Entrance qualification for Universities of Applied Sciences
Assessment	exam 120 min
Assessment modalities	PL – exam during audit period(graded)
ECTS credits	6
Workload	180h of total work load, thereof 90h of contact hours and 90h of self-study, consisting of: 70 h lecture (preparation and rework) 0 h practical training (preparation and evaluation) 20 h exam preparation
Usability of this module	Following modules: Mathematics 3 Numerical Mathematics / Optimization Stochastics
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

Module number	**ET.1.103**
Module name	**Electrical Engineering 1**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Module coordinator	Prof. Dr.-Ing. Thomas Reuter
Compulsory/ optional/ elective	Compulsory
Learning objectives	The student should learn the fundamentals of Electrical Engineering especially direct current technique, as well as basic properties and characteristics of electrical and magnetic fields in different media.
Module content	- Base items of Electrical Engineering, basic circuit, branched and no branched electrical circuit, active and passive two terminal network - Voltage and power source, energy and power balance - calculation procedure of direct current networks - characterisation and calculation of electrical and magnetic fields, transients by switching operations
Course type	3L - 2E - 0S - 0P (Lecture, Exercises, Seminar, practical course)
Learning Material	exercises, e-learning
Recommended literature	Führer u.a.: Grundlagen ET 1 + 2 Weißgerber: Elektrotechnik für Ingenieure Bd. 1 – 3 Vömel, Zastrow: Aufgabensammlung ET 1+2
Method(s) of instruction/ media being used	Lecture: work on the blackboard, tutorial exercises
Level/ category	1 (Bachelor=1, Master=2)
Summer/ Winter	winter term
Term	1st term
Compulsory requirements	none
Recommended requirements	Entrance qualification for Universities of Applied Sciences
Assessment	exam 90 min
Assessment modalities	PL – exam during audit period(graded)
ECTS credits	6
Workload	180h of total work load, thereof 75h of contact hours and 105h of self-study, consisting of: 90 h lecture (preparation and rework) 0 h practical training (preparation and evaluation) 15 h exam preparation
Usability of this module	Requirement for Electrical Engineering 2
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

Module number	**ET.1.104.1**
Module name	**Computer Science**
Sub module	Computer Science Basics
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Module coordinator	Prof. Dr.-Ing. Oliver Jack
Compulsory/ optional/ elective	Compulsory
Learning objectives	At the end of the module students are able: - to understand algorithms and basic data structures - to remember the imperative programming paradigm - to identify recursive algorithms - to understand syntax and semantics of imperative proograms - to understand structured programming - to apply refinement for developing procedural programs in the programming language C
Module content	Information, message, data, problem - algorithm – program, imperative programming constructs, structurered programming, program semantics: control-flow diagram, basic data structures: strings and arrays, abstract data types, functionsand procedures: call-by-value and call-by-reference, recursion
Course type	2L - 2E - 0S - 0P (Lecture, Exercises, Seminar, practical course)
Learning Material	Lecture slides, examples of solutions
Recommended literature	Joachim Goll und Cornelia Heinisch. Java als erste Programmiersprache: Ein professioneller Einstieg in die Objektorientierung mit Java.Springer Verlag, Berlin, 7. Auflage, 2013. Guido Krüger.Handbuch der Java Programmierung. O'Reilly Verlag, Köln, 8. Auflage, 2014. Dietmar Ratz, Jens Scheffler, Detlef Seese, und Jan Wiesenberger. Grundkurs Programmieren in Java, Band 1.Carl Hanser Verlag, München, 7. Auflage, 2014. Bernhard Steppan. Einstieg in Java 7.Galileo Press, Bonn, 4. Auflage, 2011.
Method(s) of instruction/ media being used	lecture, exercise course at the PC-Lab
Level/ category	1 (Bachelor=1, Master=2)
Summer/ Winter	winter term
Term	1. term
Compulsory requirements	none
Assessment	term paper
Assessment modalities	SL - ungraded course work during the lecture period
Further Information	The students have to do a software programming task.
ECTS credits	9 (for the total modul)
Workload	135h of total work load, thereof 60h of contact hours and 75h of self-study, consisting of: 60 h lecture (preparation and rework) 0 h practical training (preparation and evaluation) 15 h exam preparation
Usability of this module	Submodule Algorithms and data structures, Mobile Computing / Software-Engineering forMobile Systems,Operating Systems, Software Engineering, Real Time Operating Systems
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

Module number	**ET.1.104.2**
Module name	**Computer Science**
Sub module	Algorithms and data structures
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Module coordinator	Prof. Dr.-Ing. Oliver Jack
Compulsory/ optional/ elective	Compulsory
Learning objectives	At the end of the module students are able: - to apply algorithms and data structures for basic problems - to understand specific algorithms and data structures for searching, sorting and graph problems - to analyse algorithms with respect to efficiency and correctness - to test programs systematically - to understand object-oriented programming - to apply object-oriented program develoment methods in C++
Module content	Basic algorithms and data structures,Interdependency between algorithms and data structure, proof of correctness, efficiency considerations, programming paradigms
Course type	2L - 2E - 0S - 0P (Lecture, Exercises, Seminar, practical course)
Learning Material	Lecture slides, examples of solutions
Recommended literature	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, und Clifford Stein: Algorithmen - Eine Einführung, Oldenbourg 2010 Aho, A.V., Hopcroft, J.E., Ullman, J.D.: Data Structures and Algorithms, Addison-Wesley 1993 Sedgewick, R.: Algorithms in C, Addison Wesley 1990 Sedgewick, R.: Algorithmen in C++, Addison Wesley 2002
Method(s) of instruction/ media being used	lecture, exercises
Level/ category	1 (Bachelor=1, Master=2)
Summer/ Winter	summer term
Term	2. term
Compulsory requirements	none
Recommended requirements	Modul ET.1.104.1 - Grundlagen der Programmierung
Assessment	term paper
Assessment modalities	APL – assessment during the term period (graded)
Further Information	The students have to conduct a software programming project
ECTS credits	9 (for the total modul)
Workload	135h of total work load, thereof 60h of contact hours and 75h of self-study, consisting of: 60 h lecture (preparation and rework) 0 h practical training (preparation and evaluation) 15 h exam preparation
Usability of this module	Mobile Computing / Software-Engineering forMobile Systems,Operating Systems, Real-Time-Operating Systems, Software Engineering
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

Module number	**ET.1.105.1**
Module name	**Physics**
Sub module	Physics 1
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Module coordinator	Prof. Dr. Stefan Sienz
Compulsory/ optional/ elective	Compulsory
Learning objectives	Consolidated and extended basic physical knowledge, modelling of physical problems and application to simple examples in mechanics, electrostatics and magnetostatics (abstraction, setting up and solving of equations, distinction of essential from negligible influences, interpretation of the results)
Module content	Kinematics, dynamics of point mass , rigid body dynamics, oscillation, fluid mechanics, electrostatics, magnetostatics
Course type	2L - 2E - 0S - 0P (Lecture, Exercises, Seminar, practical course)
Learning Material	Worksheets, exercises, e-learning
Recommended literature	D. C. Giancoli, Physik: Lehr- und Übungsbuch, Pearson Studium; 3. Auflage 2009 D. Halliday, R. Resnick, J Walker, Physik, Bachelor Edition Wiley-VCH, Weinheim 2007 Paul A Tipler, Gene Mosca Physik für Wissenschaftler und Ingenieure, Elsevier, 2. Aufl. 2004, ISBN 3-8274-1164-5 F. Kuypers, Physik für Ingenieure, Bd.1: Mechanik und Thermodynamik, VCH-Verlag Weinheim 2002 M. Alonso, E. Finn, Physics, Addison Wesley; Revised edition (June 10, 1992)
Method(s) of instruction/ media being used	Lecture with exercise courses
Level/ category	1 (Bachelor=1, Master=2)
Summer/ Winter	winter term
Term	1st term
Recommended requirements	Entrance qualification for Universities of Applied Sciences
Assessment	exam 90 min
Assessment modalities	PL – exam during audit period(graded)
Further Information	Successful participation and cooperation in excercises and if any e-learning
ECTS credits	9 (for the entire module)
Workload	135h of total work load, thereof 60h of contact hours and 75h of self-study, consisting of: 35 h lecture (preparation and rework) 25 h practical training (preparation and evaluation) 15 h exam preparation
Usability of this module	Measurement technology
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

Module number	**ET.1.105.2**
Module name	**Physics**
Sub module	Physics 2
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Module coordinator	Prof. Dr. Stefan Sienz
Compulsory/ optional/ elective	Compulsory
Learning objectives	Extended basic physical knowledge, application to simple examples (recognition of analogies, distinction of essential from not essential influences, interpretation of the results), application of the knowledge in practical laboratory courses (consolidation of the knowledge, practice with measuring instruments, first experience in evaluation and valuation of measuring results)
Module content	Thermodynamics, waves, geometrical optics, wave optics, selected topics of quantum physics, among others the wave-particle dualism
Course type	2L - 1E - 0S - 1P (Lecture, Exercises, Seminar, practical course)
Learning Material	Worksheets, exercises, E-learning
Recommended literature	D. C. Giancoli, Physik: Lehr- und Übungsbuch, Pearson Studium; 3. Auflage 2009 D. Halliday, R. Resnick, J Walker, Physik, Bachelor Edition Wiley-VCH, Weinheim 2007 Paul A Tipler, Gene Mosca Physik für Wissenschaftler und Ingenieure, Elsevier, 2. Aufl. 2004, ISBN 3-8274-1164-5 F. Kuypers, Physik für Ingenieure, Bd.1: Mechanik und Thermodynamik, VCH-Verlag Weinheim 2002 M. Alonso, E. Finn, Physics, Addison Wesley; Revised edition (June 10, 1992)
Method(s) of instruction/ media being used	Lectures with exercise courses and practical laboratory courses
Level/ category	1 (Bachelor=1, Master=2)
Summer/ Winter	summer term
Term	2nd term
Compulsory requirements	none
Assessment	exam 90 min
Assessment modalities	PL – exam during audit period(graded)
Further Information	Successful participation and cooperation in exercise coures, practical laboratory courses and e-learning if applicable, exam 90 min
ECTS credits	9 (for the entire module)
Workload	135h of total work load, thereof 60h of contact hours and 75h of self-study, consisting of: 35 h lecture (preparation and rework) 10 h excercise courses 15 h practical training (preparation and evaluation) 15 h exam preparation
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

Module number	**ET.1.106**
Module name	**Technical English**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Module coordinator	Frau Wiedemann
Compulsory/ optional/ elective	Compulsory
Learning objectives	Students are enabled to deal with a wide variety of study and work-related situations in English (Level B2 of the Common European Framework). At the same time, students consolidate and extend their existing language skills as well as general vocabulary and grammar.
Module content	- studying at the UAS Jena - basic mathematics and describing graphs - IT, technical devices and measuring instruments - lab sessions - materials, energy, electricity - projects and presentations
Course type	0L - 2E - 0S - 0P (ET.1.106.1) 0L - 3E - 0S - 0P (ET.1.106.2) (Lecture, Exercises, Seminar, practical course)
Learning Material	script and handouts
Recommended literature	- Comfort,Hick, Savage „Basic Technical English“ Oxford University Press, 1990 - Wagner” Science and Engineering” Cornelsen & Oxford, 2000 - AGlendinning , McEwan” Oxford English for Electronics”, Oxford University Press,1993 - Bauer “English for technical purposes” Cornelsen & Oxford, 2000 - Englisch für technische Berufe – Computer und IT-Berufe, Klett-Verlag 2002 - Encyclopaedia Britannica, CD-ROM editino, 1997 - Murphy “English Grammar in Use” CUP/ Klett-Verlag - Wagner, Zörner „Technical Grammar and Vocabulary”, Cornelsen& Oxford, 1998 - Vince, Michael, Macmillan English Grammar in Context -Zeitschrift: “Inch” (Technical English Inch by Inch) -Cambridge English for Engineering. CPU 2012 -Cambridge English for Scientists. CPU 2012
Method(s) of instruction/ media being used	Multimedia, Video, Audio materials
Level/ category	1 (Bachelor=1, Master=2)
Summer/ Winter	winter term and summer term
Term	1st and 2nd term
Recommended requirements	Above level B1 of Common European Framework of Reference for Languages
Assessment	course attendance certificate, written test
Assessment modalities	SL - ungraded course work during the lecture period
Further Information	MODULE ACHIEVEMENT after 1st Term written examination (90 minutes) in 2nd Term
ECTS credits	6 (for the entire module)
Workload	180 h of total work load, therefrom 75 of presence at university and 105 h of self-study, consisting of: - 80 h seminar (preparation and rework) - 25 h preparation for examination
Usability of this module	Creditable for other Modules of Technical English within the Bachelor studies at the University of Applied Sciences Jena, equivalent to level B2 CEF or Unicert II technical language
Time	According time table
Duration of module	1 term

Place/ room	EAH Jena
Frequency of offer	Annually
Language	English

Module number	**ET.1.201**
Module name	**Electronic Components**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Module coordinator	Prof. Dr. Martin Hoffmann
Compulsory/ optional/ elective	Compulsory
Learning objectives	- Basic knowledge about function, construction and application of electronic components - Practical experience in measurement of parameters of electronic components - Standard applications in electronic cirquits - Definition of Parameters for electronic devices in applications and selection of devices by data sheets
Module content	Passive components R,L,C, semiconductor diodes, bipolar transistors, unipolar transistors, thyristors, optoelectronic devices
Course type	2. Term 3L – 0E – 0S – 2P (ET.1.201.1) 3. Term 1L – 0E – 0S – 2P (ET.1.201.2) (Lecture, Exercises, Seminar, practical course)
Learning Material	Literature, lab instruction sheets, handouts
Recommended literature	Passive elektronische Bauelemente - Aufbau, Funktion, Eigenschaften, Dimensionierung und Anwendung, Leonhard Stiny, Verlag Springer Vieweg Aktive elektronische Bauelemente - Aufbau, Struktur, Wirkungsweise, Eigenschaften und praktischer Einsatz diskreter und integrierter Halbleiter-Bauteile, Leonhard Stiny, Verlag Springer Vieweg WerCCToffe und Bauelemente der Elektrotechnik, Hanno Schaumburg, Verlag Teubner
Method(s) of instruction/ media being used	Lecture, practical course, self-study
Level/ category	1 (Bachelor=1, Master=2)
Summer/ Winter	Summer term- / winter term
Term	2. and 3. term
Compulsory requirements	none
Recommended requirements	Electrical Engineering 1, Analysis 1, Physik
Assessment	exam 90 min
Assessment modalities	PL – exam during audit period(graded)
ECTS credits	9
Workload	270h (SWS) of total work load, thereof 90h of contact hours and 180h of self-study, consisting of: 80 h lecture (preparation and rework) 70 h practical training (preparation and evaluation) 30 h exam preparation
Usability of this module	Analog and Digital Circuit Organisation, Basic Measurement Techniques, Audio Engineering, Electronic Design
Time	According time table
Duration of module	2 terms
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

Module number	**ET.1.202**
Module name	**Mathematics 3**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Module coordinator	Prof. Dr. Henning Kempka
Compulsory/ optional/ elective	Compulsory
Learning objectives	Confidence in dealing with methods of differential calculus and integration in several variables, in ordinary differential equations as well as in Laplace – and Fourier transform to solve practical problems. After succesfull participation at the module MathemaCEAI 3 the students are able to apply the methods which are taught in the areas which are content of the module. Further, they posess the Abbility to sucessfully apply the mathematical procedures on physical and engineering problems. Furthermore, the students know the fundamental concepts of stochastics.
Module content	Multidimensional differential calculus - Functions of several variables - partial derivative and extremal values Multidimensional integral calculus - 2D-integrals in cartesian and polar coordinates - 3D-integrals in cartesian, zylinder- and spherical coordinates - Applications - line integrals, line parametrization Integral transforms - Fourier transform - Laplace transform Ordinary Differential Equations - Introduction, basic concepts, equations 1st order - Linear Differential Equations of 2nd (and higher) order with constant coefficients - Systems of linear Differential Equations of 1st order with constant Coefficients Stochastics - Basic concept of descritive Statistics - Correlation - Regression - Normal distribution A glimpse on Statistical inference
Course type	4L - 2E - 0S - 0P (Lecture, Exercises, Seminar, practical course)
Learning Material	Exercises with solutions, worksheets
Recommended literature	Papula, MathemaCEAI für Ingenieure und Naturwissenschaftler, Bd. 1-3 Preuß/Wenisch, Lehr- und Übungsbuch MathemaCEAI, Bd. 1-2 Papula, Mathematische Formelsammlung Bartsch, Mathematische Formeln Hartung, Elpelt, Klösener: StatisCEAI, Lehr- und Handbuch der angewandten StatisCEAI, DeGruyter (2012)
Method(s) of instruction/ media being used	Lecture, supplemented by exercises
Level/ category	1 (Bachelor=1, Master=2)
Summer/ Winter	summer term
Term	2nd term
Recommended requirements	Mathematics 1 and Mathematics 2
Assessment	exam 120 min
Assessment modalities	PL – exam during audit period(graded)
ECTS credits	6
Workload	180h of total work load, thereof

	90h of contact hours and 90h of self-study, consisting of: 70 h lecture (preparation and rework) 0 h practical training (preparation and evaluation) 20 h exam preparation
Usability of this module	Numerical Mathematics / Optimization
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

Module number	**ET.1.203**
Module name	**Electrical Engineering 2**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Module coordinator	Prof. Dr.-Ing. Matthias Förster
Compulsory/ optional/ elective	Compulsory
Learning objectives	The basics of alternating current technology are to be taught. After successful participation, students are able to calculate different characteristics (effective value etc.) of alternating and mixed signals (signal shapes). Students can display sine sizes using pointers and perform calculations at the complex level. You are aware the relationships of power and can be applied. Students get to know to draw local curves and understand the three-phase system
Module content	The topics of the lecture are: description of sinusoidal and non-sinusoidal alternating variables - network calculation for alternating currents– symbolic method – phasor diagrams – transfer locus'– energy – power – three-phase systems
Course type	2L - 2E - 0S - 2P (Lecture, Exercises, Seminar, practical course)
Learning Material	exercises, lab instruction sheets
Recommended literature	Führer u.a.: Grundlagen ET 1 + 2 Weißgerber: Elektrotechnik für Ingenieure Bd. 1 - 3 Vömel, Zastrow: Aufgabensammlung ET 1+2 Hagmann: Grundlagen der Elektrotechnik, Aufgabensammlung zu den Grundlagen der Elektrotechnik
Method(s) of instruction/ media being used	Lecture: work on blackboard, tutorial exercises, experiments in the laboratory after instructions and written preparations
Level/ category	1 (Bachelor=1, Master=2)
Summer/ Winter	summer term
Term	2. term
Compulsory requirements	none
Recommended requirements	Elektrotechnik 1
Assessment	exam 90 min, laboratory internship certificate
Assessment modalities	PL – exam during audit period(graded)
ECTS credits	6
Workload	180 h of total work load, thereof - 90 h of contact hours - 90 h of self-study, consisting of: preparation and rework lecture 20 h exercise 20 h practical training 30 h (preparation and evaluation) exam preparation 20 h
Usability of this module	Basis for all further ET-Moduls
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

Module number	**ET.1.301**
Module name	**Circuit Design**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Module coordinator	Prof. Dr.-Ing. Martin Hoffmann
Compulsory/ optional/ elective	Compulsory
Learning objectives	acquiring fundamental knowledge of design, function and application of electronic components and units including hands-on experience
Module content	- Design and properties, parameters and thresholds, typical application of components, diodes, bipolar and unipolar transistors, field effect transistors, thyristors, optoelectronic - Simulation of electronic circuits of digital and analogue technology
Course type	1L - 0E - 0S - 2P (Lecture, Exercises, Seminar, practical course)
Learning Material	List will be announced during the lecture.
Recommended literature	B. Beetz: Elektroniksimulation mit PSpice. Vieweg-Verlag 2010
Method(s) of instruction/ media being used	lecture, practical course
Level/ category	1 (Bachelor=1, Master=2)
Summer/ Winter	winter term
Term	3. term
Compulsory requirements	None
Recommended requirements	Modules: Electronic Components, Electrical Engineering 1
Assessment	course attendance certificate
Assessment modalities	SL - ungraded course work during the lecture period
ECTS credits	3
Workload	90h of total work load, thereof 45h of contact hours and 45h of self-study, consisting of: 15 h lecture (preparation and rework) 20 h practical training (preparation and evaluation) 10 h exam preparation
Usability of this module	Design of electronic systems
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

Module number	**ET.1.302**
Module name	**Theory of Signals and Systems**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Module coordinator	Prof. Dr.-Ing. Frank Giesecke
Compulsory/ optional/ elective	Compulsory
Learning objectives	Learning of methods for analysis of signals and systems for use in specification and test of modern communication systems and the development of solutions in automation.
Module content	Standard signals – classification of signals - characterization of signals by means of statistics – properties of systems - characterization of systems – convolution – Fourier transform – Laplace transform – sampling theorem – correlation
Course type	4L – 2E – 0S – 0P (Lecture, Exercises, Seminar, practical course)
Learning Material	lecture scripts, textbooks, tasks and solutions
Recommended literature	Frey, T.; Bossert, M.: Signal- und Systemtheorie Kreß, D.; Irmer, R.: Angewandte Systemtheorie Meyer, M.: Grundlagen der Informationstechnik
Method(s) of instruction/ media being used	lectures, exercises
Level/ category	1 (Bachelor=1, Master=2)
Summer/ Winter	winter term
Term	3. term
Compulsory requirements	None
Recommended requirements	Mathematics, Basics of Electrical Engineering, Basics of Computer Science
Assessment	exam 90 min
Assessment modalities	PL – exam during audit period(graded)
ECTS credits	6
Workload	180 h of total work load, thereof - 90 h of contact hours - 90 h of self-study, consisting of: preparation and rework lecture 30 h exercise 30h exam preparation 30 h
Usability of this module	Usable for modules mainly related to processing of signals, for instance control engineering, measurement technology, audio and video processing, communication technology, computer sciences and signal processors. Furthermore this module is used for the course of studies in mechatronics
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

Module number	**ET.1.303**
Module name	**Measurement Techniques**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Module coordinator	Prof. Dr. Alexander Richter
Compulsory/ optional/ elective	Compulsory
Learning objectives	After successful participation, the student is able to - define fundamentals of measurement (general definitions, standards, International System of Units) - derive uncertainties in measurement - characterize and parameters of measurement devices - know electromechanical measurement devices - introduce Digital Measurement - handle oscilloscopes - measure electrical quantities (I, U, R, Z, f, t) - measure circuit parameters - measure in Time Domain and in Frequency Domain (FFT Analyser, Spectrum Analyser, Network Analysis) - define signals and noise, Signal-to-Noise-Ratio, Noise figure - solve simlpe tasks in sensoric of non-electrical quantities by electrical means (displacement, position, angle, thickness of layers, force, pressure, temperature, material and gas humidity, vibration)
Module content	- fundamentals of measurement (general definitions, standards, International System of Units) - expression of uncertainties in measurement - characteristics and parameters of measurement devices - electromechanical measurement devices - introduction to Digital Measurement - measurement of electrical quantities (I, U) - oscilloscopes - measurement of electrical quantities (I, U, R, Z, f, t) - measurement of circuit parameters - measurement in Time Domain and in Frequency Domain (FFT Analyser, Spectrum Analyser, Network Analysis) - signals and noise, Signal-to-Noise-Ratio, Noise figure - expression of uncertainties in measurement (advanced level, correlated signals) - measurement of non-electrical quantities by electrical means (displacement, position, angle, thickness of layers, force, pressure, temperature, material and gas humidity, vibration)
Course type	3th Term: 2L – 1E – 0S – 1P (ET.1.303.1) 4th Term: 2L – 1E – 0S – 1P (ET.1.303.2) (Lecture, Exercises, Seminar, practical course)
Learning Material	Script, worksheets, lab instruction sheets
Recommended literature	Tränkler, R, „Taschenbuch der Messtechnik“, Oldenbourg, 1996 Schrüfer, E, „Elektronische Messtechnik“, Hanser, 2007 Mühl, T.: „Einführung in die elektrische Messtechnik“, Teubner, 2001 Partier, R, „Messtechnik“, Vieweg, 2001 Adunka, F, „ Messunsicherheiten, Vulkan, 1998 DIN V ENV 13005: „Leitfaden Angabe der Unsicherheit beim Messen“, 1999
Method(s) of instruction/ media being used	Lecture, theoretical exercises, practical course
Level/ category	1 (Bachelor=1, Master=2)
Summer/ Winter	winter term and summer term
Term	3th and 4th term
Compulsory requirements	none

Recommended requirements	Mathematics, Physics, Electrical Engineering
Assessment	exam 90 min, Laboratory internship certificate
Assessment modalities	PL – exam during audit period(graded)
Further Information	The module examination consists of a written test at the end of the 4th term. In the test, students create solutuions for selected metrological questions, and calculate various technically relevant variables and para meters based on given practical examples.
ECTS credits	9
Workload	270 h
Time	According time table
Duration of module	2 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

Module number	**ET.1.304**
Module name	**Automatic Control**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Module coordinator	Prof. Dr.-Ing. habil. Klaus-Peter Döge
Compulsory/ optional/ elective	Compulsory
Learning objectives	Students will be enabled to analyze and evaluate simple control loop structures.
Module content	- Description of the system by means of differential equations and transfer function - PID controller and derivatives - linear transfer elements - investigation of stability, vibration capability and control error of control systems
Course type	2L - 1E - 0S - 1P (Lecture, Exercises, Seminar, practical course)
Learning Material	Lecture script, collection of tasks, lab instruction sheets
Recommended literature	Reuter, M.; Zacher, S.: Regelungstechnik für Ingenieure, F.Vieweg-Verlag, 10. Auflage, Braunschweig/Wiesbaden, 2002 Wendt, L.: Taschenbuch der Regelungstechnik, Verlag Harri Deutsch, 3. Auflage, Thun/ Frankfurt 2000
Method(s) of instruction/ media being used	lab instruction sheets and collection of tasks on the Internet; CAE-Software
Level/ category	1 (Bachelor=1, Master=2)
Summer/ Winter	winter term
Term	3. term
Compulsory requirements	-linear differential equations - calculate with complex numbers -matrix calculus -Laplace transform -partial fraction decomposition
Recommended requirements	none
Assessment	written university exam 90 min
Assessment modalities	PL – during period of exams (graded)
ECTS credits	6
Workload	180h of total work load, thereof 60h of contact hours and 120h of self-study, consisting of: 70 h lecture (preparation and rework) 25 h practical training (preparation and evaluation) 25 h exam preparation
Usability of this module	- Modelling/ Simulation - Digital Control Systems - optimal control theory
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

Module number	**ET.1.305**
Module name	**Digital Systems**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Module coordinator	Prof. Dr.-Ing. habil. Jürgen Kampe
Compulsory/ optional/ elective	Compulsory
Learning objectives	At the end of the module students are able to understand the main digital signal codings. The students remember mathematical and formal forms of description as well as gate-level implementations of Boolean functions, they are able to apply the laws of Boolean algebra and Boolean algebra Rules as well as gate level minimization techniques, and they are able to design, build (assemble) and analyse basic as well as specific combinatorical circuits of computer science, measurement and automation technology. The students remember different forms of behavioral description and main models for finite state machines, and they are able to verify formal properties. The students remember several approaches of FSM state encoding, and they are able to design synchonouse and asynchronous automata, to assemble them of basic elements, and to analyse there behaviour. The students remember sources of dynamic errors in logic gate and in sequential circuits, and the students are able to apply principles to avoid them.
Module content	- Binary signals, signal coding, number systems, Boolean algebra; - truth table, basic functions / fundamental systems; - Boolean equations, logic minimization by equation transformation, Karnaugh-diagram, Quine-McCluskey, and K-diagram based factorization; logic synthesis and analysis; - kombinatorical main functions for data processing purposes; - sequential basic circuits and flip flops; - register, counter, finite state machines (FSM), there properties, modeling by state diagrams, models for Mealy and Moore automata and the conversation into one another, synthesis and verification of synchronous and asynchronous FSM; - dynamic behaviour of gate logic and automata; - practical exercise on the design of gate logic and automata, including keyboard controller, variable frequency signal generator, and pulse width modulator.
Course type	2L - 0E - 1S - 2P (Lecture, Exercises, Seminar, practical course)
Learning Material	Lecture notes, exercises, lab instruction sheets
Recommended literature	K. Fricke: Digitaltechnik. Vieweg 2001 K. Urbanski, R.Woitowitz: Digitaltechnik; Ein Lehr- und Übungs-buch. Springer 2000 A.E.A. Almaini: Kombinatorische und sequentielle Schalt¬systeme. VCH 1989 G. Scarbata: Synthese und Analyse Digitaler Schaltungen H.-D. Wuttke, K. Henke: Schaltsysteme: Eine Automaten-theoretische Einführung. Pearson Studium 2003
Method(s) of instruction/ media being used	Lecture notes, exercises, lab instruction sheets
Level/ category	1 (Bachelor=1, Master=2)
Summer/ Winter	winter term
Term	3. term
Compulsory requirements	none
Assessment	exam 120 min, Laboratory internship certificate
Assessment modalities	PL – exam during audit period(graded)

Further Information	The exam take place at the end of the 3rd term. Regardless of the exam, the laboratory internship must be completed successfully.
ECTS credits	6
Workload	180h of total work load, thereof 75h of contact hours and 105h of self-study, consisting of: 45 h lecture (preparation and rework) 25 h practical training (preparation and evaluation) 25 h exam preparation
Usability of this module	Digital Design, Information Technology, Microprocessor Technology, Embedded Systems
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

Module number	**ET.1.401**
Module name	**Microprocessor Technology**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Module coordinator	Prof. Dr.-Ing. Burkart Voß
Compulsory/ optional/ elective	Compulsory
Learning objectives	After successful completion of the module the students are able to: - understand the working principles and application potential of microcontrollers. - apply the datasheet as a main source of information needed to use the microcontroller - program microcontrollers in C - debug microcontroller based systems in a systematic way.
Module content	- General design of freely programmable hardware - Abstraction onto a programming model - General design of peripheral modules - general method of accessing peripheral modules via software - Programming procedure in C
Course type	2L - 0E - 0S - 2P (Lecture, Exercises, Seminar, practical course)
Learning Material	datasheet, examples of solutions, tutorials for development tools
Recommended literature	Hennessy, J.L.; Patterson, D.A.: „Computer architecture: a quantitative approach“, Morgan Kaufmann, 2002 Schmitt, G.: „Mikrocomputertechnik mit Controllern der Atmel AVR-RISC-Familie“, Oldenburg, 2007 Clements, Alan: The principles of computer hardware, Oxford University Press, 2000
Method(s) of instruction/ media being used	Lecture, labs, self-study
Level/ category	1 (Bachelor=1, Master=2)
Summer/ Winter	summer term
Term	4th term
Compulsory requirements	Basic programming skills, basics of digital circuit design
Assessment	course attendance certificate
Assessment modalities	SL - ungraded course work during the lecture period
Further Information	The skills in using microcontrollers are proven with the successful completion of a team project. The success of the project is demonstrated in the frame of a robot competition. The inividual ability to use microcontrollers successfully is proven in an interview
ECTS credits	6
Workload	180h of total work load, thereof 60h of contact hours and 120h of self-study, consisting of: 45 h lecture (preparation and rework) 50 h practical training (preparation and evaluation) 25 h exam preparation
Usability of this module	Real Time Operating Systems, Microcomputer Design, Digital Signal Processors, Processor Design
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

Module number	**ET.1.402**
Module name	**Analog Circuit Design**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Module coordinator	Prof. Dr.-Ing. Thomas Reuter
Compulsory/ optional/ elective	Compulsory
Learning objectives	The student should familiarise with fundamentals of analog circuit organisation and get to know possible applications of operational amplifiers. The main aim if the knowledge of methods for circuit analysis and synthesis.
Module content	- differential amplifier, characteristics and properties of operational amplifiers - inverting / not-inverting amplifiers, current-to-voltage converter - transimpedance amplifier, computational circuits, constant sources - comparator, Schmitt-trigger
Course type	4. Term 2L – 1E – 0S – 0P (ET.1.402.1) EE/IE 5. Term 0L – 0E – 0S – 2P (Lecture, Exercises, Seminar, practical course)
Learning Material	exercises, lab instruction sheets
Recommended literature	Tietze. U.; Schenk. C.: Halbleiterschaltungstechnik Bystron/Borgmeyer: Grundlagen der technischen Elektronik Morgenstern, B: Elektronik, Band II: Schaltungen
Method(s) of instruction/ media being used	Lecture: work on the blackboard Tutorial exercises experiments at the laboratory after instruction with written preparations
Level/ category	1 (Bachelor=1, Master=2)
Summer/ Winter	summer term/ winter term
Term	4. und 5. Term
Compulsory requirements	none
Recommended requirements	4. und 5. Term
Assessment	exam 90 min, Laboratory internship certificate
Assessment modalities	PL – exam during audit period(graded)
Further Information	The exam takes place at the end of the 5th term.
ECTS credits	6
Workload	180h of total work load, thereof 90h of contact hours and 90h of self-study, consisting of: 45 h lecture (preparation and rework) 30 h practical training (preparation and evaluation) 15 h exam preparation
Usability of this module	Integrated Circuits, Integration of mixed-signal circuits (SD Master), Analog Design (SD Master), Usage of module in other study courses: BMT, PT, ME
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

Module number	**ET.1.404**
Module name	**Electrical Drives**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba), Me (Ba)
Specialization	AER
Module coordinator	Prof. Dr.-Ing. Matthias Förster
Compulsory/ optional/ elective	Compulsory
Learning objectives	The students will understand the work and the behavior of electrical machines. This gives the basic for understanding the typical solutions of power electronics for speed control. After successfully participating in this course, students are able to define the requirements for an electrical drive and to select the electrical machine and power electronics for the needed function.
Module content	Topics of the lecture are - Introduction: Explanation of the structure of drive systems, the conversion of energy related to the principles for generating mechanical forces and basics of mechanics - Basics of electrical machines with D.C. brush motors, induction motors and synchronous motors - Rating of machines - Control of machines: Control of D.C. motors, induction motors, AC-servomotors. Introduction to field orientated control and motion control The main topics are trained in lab sessions with the following experiments: - DC- motoer and induction motor - circle diagram of induction motors - D.C. motor with phase controlled rectifier - frequency converter - AC-servo motor
Course type	4L - 0E - 0S - 2P (Lecture, Exercises, Seminar, practical course)
Learning Material	lecture papers and experiment instructions
Recommended literature	Fischer, F.: Elektrische Maschinen Müller, G.: Grundlagen Elektrischer Maschinen Specovius, J.: Grundkurs Leistungselektronik Gerke, W: Elektrische Maschinen und Aktoren
Method(s) of instruction/ media being used	Lecture and experiment
Level/ category	1 (Bachelor=1, Master=2)
Summer/ Winter	summer term
Term	4. term
Compulsory requirements	none
Recommended requirements	Electrical Engineering 1 and 2
Assessment	exam 90 min
Assessment modalities	PL – exam during audit period(graded)
ECTS credits	6
Workload	180h of total work load, thereof 90h of contact hours and 90h of self-study, consisting of: 20 h lecture (preparation and rework) 40 h practical training (preparation and evaluation) 30 h exam preparation
Usability of this module	Motion Control, Automation Systems
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

Module number	**ET.1.405.1**
Module name	**Control Systems**
Sub module	Control Systems/ PLC
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Specialization	AER
Module coordinator	Prof. Dr.-Ing. Jörg Müller
Compulsory/ optional/ elective	Compulsory
Learning objectives	After students have attended the course, they are able to - interpret verbal control tasks, - recognize task classes and demonstrate the corresponding solution approaches - outline solutions - demonstrate solutions from common industrial systems
Module content	- general survey of control technique in automation - description-methods and – techniques - logic control - sequential control - structure and function of programmable logic controller (PLC) - programming according to the IEC-norm - Safety of control - implementation
Course type	2L - 0E - 0S - 1P (Lecture, Exercises, Seminar, practical course)
Learning Material	lecture script, lab instruction sheets, extracts of standards
Recommended literature	Wellenreuther, G. u.a.: Automatisieren mit SPS – Theorie und Praxis; Wiesbaden: Vieweg von Aspern, J: SPS-Softwareentwicklung mit IEC 61131; Heidelberg: Hüthig Seitz, M.: Speicherprogrammierbare Steuerungen; München, Leipzig: Carl Hanser
Method(s) of instruction/ media being used	Team work, reflections in the plenum, lab sessions
Level/ category	1 (Bachelor=1, Master=2)
Summer/ Winter	summer term
Term	4th term
Compulsory requirements	None
Recommended requirements	Digital Systems: Boolean Algebra, Flip Flops
Assessment	exam 90 min, Laboratory internship certificate
Assessment modalities	PL – exam during audit period(graded)
ECTS credits	6 for the whole module (ET1.405)
Workload	90h of total work load, thereof 45h of contact hours and 45h of self-study, consisting of: 20 h lecture (preparation and rework) 15 h practical training (preparation and evaluation) 10 h exam preparation
Usability of this module	Automation Systems
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

Module number	**ET.1.405.3**

Module name	**Control Systems**
Sub module	Robotic Systems
Department	Electrical Engineering and Information Technology
Degree program	ET/ IT (Ba)
Specialization	AER
Module coordinator	Prof. Dr.-Ing. Johannes Trabert
Compulsory/ optional/ elective	Compulsory
Learning objectives	The lectures give a basic overview of the diverse field of robotic systems. Upon successful completion of the module, - the students have an overview of different robot applications and corresponding system architectures - they know essential hardware components of robotic systems, - have an overview of different methodological approaches to sensor data processing, orientation and obstacle avoidance in the robot environment, decision-making and behaviour control as well as interaction possibilities.
Module content	- Applications of robotic systems: stationary industrial robots, intelligent assistance robots/service robots, autonomous mobile robots, humanoid robots, robots in health/care and medicine, etc. - Robot architectures, kinematics and dynamics of different robot designs - Human-robot collaboration, collision avoidance - Hardware components: sensor technology, drive technology/actuators, information processing, energy supply, safety devices - Introduction to methods for localisation and navigation
Course type	2L - 0E - 0S - 0P
Learning Material	Books, script/ set of slides, practical demonstrations, follow-up questions
Recommended literature	- C. Bartneck, T. Belpaeme, F. Eyssel, T. Kanda, M. Keijsers, S. Šabanovi: Mensch-Roboter-Interaktion - Eine Einführung, Hanser Verlag. - M. Ben-Ari, F. Mondada: Elements of Robotics, Springer Verlag. - H. Maier: Grundlagen der RoboCEAI, VDE Verlag. - R. Siegwart, R. Nourbakhsh, D. Scaramuzza: Introduction to Autonomous Mobile Robots, The MIT Press. - Tsai, L.-W.: Robot Analysis, The mechanics of serial and parallel Manipulators, John Wiley & Sons. - W. Weber, H. Koch: Industrieroboter – Methoden der Steuerung und Regelung, Hanser Verlag. - D. W. Wloka, P. Nijkamp: Robotersysteme - Bände 1 - 3, Springer Verl.
Method(s) of instruction/ media being used	Seminar-based lectures and self-study
Level/ category	1
Summer/ Winter	Winter term
Term	5th Term
Compulsory requirements	No specific requirements
Recommended requirements	Mathematics, Physics/ Kinematics, Control Engineering, Electric Drives, Basics of Programming
Assessment	Written test, Certificate (“Testat”) upon successful participation
Assessment modalities	SL - Course achievement (ungraded)
Further information	
ECTS credit points	3

Workload	60 h total workload, of which are
	- 30 h attendance hours (2 SWS) and
	- 30 h of self-study, consisting of:
	  - 15 h preparation and follow-up of lectures
	  - 15 h exam preparation

Module is a suggested preparation for	Mobile robotics, Master's degree programmes in Automation Technology and Robotics, Computer Engineering and Artificial Intelligence, Manufacturing Automation, Production Logistics, Plant Engineering, Industry 4.0
Time	According to time table

Duration of module	1 term
Place/ room at	EAH Jena
Frequency of offer	Annually
Language	German
Last modification	03/27/2022

Module number	**ET.1.406**
Module name	**Image Processing**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Specialization	AER, CCT, CEAI
Module coordinator	Prof. Dr.-Ing. Sebastian Knorr
Compulsory/ optional/ elective	Compulsory
Learning objectives	The student should learn the fundamental procedures for digitizing and processing images. He/She should be able to apply adequate software such as ImageJ and is able to implement basic image processing methods.
Module content	- Introduction to the fundamentals of digital image processing - Digitisation: scanning, quantisation, scanning theorem - Gray-scale statistic: average value, variance, entropy, co-occurrencematrix - Point operators: E.g., histogram equalization, gamma correction - Local operators: linear and non-linear filters, smoothing, median filtering, edge filtering, unsharp mask - Global operators: 2D Fourier Transform, Discrete Cosine Transform - Image segmentation, region labeling, simple region descriptors - Color image processing, color spaces - Fundamentals of feature extraction and pattern recognition
Course type	3L - 2E - 0S - 0P
Learning Material	Scripts and lab instruction sheets on the Internet
Recommended literature	Burger, Wilhelm und Burge, Mark J.: Digitale Bildverarbeitung: Eine algorithmische Einführung mit Java, Springer, Auflage 20. Erhardt, Angelika: Einführung in die Digitale Bildverarbeitung, Vieweg + Teubner, 2008.
Method(s) of instruction/ media being used	Interactive lecture, practical course, work in little teams, self-study, exercises
Level/ category	1
Summer/ Winter	summer term
Term	4. bzw. 6. Term
Compulsory requirements	none
Recommended requirements	Signal Processing, Basics in computer programming, Algorithms and data structures
Assessment	exam 90 min
Assessment modalities	PL - Prüfungsleistung während des Prüfungszeitraums (benotet)
Further information	
ECTS credits	6
Workload	180h of total work load, thereof 75h of contact hours and

	105h of self-study, consisting of: 80 h lecture (preparation and rework) 0 h practical training (preparation and evaluation) 25 h exam preparation
Usability of this module	Immersive Media Technology, Computer Vision, 3D Robot Vision, Machine Learning for Visual Computing, Augmented and Virtual Reality
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	DeutschGerman
Last modification	06.08.2021

Module number	**ET.1.407**
Module name	**Optoelectronics**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Specialization	AER, CCT
Module coordinator	Prof. Dr. Alexander Richter
Compulsory/ optional/ elective	Compulsory
Learning objectives	The students acquire knowledge of the operating conditions of optoelectronic basic components. This enables them to design and develop simple optoelectronic assemblies and systems. Due to the intensive study of the basics of optoelectronics and technical optics, graduates are able to familiarize themselves with new tasks in optoelectronic system development at short notice.
Module content	- Mediation of the theoretical bases to photonics events in semiconductor structures; - Functional conditions and qualities of optoelectronic transmitter and detection devices considering her specific use fields; - Interaction of the construction elements in typical application cases; - Application of optoelectronics in automation technology - Introduction to transmission technology
Course type	2L - 1E - 0S - 1P (Lecture, Exercises, Seminar, practical course)
Learning Material	lecture script, collection of exercises
Recommended literature	- Paul: Optoelektronische Halbleiterbauelemente, Teubner-Verlag, 1992 - Jansen: Optoelektronik, Vieweg, 1993 - Jones: Optoelektronik, VCH, 1992 - Brückner: Optische Nachrichtentechnik, Teubner, 2003 - Krieg: Automatisieren mit Optoelektronik, Vogel, 1992
Method(s) of instruction/ media being used	lectures, self-study, discussion at the practical course
Level/ category	1 (Bachelor=1, Master=2)
Summer/ Winter	summerterm
Term	4th term
Compulsory requirements	None
Recommended requirements	Electronic Components, Physics, Mathematics
Assessment	written test, 60min
Assessment modalities	PL – exam during audit period(graded)
Further Information	The module examination consists of a written test. In the test, students create solutuions for selected optoelectronic questions, and calculate various technically relevant variables and parameters based on given practical examples
ECTS credits	6
Workload	180h of total work load, thereof 60h of contact hours and 120h of self-study, consisting of: 55 h lecture (preparation and rework) 35 h practical training (preparation and evaluation) 30 h exam preparation
Usability of this module	Optoelectronics II Laser Techniques Optical and Optoelectronical Sensors Optoelectronical Systems
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

Module number	**ET.1.410**
Module name	**Software Engineering**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Specialization	CEAI
Module coordinator	Prof. Dr.-Ing. Oliver Jack
Compulsory/ optional/ elective	Compulsory
Learning objectives	At the end of the module students are able: - to understand methods for sysematic software design - to assess requirements analysis methods by example problems - to apply application software planning methods for micro computers and micro controllers - to apply best practice methods of software quality assurrance
Module content	Principles, Procedures, Methods, Tools for Development, Service and Support of Software, Software Development Models and Phases, V-Model, Basic Concepts of Object-Oriented Software Develpoment, Fundamentals of the Unified Modelling Language (UML), Software Test and Validation Methods
Course type	2L - 2E - 0S - 0P (Lecture, Exercises, Seminar, practical course)
Learning Material	
Recommended literature	- Helmut Balzert. Lehrbuch der Software-Technik, Band 1. Software Entwicklung. Spektrum Akademischer Verlag, Heidelberg Berlin, 2. Aufl., 2000. - Helmut Balzert. Lehrbuch der Software-Technik, Band 2. Software-Management, Software-Qualitätssicherung und Unternehmensmodellierung. Spektrum Akademischer Verlag, Heidelberg Berlin, 2. Aufl., 1998. - Ian Sommerville. Software engineering. Addison-Wesley, Harlow [u.a.], 8. edition, 2007. - Wolfgang Zuser, Thomas Grechenig, und Monika Köhle. Software-Engineering mit UML und dem Unified Process. Pearson Studium, München [u.a.], 2., überarb. Aufl., 2004.
Method(s) of instruction/ media being used	lecture, practical course, exercises, self-study
Level/ category	1 (Bachelor=1, Master=2)
Summer/ Winter	summer term
Term	4. term - EE/IE-TI
Compulsory requirements	none
Recommended requirements	Computer Science
Assessment	term paper
Assessment modalities	APL – assessment during the term period (graded)
Further Information	The students have to conduct an extensive software development project
ECTS credits	6
Workload	180h of total work load, thereof 60h of contact hours and 120h of self-study, consisting of: 90 h lecture (preparation and rework) 30 h exam preparation
Usability of this module	Operating Systems
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

Module number	**ET.1.411**
Module name	**Digital Signal Processing**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Specialization	AER, CEAI, CCT
Module coordinator	Prof. Dr.-Ing. Frank Giesecke
Compulsory/ optional/ elective	Compulsory
Learning objectives	Obtain the skills for design, simulation and evaluation of digital systems using transformation as well as for estimation of the impact resulted by the quantization of values
Module content	Sampling theorem for low- and bandpass signals – discrete Fourier-Transform – windowing – z-Transform – FIR- and IIR-Structures – quantization noise – signal to noise ratio – sampling rate conversion – approximation of continuous-time by discrete-time processes – transmission behaviour of digital systems in z-domain – test of stability
Course type	2L - 0E - 0S - 1P (Lecture, Exercises, Seminar, practical course)
Learning Material	Lecture scripts, tasks and solutions, simulation scripts
Recommended literature	Scheithauer, R.: Signale und Systeme Kreß, D.; Irmer, R: Angewandte Systemtheorie Meyer, M.: Grundlagen der Informationstechnik v. Grünigen, D. Ch.: Digitale Signalverarbeitung Brigham, E. O.: FFT-Anwendungen
Method(s) of instruction/ media being used	Lectures, exercises, simulations by software tool MATLAB
Level/ category	1 (Bachelor=1, Master=2)
Summer/ Winter	summer term
Term	4. term
Compulsory requirements	none
Recommended requirements	Mathematics, Basics of Electrical Engineering, Computer Science, Theory of Signals and Systems, Control Engineering, MATLAB
Assessment	exam 90 min
Assessment modalities	PL – exam during audit period(graded)
ECTS credits	3
Workload	90 h of total work load, thereof - 45 h of contact hours and - 45 h of self-study, consisting of: preparation and rework lecture 15 h practical training 15 h (preparation and evaluation) exam preparation 15 h
Usability of this module	Usable for modules related to processing of informations.
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

Module number	**ET.1.501**
Module name	**Nontechnical complusory elective modules**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Compulsory/ optional/ elective	elective
Module content	The compulsory elective module (6 ECTS credits) makes it possible to select modules from a range of different compulsory elective modules according to the interests and inclinations of the students. The following modules are available: ET.1.501.1 Business Administration ET.1.501.2 Management of projects Exact content see corresponding module description.
Course type	(Lecture, Exercises, Seminar, practical course)
Level/ category	1 (Bachelor=1, Master=2)
Summer/ Winter	winter term or summer term
Term	5th or 6th term
ECTS credits	6
Workload	180 h
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

Module number	**ET.1.501.1**
Module name	**Applied Business Administration**
Sub module	Business Administration
Department	Business Administration
Degree program	EE/IE (Ba)
Module coordinator	Fachbereich Betriebswirtschaft, Department Business Administration
Compulsory/ optional/ elective	elective
Learning objectives	- Ability of scientific, economic thinking as well as recognition of basic interrelations in industrial enterprises. - Getting to know fundamental management functions and their application.
Module content	- Basic model of an enterprise and its constitutive characteristics. - Structures and processes within an enterprise. - The management of enterprises and decision-oriented methods.
Course type	0L - 0E - 2S - 0P (Lecture, Exercises, Seminar, practical course)
Learning Material	Lecture script, additional material
Recommended literature	- Härdler, J. (Hrsg.): Betriebswirtschaftslehre für Ingenieure, 2. Aufl., München, Wien 2007. - Steinmann, H.; G. Schreyögg: Management – Grundlagen der Unternehmensführung, 6. Aufl., Wiesbaden 2005.
Method(s) of instruction/ media being used	Seminar, self study
Level/ category	1 (Bachelor=1, Master=2)
Summer/ Winter	winter term
Term	5th term
Compulsory requirements	none
Assessment	written test
Assessment modalities	APL – assessment during the term period (graded)
ECTS credits	6 (for the entire module ET.1.501)
Workload	90h of total work load, thereof 30h of contact hours and 60h of self-study, consisting of: 40 h lecture (preparation and rework) 0 h practical training (preparation and evaluation) 20 h exam preparation
Usability of this module	Applied Business Administration/Management of Projects
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

Module number	**ET.1.501.2**
Module name	**Management of Projects**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Module coordinator	Nina Hauser
Compulsory/ optional/ elective	elective
Learning objectives	- Ability of scientific, economic thinking as well as recognition of basic interrelations in industrial enterprises. - Getting to know fundamental management functions and their application.
Module content	- Basic model of an enterprise and its constitutive characteristics. - Structures and processes within an enterprise. - The management of enterprises and decision-oriented methods.
Course type	0L - 0E - 2S - 0P (Lecture, Exercises, Seminar, practical course)
Learning Material	Lecture script, additional material
Recommended literature	- Härdler, J. (Hrsg.): Betriebswirtschaftslehre für Ingenieure, 2. Aufl., München, Wien 2007. - Steinmann, H.; G. Schreyögg: Management – Grundlagen der Unternehmensführung, 6. Aufl., Wiesbaden 2005.
Method(s) of instruction/ media being used	Seminar, self study
Level/ category	1 (Bachelor=1, Master=2)
Summer/ Winter	summer term
Term	6th term
Compulsory requirements	none
Recommended requirements	Applied Business Administration (ET.1.501.1)
Assessment	written test
Assessment modalities	APL – assessment during the term period (graded)
ECTS credits	6 (for the entire module)
Workload	90h of total work load, thereof 30h of contact hours and 60h of self-study, consisting of: 40 h lecture (preparation and rework) 20 h exam preparation
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

Module number	**ET.1.502**
Module name	**Modelling/ Simulation**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Spezialication	AER
Module coordinator	Prof. Dr.-Ing. habil. Klaus-Peter Döge
Compulsory/ optional/ elective	Compulsory
Learning objectives	Basic skills of the experimental and theoretical modelling using MATLAB and Simulink.
Module content	- Experimental modeling, theoretical modelling -static signal models, static system models -dynamic signal models, dynamic system models -determined and stochastic signals and systems
Course type	4L - 1E - 0S - 0P (Lecture, Exercises, Seminar, practical course)
Learning Material	- graphical material of the lecture - transformation table - excercises with Matlab/Simulink
Recommended literature	B. Girod, (2003) Einführung in die Systemtheorie, 2.Auflage, Teubner Verlag Stuttgart R. Isermann, (1991) Identifikation dynamischer Systeme 1, Springer Verlag Berlin R. Isermann, (1992) Identifikation dynamischer Systeme 2, Springer Verlag Berlin J. Lunze (2002) Regelungstechnik 2, Springer Verlag Berlin R. Storm, (2001) Wahrscheinlichkeitsrechnung, mathematische StatisCEAl und statistische Qualitätskontrolle, 11. Auflage, Fachbuchverlag Leipzig H. Strobel, (1975) Experimentelle Systemanalyse , Akademie Verlag Berlin J. Wernstedt (1989) Experimentelle Prozeßanalyse, Verlag Technik Berlin
Method(s) of instruction/ media being used	lecture, excercise, blackboard and graphical material via data projector
Level/ category	1 (Bachelor=1, Master=2)
Summer/ Winter	winter term
Term	5. term
Compulsory requirements	Control Theory Theory of Signals and Systems
Recommended requirements	- analysis - algebra - stochastic - physics
Assessment	written university exam 90 min
Assessment modalities	PL – during period of exams (graded)
ECTS credits	6
Workload	180h of total work load, thereof 75h of contact hours and 105h of self-study, consisting of: 80 h lecture (preparation and rework) 25 h exam preparation
Usability of this module	- digital control Systems - optimal control theory
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

Module number	**ET.1.503**
Module name	**Automation Systems**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Specialization	AER
Module coordinator	Prof. Dr.-Ing. Jörg Müller
Compulsory/ optional/ elective	Compulsory
Learning objectives	The student is able to create and to implement an automation concept for a technical plant. For that he knows the devices and components, which satisfy the automation tasks, knows the selection criteria and the influence of the environment on the master plan (availability redundancy, explosion protection.
Module content	- tasks of automation - devices systems and their structures - periphery to process periphery - components close to process - display and control components - Open systems vs. compact systems - availability, reliability, redundancy, safety, explosion protection - design: phases, methods, product concept catalogue , customer requirement specification, processing
Course type	3L - 0E - 0S - 2P
Learning material	Lecture script, lab instruction sheets, extracts of standards
Recommended literature	-Bergmann, J.: Automatisierungs- und Prozessleittechnik; Leipzig: Fachbuchverlag -Bindel, T. u.a.: Projektierung von Automatisierungsanlagen; Wiesbaden: Vieweg -Langmann, R.: Taschenbuch der Automatisierung; Leipzig: Fachbuchverlag
Method(s) of instruction/ media being used	teamwork, reflections in plenum, practical course
Level/ category	1
Summer/ Winter	winter term
Term	5th term
Requirements for attendance (compulsary)	none
Recommended requirements	none
Assessment	exam 90 min, Laboratory internship certificate
Assessment modalities	PL – exam during audit period (graded)
Further information	
ECTS credits	6
Workload	180h of total work load, thereof 75h of contact hours and 105h of self-study, consisting of: 50 h lecture (preparation and rework) 35 h practical training (preparation and evaluation) 20 h exam preparation

Usability of this module	none
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German
Last modification	08/10/2021

Module number	**ET.1.504.1**
Module name	**Process Communication**
Sub module	Field Bus
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Specialization	AER, CEAI
Module coordinator	Prof. Dr.-Ing. Jörg Müller
Compulsory/ optional/ elective	Compulsory
Learning objectives	After students have attended the course, they are able to - interpret a task related to process communication, - generalize the task, - compare different industrial solutions, - select devices and device structures, - demonstrate solutions on commonly used systems
Module content	- communication in automation technology: requirements, technologies - Basics of communication, logical models of LAN, embedding in concept of common communication systems - classification by topology, transmission, and access methods - Internetworking (Bridging, Switching, Routing) - wireless LAN, Industrial Ethernet - ProfiNet, CANopen, Powerlink, OPC-UA
Course type	2L - 0E - 0S - 1P (Lecture, Exercises, Seminar, practical course)
Learning Material	Lecture script, lab instruction sheets, extracts of standards
Recommended literature	Furrer, F. J.: Industrieautomation mit Ethernet-TCP/IP und Web-Technologie; Heidelberg: Hüthig Etschberger,K.: Controller-Area-Network; München, Wien: Hanser Popp, M.: Das PROFINET IO-Buch; Heidelberg: Hüthig Schnell, G.: Bussysteme in der Automatisierungstechnik; Braunschweig, Wiesbaden: Vieweg
Method(s) of instruction/ media being used	teamwork, reflections in plenum, practical course (in 6th term – during sub-module ET.1.504.2)
Level/ category	1 (Bachelor=1, Master=2)
Summer/ Winter	winter term, summer term
Term	5th term lecture 6th term practical course
Compulsory requirements	none
Assessment	exam 90 min, Laboratory internship certificate
Assessment modalities	PL – exam during audit period(graded)
ECTS credits	6
Workload	90h of total work load, thereof 45h of contact hours and 45h of self-study, consisting of: 40 h lecture (preparation and rework)
Time	According time table
Duration of module	2 terms
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

Module number	**ET.1.504.2**
Module name	**Process Communication**
Sub module	Local Area Networks (LAN)
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Specialization	AER,CEAI
Module coordinator	Prof. Dr. Johannes Trabert, Prof. Dr.-Ing. Jörg Müller
Compulsory/ optional/ elective	Compulsory
Learning objectives	Upon completion of the module, students - have a general idea of local area networks and understand importand functions - have a basic knowledge about networks using internet protocols - are able to calculate network loads, - are able to handle some simple configuration and test tasks
Module content	- Basics of communication, logical LAN-models, embedding into the concept of common communication systems - Classification by topology, transmission techniques and access methods - LAN-standardisation and open systems interconnection model - Wiring systems - Overview of access methods - CSMA/CD-Ethernet basics and historical development - 10 M, 100M, 1G und 10G Ethernet - additional technologies (AUTONEG and others) - Internetworking (Bridging, Switching, Routing) - wireless LAN
Course type	2L - 0E - 0S - 0P (Lecture, Exercises, Seminar, practical course)
Learning Material	books, script and lab instruction sheets
Recommended literature	- Spurgeon, C. E.: Ethernet, O'Reilly 2000 - Johnson, H. W.: Fast Ethernet, Prentice Hall PTR 1996 - Halsall, F.: Data Communications, Computernetworks and Open Systems, Addison-Wesley 1995 - Martin Werner: Netze, Protokolle, Schnittstellen und Nachrichtenverkehr, Verlag Vieweg 2005 - Perlman, R.: Bridges, Router, Switches und internetworking-Protokolle, Addison Wesley 2003
Method(s) of instruction/ media being used	Lecture, teamwork, reflections in plenum, practical course
Level/ category	1 (Bachelor=1, Master=2)
Summer/ Winter	summer term
Term	6th term
Compulsory requirements	none
Assessment	exam 90 min, Laboratory internship certificate, in combination with modul Field Bus
Assessment modalities	PL – exam during audit period(graded, in combination with modul Field Bus)
ECTS credits	6, in combination with modul Field Bus
Workload	120h of total work load, thereof 45h of contact hours and 65h of self-study, consisting of: 25 h lecture (preparation and rework) 15 h practical training (preparation and evaluation) 25 h exam preparation
Time	According time table
Duration of module	2 terms
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

Module number	**ET.1.505**
Module name	**Computer Vision**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Specialization	CEAI
Module coordinator	Prof. Dr.-Ing. Sebastian Knorr
Compulsory/ optional/ elective	Compulsory
Learning objectives	After successfully participating in the module, the students know the basic processes for pattern recognition in images (supervised and unsupervised machine learning processes) and understand their basic principles. Furthermore, they are able to independently apply the essential methods of classic machine learning to new data. This includes methods for classification and clustering as well as the theoretical basics (probability theory, optimization theory) to further develop processes and analyze them theoretically.
Module content	• Interest point detection, Harris detector • Hough transform: Recognition of lines and simple curves • 3D reconstruction • Feature extraction, representation of image regions, SIFT features, bag of words • Probability theory and Bayes decision theory • Pattern recognition and machine learning, supervised and unsupervised learning methods: K-Means clustering, agglomerative clustering, Bayes classification, neural networks, support vector machines, Adaboost Object detection and recognition
Course type	2L - 1E - 0S - 1P
Learning Material	Lecture slides and selected literature
Recommended literature	• Christopher M. Bishop (2006) Pattern Recognition And Machine Learning, Springer. • L. Wasserman (2004) All of Statistics, Springer • Richard O. Duda, Peter E. Hart, David G. Stork (2001) Pattern Classification, Wiley (2. Auflage). • Trevor Hastie, Robert Tibshirani, Jerome Friedman (2001) The Elements of Statistical Learning, Springer. • Richard Hartley und Andrew Zisserman (2004). Multiple View Geometry, Cambridge University Press Marc Pollefeys (2000). Tutorial on 3D Modeling from Images, Lecture Notes, ECCV
Method(s) of instruction/ media being used	Lecture, practical course, exercises
Level/ category	1
Summer/ Winter	winter
Term	5. Term
Compulsory requirements	none
Recommended requirements	Signal Processing, Computer Science, Image Processing / Image Analysis 1
Assessment	Oral examination and programming assignment
Assessment modalities	APL – assessment during the term period (graded)
ECTS credits	6
Further information	
Workload	180h of total work load, thereof

	60h of contact hours and 120h of self-study, consisting of: 25 h lecture (preparation and rework) 25 h exercises (preparation and rework) 50 h practical training (preparation and evaluation) 20 h exam preparation
Usability of this module	Immersive Media Technology, 3D Robot Vision, Machine Learning for Visual Computing, Augmented and Virtual Reality
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German
Last modification	06.08.2021

Module number	**ET.1.506.1**
Module name	**Radio Frequency Engineering**
Sub module	Radio Frequency Engineering 1
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Specialization	CCT
Module coordinator	Prof. Dr.-Ing. Johannes Trabert
Compulsory/ optional/ elective	Compulsory
Learning objectives	Upon successful completion, the students will be able to - evaluate the specifics of high-frequency signal processing and conducted or wireless-based transmission, - understand the propagation of electromagnetic waves on transmission lines and their function as waveguides, - apply high-frequency lines for different purposes - apply the model of waves to various problems in RF engineering, - apply the techniques needed to perform typical design tasks for high-speed circuits and in RF engineering, such as optimising transmission line parameters, calculating matching networks, - understand and use the effects of electromagnetic wave propagation in space and the operation of antennas, and - estimate the properties of free-space propagation quantitatively for the specification of a transmission link.
Module content	- Overview: Electromagnetic waves in space, Maxwell's equations - Transmission line model, electromagnetic waves on lines and solution of the Telegraph equations in the stationary case - Reflection and standing waves on transmission lines - Transmission line elements as circuit elements, transformers and resonators - The Smith chart and its applications, scattering parameters, circuits for impedance transformation - One-ports, two-ports, n-poles/ n-ports - Principle of RF transmission: Hertzian dipole, near and far field - Properties and technical description of antennas - Radio propagation, directed propagation of electromagnetic waves in space (radio links)
Course type	2L - 0E - 1S - 0P
Learning Material	Books, script/ set of slides, exercises and follow-up questions
Recommended literature	- R. E. Collin: Field Theory of Guided Waves. Oxford University Press & IEEE - J. Detlefsen, U. Siart: Grundlagen der Hochfrequenztechnik. Oldenbourg Verlag - G. Gronau: Höchstfrequenztechnik. Springer Verlag - F. Gustrau: Hochfrequenztechnik - Grundlagen der mobilen Kommunikationstechnik. Hanser Verlag - H. Heuermann: Hochfrequenztechnik - Komponenten für High-Speed- und Hochfrequenzschaltungen. Springer Verlag - M. Hoffmann: Hochfrequenztechnik, ein systemtheoretischer Zugang. Springer Verlag - P. Leuchtmann: Einführung in die elektromagnetische Feldtheorie. Pearson Verlag

	- H. H. Meinke, F.W. Gundlach: Taschenbuch der Hochfrequenztechnik Band 1: Grundlagen and Band 2: Komponenten. Springer Verlag - S. Orfanidis: https://www.ece.rutgers.edu/~orfanidi/ewa/ . Website with book for download „Electromagnetic Waves and Antennas“ - D. M. Pozar: Microwave engineering. Wiley - A. J. Schwab: Begriffswelt der Feldtheorie. Springer Verlag - O. Zinke, H. Brunswig: Lehrbuch Hochfrequenztechnik, Band 1: Hochfrequenzfilter, Leitungen, Antennen. Springer Verlag
Method(s) of instruction/ media being used	Seminar-based lectures, simulation examples, exercises and self-study
Level/ category	1
Summer/ Winter	Winter term
Term	5th Term
Compulsory requirements	No specific requirements
Recommended requirements	Fundamentals of Electrical Engineering, Signal Processing, Introduction to Communications Engineering, Linear Ordinary Differential Equations and Partial Differential Equations
Assessment	Written test, Certificate of successful participation (Testat)
Assessment modalities	SL - Study Performance (ungraded)
Further information	
ECTS credits	3
Workload	90 h total workload, of which are - 45 h attendance hours (SWS) and - 45 h of self-study, consisting of: - 10 h preparation and follow-up of lectures - 20 h preparation and follow-up of exercises - 15 h exam preparation
Usability of this module	Radio Frequency Engineering II, High-speed Circuits Engineering/ Digital Circuits Design, Electromagnetic Compatibility, Master courses on Communication- and Circuit Engineering or on Space Electronics
Time	According to time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German
Last modification	08/10/2021

Module number	**ET.1.506.2**
Module name	**Radio Frequency Engineering**
Sub module	Radio Frequency Engineering 2
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Specialization	CCT
Module coordinator	Prof. Dr.-Ing. Johannes Trabert
Compulsory/ optional/ elective	Compulsory
Learning objectives	Upon successful completion of the module, students will be able to - understand the basic structure and operation of high-frequency systems and RF-devices, e.g. in communication and measurement technology, biotechnology and medical technology and RADAR, - analyse their important passive and active components and functional blocks and evaluate relevant parameters, - Analyse and evaluate linear properties and non-linear effects that occur in active high-frequency circuits, - Determine selected parameters such as frequency range, scattering parameters, gain, dynamic range, noise figure, power requirements, efficiency, etc. of components, compare different components and estimate influence on system properties, - design simple passive and active linear RF circuits themselves and gain initial experience in using RF and microwave CAD systems for circuit simulation and 3D EM field modelling, e.g. for estimating the feasibility or optimisation of given circuit parts.
Module content	- Introduction: System considerations, active components and assemblies - High-frequency amplifiers, power transmission via linear two-port networks, definition of gain, RF transistors (BJT, FET), transistor circuits, description of non-linear signal distortions, dynamic range - Noise, causes of noise, description of noise processes, noise matching and cascading of functional building blocks - Frequency synthesis: oscillation generation, basic oscillator circuits, quartz oscillators, phase-locked loop (PLL)-based and direct frequency synthesis (DDS), frequency multiplication - Frequency conversion, mixing, selected mixer circuits - Modulators and demodulators, amplitude and angle modulation, occupied bandwidth, spectral efficiency - Frequency-selective elements, basic circuits of passive and active filters - Synthesis of RF systems: Receiver and transmitter concepts with homodyne and heterodyne architectures, software-defined radio (SDR), system characteristics - practical Application of RF measurement technology for power measurement, spectral analysis, reflection factors on transmission lines as well as network analysis (scattering parameters), for determining field strength and polarisation of EM-waves, directional diagrams of antennas - practical. Application of CAD tools for RF circuit simulation and 3D modelling of electromagnetic fields e.g. for PCB design, antennas etc.
Course type	2L - 1E - 0S - 2P
Learning Material	Books, script/ set of slides, exercises, follow-up questions and laboratory instruction
Recommended literature	- J. Detlefsen, U. Siart: Grundlagen der Hochfrequenztechnik. Oldenbourg Verlag - G. Gronau: Höchstfrequenztechnik. Springer Verlag - F. Gustrau: Hochfrequenztechnik - Grundlagen der mobilen Kommunikationstechnik. Hanser Verlag - F. Gustrau, D. Manteuffel: EM Modeling of Antennas and RF Components for Wireless Communication Systems. Springer Verlag - H. Heuermann: Hochfrequenztechnik - Komponenten für *High-Speed*- und Hochfrequenzschaltungen. Springer Verlag

	- M. Hoffmann: Hochfrequenztechnik, ein systemtheoretischer Zugang. Springer Verlag - H. H. Meinke, F.W. Gundlach: Taschenbuch der Hochfrequenztechnik, Band 1: Grundlagen, Band 2: Komponenten and Band 3: Systeme. Springer Verlag - D. M. Pozar: Microwave engineering. Wiley - O. Zinke, H. Brunswig: Lehrbuch Hochfrequenztechnik, Band 1: Hochfrequenzfilter, Leitungen, Antennen, Band 2: Elektronik und Signalverarbeitung. Springer Verlag
Method(s) of instruction/ media being used	Seminar-based lectures, exercises and simulation tasks, practical laboratory experiments and self-study
Level/ category	1
Summer/ Winter	Summer term
Term	6th Term
Compulsory requirements	No specific requirements
Recommended requirements	Radio Frequency Engineering I, Analogue Circuit Technology, Communications Engineering and Information Transmission Technology, Theory of Signals and Systems, Signal Processing, Fundamentals of Electrical Engineering, Fundamentals of Semiconductor and Solid-State Physics
Assessment	Written exam 90 min., Certificate for successfully completed laboratory experiments
Assessment modalities	PL - Assessment during the examination period (graded)
Further information	
ECTS credits	6
Workload	180 h total workload, of which are - 70 h attendance hours (SWS) and - 110 h of self-study, consisting of: - 20 h preparation and follow-up of lectures - 30 h preparation and follow-up of seminars and exercises - 30 h preparation, evaluation and follow-up of laboratory experiments - 30 h exam preparation
Usability of this module	High-speed Circuits Engineering/ Digital Circuits Design, Electromagnetic Compatibility, Complex/ Engineering Internship, Master courses on Communication- and Circuit Engineering or on Space Electronics
Time	According to time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German
Last modification	08/10/2021

Module number	**ET.1.507**
Module name	**Communication Networks**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Specialization	CCT
Module coordinator	Prof. Dr.-Ing. Johannes Trabert
Compulsory/ optional/ elective	Compulsory
Learning objectives	Upon successful completion of the module, students - have an overview of the technology of wired and wireless communication networks and understand important functions and processes, both for local (LAN) and wide area networks (WAN) - know the techniques and protocols of circuit-switched and packet-switched networks, - have an understanding of networks based on Internet protocols (IP), - can plan IP network addresses and calculate network loads, - can conceptualise simple networks and evaluate them in terms of their performance, - can master configuration tasks and test tasks.
Module content	- Basics of communication networks (classification according to topology, transmission technology and access methods) - Local networks, Ethernet and wireless LAN - Cabling and connector systems (copper, fibre optics) - Wide area networks, connection-oriented systems (PDH, SDH, ISDN) - Wide area networks, packet-oriented systems (ATM, MPLS, Metro Ethernet, IP networks) - Access networks, DSL systems - Important performance features and application aspects - Network management - Mobile communication, 5G
Course type	4L - 0E - 0S - 1P
Learning Material	Books, script/ set of slides, follow-up questions and lab instructions
Recommended literature	- M. Bossert, M. Breitbach: Digitale Netze. Verlag B.G. Teubner Verlag - M. Bossert: Einführung in die Nachrichtentechnik. Oldenbourg Verlag - F. Halsall: Data Communications, Computernetworks and Open Systems. Addison-Wesley - M. Hochmut, F. Wildenhain: ATM-Netze, Architektur und Funktionsweise. International Thomson Publishing

	- H. W. Johnson: Fast Ethernet. Prentice Hall PTR - I. Minei, J. Lucek: MPLS-enabled Applications. John Wiley and Sons - R. Perlman: Bridges, Router, Switches und Internetworking-Protokolle. Addison Wesley - J. Seitz, M. Debes: Kommunikationsnetze - Eine umfassende Einführung. Unicopy Campus Edition der TU-Ilmenau - C.E. Spurgeon: Ethernet. O'Reilly - M. Werner: Netze, Protokolle, Schnittstellen und Nachrichtenverkehr. Springer Vieweg Verlag
Method(s) of instruction/ media being used	Seminar-based lectures, practical laboratory experiments and self-study
Level/ category	1
Summer/ Winter	Summer term
Term	4th Term
Compulsory requirements	No specific requirements
Recommended requirements	Introduction to Communication Engineering, Signal Processing, Theory of Signals and Systems, Fundamentals of Electrical Engineering and Computer Engineering, Analogue- & Digital Circuit Engineering, Digital Systems
Assessment	Written exam 90 min., Certificate for successfully completed laboratory experiments
Assessment modalities	PL - Assessment during the examination period (graded)
Further information	
ECTS credits	6
Workload	180 h total workload, of which are - 75 h attendance hours (SWS) and - 105 h of self-study, consisting of: - 60 h preparation and follow-up of lectures - 15 h preparation, evaluation and follow-up of laboratory experiments - 30 h exam preparation
Usability of this module	Information Transmission Technology, Master courses on Communication and Circuit Engineering, Computer Engineering or Space Electronics
Time	According to time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German
Last modification	08/10/2021

Module number	**ET.1.508**
Module name	**Mobile Computing**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Specialization	CEAI
Module coordinator	Prof. Dr.-Ing. Oliver Jack
Compulsory/ optional/ elective	compulsory
Learning objectives	At the end of the module students are able: - to apply software development method for mobile devices - to assess specifics of distributed mobile application compared to standard PC-applications - to generate and adapt mobile apps - to understand the Android operating system
Module content	Fundamentals of Software Development for Mobile Systems, Introduction to Platform-Specific Programming Languages and Paradigms. Application Architecture and User Interaction, and Generation and Connection of the User Interface, Access to Internal Device Hardware, such as GPS, Compass, Camera), Using Standard APIs and Handling Error States, Connection to Servers and Web Services: Client / Server Communication
Course type	2L - 2E - 0S - 0P (Lecture, Exercises, Seminar, practical course)
Learning Material	Scripts and exercises
Recommended literature	- Uwe Post: Android-Apps entwickeln. Galileo Computing, 2012 - Florian Franke, Johannes Ippen: Apps mit HTML5 und CSS3: Für iPhone, iPad und Android. Galileo Computing, 2013 - Raj Kamal: Mobile Computing. Oxford University Press, 2012
Method(s) of instruction/ media being used	Interactive lecture, work in little teams, self-study, exercises
Level/ category	1 (Bachelor=1, Master=2)
Summer/ Winter	winter term
Term	5. term
Compulsory requirements	none
Recommended requirements	Computer Science, Knownledge in object-oriented programming
Assessment	term paper and presentation
Assessment modalities	APL – assessment during the term period (graded)
Further Information	The students have to conduct an extensive software development project.
ECTS credits	6
Workload	180h of total work load, thereof 60h of contact hours and 120h of self-study, consisting of: 95 h lecture (preparation and rework) 25 h exam preparation
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

Module number	**ET.1.509.1**
Module name	**Operating Systems**
Sub module	Computational Logic
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Specialization	CEAI
Module coordinator	Prof. Dr. Oliver Jack
Compulsory/ optional/ elective	Compulsory
Learning objectives	Upon completion of the module, students are able to characterisetasks and function modes of operating systems, and to analyse fundamental operating system concepts, their implementations, and their properties. Additionally they can apply operating system function in application programming.
Module content	- Functions of operating systems, composition of computers, operating system concepts, system calls, architecture of operating systems, virtual machines - Processes and threads: Fundamentals, condition models - Synchronisation: critical ranges, barriers, semaphors, monitors, deadlocks - Process communication: Signals, RPC - Scheduling: FIFO, Round Robin, priorities - Storage management: Address area, swapping, virtual storage management systems - File systems: Files and file access, listings, structure of a file system - Input/output: Devices, access to devices - Command shells
Course type	2L - 1E - 0S - 0P (Lecture, Exercises, Seminar, practical course)
Learning Material	Lecture script
Recommended literature	Andrew S. Tanenbaum: Moderne Betriebssysteme, 2. Auflage, Pearson Studium, 2003. William Stallings: Betriebssysteme, 4. Auflage, Pearson Studium, 2003. A. Silberschatz, P. Galvin, J. Peteron: Operating System Concepts, John Wiley and Sons, 2001
Method(s) of instruction/ media being used	Lecture, practical course
Level/ category	1 (Bachelor=1, Master=2)
Summer/ Winter	winter term
Term	5. term
Compulsory requirements	none
Recommended requirements	Basics of Programming, Algorithms and data structures
Assessment	course attendance certificate
Assessment modalities	SL - ungraded course work during the lecture period
ECTS credits	3
Workload	90h of total work load, thereof 45h of contact hours and 45h of self-study, consisting of: 35 h lecture (preparation and rework) 10 h exam preparation
Usability of this module	Real Time Operating Systems (ET.1.509.2)
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

Module number	**ET.1.509.2**
Module name	**Operating Systems**
Sub module	Real Time Operating Systems
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Specialization	CEAI
Module coordinator	Prof. Dr. Oliver Jack
Compulsory/ optional/ elective	Compulsory
Learning objectives	At the end of the module students are able: - to categorize objectives and functionality of real-time systems - to distinguish basic real-time operating system concepts and their potential pitfalls - to assess real-time scheduling Methods - to apply methods and tools for application proramming using real-time operation systems - to apply real-time system design methods
Module content	Typical Applications of Real-Time Systems, Structure of a Real-Time System, Characteristics of Real-Time Systems: Time and Event-Controlled Systems, Periodic and Sporadic Tasks, Task Coordination, Architecture Characteristics of a Real-Time Processing System,Real-Time Scheduling: Static Process Planning, Dynamic Process Planning, Algorithms for Dynamic Process Planning, Scheduling Analysis, Systematic Design of Real-Time Systems: Structured Analysis, Real-Time Analysis
Course type	2L - 2E - 0S - 0P (Lecture, Exercises, Seminar, practical course)
Learning Material	Lecture script
Recommended literature	- D.L. Buhr, R.J.A.and Bailey. An Introduction to Real-Time Systems: From Design to Multitasking with C/C++. Prentice Hall, Upper Saddle River, 1998. - Hermann Kopetz. Real-Time Systems. Design Principles for Distributed Embedded Applications. Kluwer Academic Publishers, Dordrecht, London, 1997. - Phillip A. Laplante. Real-Time Systems Design and Analysis. IEEE Computer Society Press, Los Alamitos, second edition, 1997. - Dieter Zöbel and Wolfgang Albrecht. Echtzeitsysteme: Grundlagen und Techniken. International Thomson Publishing, Bonn, 1995.
Method(s) of instruction/ media being used	Lecture, practical course
Level/ category	1 (Bachelor=1, Master=2)
Summer/ Winter	summer term
Term	6. term
Compulsory requirements	none
Recommended requirements	Computer Science, Operating Systems, Software Engineering
Assessment	term paper
Assessment modalities	APL – assessment during the term period (graded)
Further Information	The students have to conduct a software development project for a real-time system
ECTS credits	9 (for the total modul)
Workload	180h of total work load, thereof 60h of contact hours and 120h of self-study, consisting of: 90 h lecture (preparation and rework) 30 h exam preparation
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena

Frequency of offer	Annually
Language	German

Module number	**ET.1.601**
Module name	**Digital Control Systems**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Spezialication	AER
Module coordinator	Prof. Dr.-Ing. habil. Klaus-Peter Döge
Compulsory/ optional/ elective	Compulsory
Learning objectives	Students will be enabled to develop and analyze control loop structures with discrete-time controllers.
Module content	- Introduction and demands for time-discrete control systems - Mathematical description time-discrete dynamic systems - Time-discrete PID-Controller - Compensating Controller and Deadbeat Controller - state space control
Course type	3L - 1E - 0S - 1P (Lecture, Exercises, Seminar, practical course)
Learning Material	Lecture script, lab instruction sheets
Recommended literature	- Lunze, J: Regelungstechnik 2: Mehrgrößensysteme Digitale Regelung, Springer Verlag 1997 - Isermann, R.: Digitale Regelsysteme: Band 1: Grundlagen, deterministische Regelungen, Springer Verlag - Grassmann, H.: Theorie der Regelungstechnik, Verlag Harri Deutsch, Thun/ Frankfurt 1998
Method(s) of instruction/ media being used	lab instruction sheets on the Internet, CAE- Software
Level/ category	1 (Bachelor=1, Master=2)
Summer/ Winter	summer term
Term	6. term
Compulsory requirements	Basics of control engineering
Recommended requirements	Z-transformation
Assessment	written university exam 90 min
Assessment modalities	PL – during period of exams (graded)
ECTS credits	6
Workload	180h of total work load, thereof 75h of contact hours and 105h of self-study, consisting of: 70 h lecture (preparation and rework) 15 h practical training (preparation and evaluation) 20 h exam preparation
Usability of this module	Usage of module in other study courses: Mechatronics
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

Module number	**ET.1.602**
Module name	**Transmission Technique**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Specialization	CCT
Module coordinator	Prof. Dr.-Ing. Johannes Trabert
Compulsory/ optional/ elective	Compulsory
Learning objectives	Upon successful completion of the module, students will be able to - understand the sections of information transmission in space and time - apply selected major methods of information transmission systems - apply mathematical methods for evaluation the treated techniques - identify and determine characteristic parameters of treated techniques
Module content	- Information sources, source encoding and decoding - Data security: cryptography and cryptology - Channel coding and decoding - Transmission of binary signals, line coding - 1st and 2nd Nyquist Criterion - Bandpass signals and bandpass transmission - Analogue and digital modulation techniques (ASK, PSK, FSK, GMSK, QAM) - Physical channel with bandwidth limitation, attenuation, signal-to-noise ratio, bit error rates in binary transmission - Multiplexing techniques for information transmission
Course type	2L - 0E - 1S - 1P
Learning Material	Books, script/ set of slides, exercises, follow-up questions and laboratory instructions
Recommended literature	- J. B. Anderson, R. Johannesson: Understanding Information Transmission. IEEE and Wiley Online Library - M. Bossert: Einführung in die Nachrichtentechnik. Oldenbourg Verlag - B. Friedrichs: Kanalcodierung. Springer Verlag - G. Fritzsche, G. Witzschel: Informationsübertragung. Verlag Technik Berlin - D. Kreß, R. Irmer: Angewandte Systemtheorie. Verlag Technik - D. Kreß: Theoretische Grundlagen der Übertragung digitaler Signale. Akademie Verlag - M. Lipp: VPN – virtuelle private Netzwerke. Pearson or Addison-Wesley - J. Ohm, H. D. Lüke: Signalübertragung. Springer Verlag - H. Rohling, T. Müller: Einführung in die Informations- und Codierungstheorie. Teubner Verlag - H. Schneider-Obermann: Kanalkodierung. Springer Vieweg Verlag - D. Schönfeld, H. Klimant, R. Piotraschke: Informations- und Kodierungstheorie. Springer Verlag - H.-C. Yang, M.-S. Alouini: Advanced Wireless Transmission Technologies - Analysis and Design. Cambridge University Press

Method(s) of instruction/ media being used	Seminar-based lectures, exercises and simulation tasks, practical laboratory experiments and self-study
Level/ category	1
Summer/ Winter	Winter term
Term	5th Term
Compulsory requirements	No specific requirements
Recommended requirements	Introduction to Communication Engineering, Theory of Signals and Systems, Basics of Signal Transformation, Digital Signal Processing, Analogue- and Digital Circuit Technologies, Digital Systems
Assessment	Written exam 90 min., Certificate for successfully completed laboratory experiments
Assessment modalities	PL - Assessment during the examination period (graded)
Further information	
ECTS credits	6
Workload	180 h total workload, of which are - 60 h attendance hours (SWS) and - 120 h of self-study, consisting of: - 30 h preparation and follow-up of lectures - 35 h preparation and follow-up of seminars - 15 h preparation, evaluation and follow-up of laboratory experiments - 40 h exam preparation
Usability of this module	Complex/ Engineering Internship, Master courses on Communication and Circuit Engineering, Computer Engineering or on Space Electronics
Time	According to time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German
Last modification	08/10/2021

Module number	**ET.1.605**
Module name	**Microcomputer Design**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Module coordinator	Prof. Dr.-Ing. Burkart Voß
Compulsory/ optional/ elective	elective
Learning objectives	After successful completion of the module the students are able to: - understand the working principles and application potential of different processor architectures. - develop and build extension modules at PCB level. - connect extension modules to microcontrollers and write the needed software drivers. - develop microcontroller based systems in a systematic way.
Module content	- Architecture and classification of microprocessors - Programming Model of microprocessors - Memory hierarchy and bus systems - Peripheral Components - Design, manufacturing and use of a microcomputer system
Course type	2L - 0E - 0S - 1P
Learning Material	Lecture script, lab instruction sheets
Recommended literature	Tanenbaum. Computerarchitektur Pearson Studium 2001 Hermann. Rechnerarchitektur Vieweg 2001 Clements. The Principles of Computer Hardware Oxford 2000
Method(s) of instruction/ media being used	Lecture, lab session
Level/ category	1
Summer/ Winter	summer term
Term	6. Term
Compulsory requirements	none
Recommended requirements	Extended programming skills, basic knowledge of microcontrollers and their programming in C, circuit engineering fundamentals, basic knowledge in PCB design
Assessment	term paper
Assessment modalities	APL – assessment during the term period (graded)
Further Information	The ability to systematically design a microcontroller based system is shown with the documentation of the design steps of a project aiming at designing a relatively complex microcontroller based system.
ECTS credits	3
Workload	90h of total work load, thereof 45h of contact hours and 45h of self-study
Usability of this module	Industrial placement, Bachelor thesis
Time	According time table
Duration of module	1 term

Place/ room	EAH Jena
Frequency of offer	Annually
Language	DeutschGerman
Last modification	08/24/2021

Module number	**ET.1.607**
Module name	**Mobile Robotics**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Specialization	AER
Module coordinator	Prof. Dr.-Ing. Johannes Trabert
Compulsory/ optional/ elective	Compulsory
Learning objectives	The lecture covers the basics of autonomous mobile robots. Upon successful completion of the course, students will be familiar with the possible uses and system architectures of autonomous mobile robots. Selected applications are practically simulated in laboratory scenarios. Students are able to analyze the relevant hardware and software system components of mobile robot systems and evaluate their performance parameters for various tasks. They will learn methodological approaches to sensor signal processing and data fusion, orientation and obstacle avoidance in the robot environment, and decision making and behavior control, as well as basic principles for programming and simulating mobile robots. By applying the range of methods covered, students will be able to develop solution concepts for different tasks of mobile robots.
Module content	- Mobile robots in industry, retail, care and in the home environment - Architectures and control principles of mobile service robots - System components: sensors for sensing the internal states of a robot and the external environment, drive systems/actuators, information processing, communication systems, power supply incl. batteries - Methods for mission planning and behaviour control, localization and mapping, navigation with obstacle avoidance - Interaction/ human-robot collaboration, functional safety
Course type	3L - 0E - 0S - 2P
Learning Material	Books, script/ set of slides, practical demonstrations, follow-up questions
Recommended literature	M. Ben-Ari, F. Mondada: Elements of Robotics, Springer Verlag. G. Cook, F. Zhang: Mobile Robots – Navigation, Control and Sensing, Surface Robots and AUVs, Wiley-IEEE Press. U. Nehmzow: Mobile RoboCEAI - Eine praktische Einführung, Springer Verl. R. Siegwart, R. Nourbakhsh, D. Scaramuzza: Introduction to Autonomous Mobile Robots, The MIT Press. S. Thrun, W. Burgard, D. Fox: Probabilistic Robotics, The MIT Press. B. Siciliano, O. Khatib: Springer Handbook of Robotics, Springer Verlag.
Method(s) of instruction/ media being used	Seminar-based lectures, practical laboratory experiments and self-study
Level/ category	1
Summer/ Winter	Summer term
Term	6th Term
Compulsory requirements	No specific requirements
Recommended requirements	Mathematics, Physics/ Kinematics, Robotic Systems, Control Engineering, Electric Drives, Automation Systems, Basics of Programming
Assessment	Written exam 90 min., Certificate for successfully completed laboratory experiments
Assessment modalities	PL - Assessment during the examination period (graded)
Further Information	
ECTS credits	6

Workload	180 h total workload, of which are
	- 75 h attendance hours (5 SWS) and
	- 105 h of self-study, consisting of:
	  - 35 h preparation and follow-up of lectures
	  - 30 h preparation, evaluation and follow-up of laboratory experiments
	  - 40 h exam preparation

Usability of this module	Master's degree programmes in Automation Technology and Robotics, Computer Engineering and Artificial Intelligence, Manufacturing Automation, Production- and Intralogistics, Plant Engineering, Industry 4.0
Time	According to time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German
Last modification	03/27/2022

Module number	**ET.1.608**
Module name	**Introduction to Machine Learning**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Specialization	CEAI
Module coordinator	Prof. Dr. Barbara Wieczorek
Compulsory/ optional/ elective	Compulsory
Learning objectives	The students are able to distinguish between selected methods of machine learning. As for practical problems, they can decide which methods are suitable as well as they are able to implement solutions in Python, using appropriate tools from machine learning libraries.
Module content	- Machine Learning Tasks - Classification - Regression - Machine learning Methods, for example o Decision trees, Random Forests o logistic Regression o Artificial Neurons o Neural Networks o linear Regression - Implementation using Python o Implementation of selected methods Usage of libraries: Scikit-learn, TensorFlow, Keras
Course type	1V – 1Ü – 0S – 0P
Learning Material	Lecture slides, exercise instruction sheets
Recommended literature	▪ Frochte, J.: Maschinelles Lernen. Grundlagen und Algorithmen in Python. Hanser, 2019. ▪ Alpaydin, E.: Maschinelles Lernen. De Gruyter, 2019. Lunze, J.: Künstliche Intelligenz für Ingenieure: Methoden zur Lösung ingenieurtechnischer Probleme mit Hilfe von Regeln, logischen Formeln und Bayesnetzen. De Gruyter, 2016.
Method(s) of instruction/ media being used	Interactive lectures in computer lab, exercises in computer lab
Level/ category	1
Summer/ Winter	Summer term
Term	4. term
Compulsory requirements	
Recommended requirements	Basic knowledge in mathematics and computer science
Assessment	presentation and seminar paper on a self-chosen project
Assessment modalities	APL - assessment during the term period (nongraded)
Further Information	
ECTS credits	3
Workload	90 h of total work load, therefrom ▪ 30 h of presence at university ▪ 60 h of self-study
Usability of this module	Other modules where methods of machine learning are applied or where programming skills are required.
Time	According time table
Duration of module	1 terms
Place/ room	EAH Jena
Frequency of offer	annually
Language	German
Last modification	18/11/2020

Module number	**ET.1.609**
Module name	**Hardware Description**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Specialization	CCT, CEAI
Module coordinator	Prof. Dr.-Ing. habil Jürgen Kampe
Compulsory/ optional/ elective	Compulsory
Learning objectives	The Student will be enabled to systematically design digital systems from the requirements analysis, the design, the simulation of the timing analysis to the implementation of complex functions in complex programmable circuits. Besides getting to know the design strategies the practical conversion for the design of a programmable SoC with a Hardware description language is emphasized. At the end of the module students know different design methodologies and are able to apply them in a given application context. The students know general methods of implementation for digital systems and they are able to evaluate their practicability. The students understand the design phases on different levels of abstraction and are able to establish appropriate design models. The students are able to apply basic synthesis approaches (such as, for example, high-level synthesis, scheduling and allocation, hierarchical decomposition, data- and control-path extraction, signal transition diagram and reachablitiy graph based synthesis of communication protocols, as well as ROBDD based logic synthesis) and ROBDD based verification approaches. At the end of the hands-on training students are able to design an application system on a FPGA development board, to create the behavioural specification and the architecture for the implementation, and to use the appropriate design tools.
Module content	- Systematic design methodology for application specific integrated systems (levels of abstraction on the basis of the Y-diagram, synthesis types, basic design flow for the top-down synthesis of digital systems); - means of implementation for digital systems (programmable devices, application specific devices); - hardware description languages, background information and history, basic concepts of HDL-based simulation, synthesis and verification (signals and variables, time modeling concept and delta cycles, test benches, formal verification); - hardware description language VHDL, coding examples, special modeling techniques such as counters, utilization of RAM-Structures, finite state machine with data path (FSMD), process model graph (PMG), communication between synchronous and asynchronous FSMs, modeling on different levels of abstraction; - differences and similarities of VHDL, Verilog and SystemC; - practical exercise on the VHDL-based design of an individually defined application on an FPGA evaluation board.
Course type	2L - 0E - 1S - 2P
Learning Material	Lecture notes, exercises, lab instructions, examples
Recommended literature	D. Gajski et al.: Specifications and Design of Embedded Systems. AddisonWesley, 1994

	D. Gajski et al.: High-Level-Synthesis: Introduction to Chip and System Design. Kluwer Academic Publishers, 1992 G. Herrmann, D.Müller: ASIC - Entwurf und Test. Fachbuchverlag Leipzig, 2004 F. Rammig: Systematischer Entwurf digitaler Systeme. B.G. Teubner, 1989 T. Kropf: VLSI-Entwurf. Vorgehen, Methoden, Automatisierung. Int. Thomson Publishing, 1995 K. ten Hagen: Abstrakte Modellierung digitaler Schaltungen. Springer, 1995 T. Kropf: Introduction to Formal Hardware Verification. Springer Verlag S. Sjoholm, L. Lindh: VHDL for Designers. Prentice Hall Europe, 1997 K. C. Chang: Digital Design and Modeling with VHDL and Synthesis. IEEE Computer Society Press, 1996 Peter J. Ashenden: The Designer's Guide to VHDL. Morgan Kaufmann, 1995 D. Perry: VHDL. McGraw-Hill, 1998
Method(s) of instruction/ media being used	Talk, peer instruction, individual work, hands-on training, group work, case study
Level/ category	1
Summer/ Winter	summer
Term	4th term
Compulsory requirements	none
Recommended requirements	Digital Systems, Computer Science Basics
Assessment	project work, written test 75 min
Assessment modalities	APL - assessment during the term period (graded)
Further Information	Project work (50%) and written test (50%)
ECTS credits	6
Workload	180h of total work load, thereof 75h of contact hours and 105h of self-study, consisting of: 25 h lecture (preparation and rework), 15 h seminar (preparation and rework), 50 h project work, 15 h exam preparation
Usability of this module	Digital Signal Processing, Microprocessor Technology, Embedded Systems; usable as optional module for KIT 6th term
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German
Last modification	9/16/2021

Module number	**ET.1.610**
Module name	**Machine Learning for Visual Computing**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Specialization	CEAI
Module coordinator	Prof. Dr. Sebastian Knorr
Compulsory/ optional/ elective	Compulsory
Learning objectives	At the end of the module students are able to implement classical machine learning approachesklassischen including methods for clustering and classification, to understand the theoretical fundamentals (probability theory, optimization theorie) to further develop and analyse applications in clustering and classification. Furthermore, students are able to implement convolutional neural networks (CNNs) for deep learning in different application scenarios.
Module content	Fundamentals in probability theory, estimation theory (maximum-likelihood, EM-Algorithm, Bayes). Fundamentals in machine learning: clustering, supervised learning (least-squares regression, SVM, K-Nearest-Neighbor, etc.) Convolutional Neural Networks: • Architectures (e.g. Inception modules, residual networks, recurrent networks, Auto-Encoder, Generative-Adversarial Networks), Convolution / Pooling Layers (layers, spatial arrangement, layer patterns, layer sizing patterns, AlexNet/ZFNet/VGGNet case studies, computational considerations) • Optimization and Backpropagation • Regularization (L1/L2 regularization, dropout, data augmentation, etc.) • Understanding/Visualization and Training of Convolutional Neural Networks • Transfer Learning and Fine-tuning Convolutional Neural Networks Applications of deep learning: Classification, segmentation, image manipulation, depth estimation, etc.
Course type	3L – 0E – 1S – 1P
Learning Material	Lecture slides, Literature recommendation specific to the seminar sessions
Recommended literature	• Christopher M. Bishop (2006) Pattern Recognition And Machine Learning, Springer. • L. Wasserman (2004) All of Statistics, Springer • Richard O. Duda, Peter E. Hart, David G. Stork (2001) Pattern Classification , Wiley (2. Auflage). • Trevor Hastie, Robert Tibshirani, Jerome Friedman (2001) The Elements of Statistical Learning, Springer. • Charu C. Aggarwal (2018) Neural Networks and Deep Learning: A Textbook Ian Goodfellow, et al. (2017) Deep Learning
Method(s) of instruction/ media being used	Lecture, Seminar, Exercisises
Level/ category	1
Summer/ Winter	summer
Term	6. Term
Compulsory requirements	none
Recommended requirements	Programming skills (Matlab/Python), basic knowledge in digital image processing, good knowledge of mathmatics, statistics, linear algebra, probability theory.

Assessment	Oral exam and seminar presentation
Assessment modalities	APL – alternativ exam during lecture period (graded)
Further Information	
ECTS credits	6
Workload	180h of total work load, thereof 60h of contact hours and 120h of self-study, consisting of: 100 h lecture (preparation and and seminar work), practical training (preparation and evaluation) 20 h exam preparation
Usability of this module	Immersive Media Technology, Computer Vision, 3D Robot Vision, Augmented and Virtual Reality, Automatisation and Robotics
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German
Last modification	16.01.2023

Module number	**ET.1.611**
Module name	**Electronic Design/PCB**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Specialization	CCT
Module coordinator	Prof. Dr.-Ing. Martin Hoffmann
Compulsory/ optional/ elective	Compulsory
Learning objectives	Basic knowledge of technical representation of electronic components using CAD are to be taught. Students can apply the aquired knowlage to PCB design.
Module content	- technical illustrations in electronics - technical illustrations of mechatronical devices with 3D CAD Software - Simulation of electronic devices with FEM tools
Course type	1L - 0E - 0S - 1P
Learning Material	Will be announced during the lecture.
Recommended literature	1.Fucke, Rudolf; Kirch, Konrad; Nickel, Heinz: Darstellende Geometrie für Ingenieure, Carl Hanser 2004, ISBN 3-446-22723-7 2.Vogel, Harald: Einstieg in CAD; Hanser, München und Wien, 2004; ISBN 3-446-22381-9
Method(s) of instruction/ media being used	Lecture and practical course
Level/ category	1
Summer/ Winter	summer term or winter term
Term	5. oder 6. Term
Compulsory requirements	none
Recommended requirements	Electronic Components, Electrical Engineering
Assessment	term paper
Assessment modalities	APL - alternative Prüfungsleistung während des Vorlesungszeitraums (benotet)
Further Information	
ECTS credits	3
Workload	90h of total work load, thereof 45h of contact hours and 45h of self-study, consisting of: 15 h lecture (preparation and rework) 20 h practical training (preparation and evaluation) 10 h exam preparation
Usability of this module	Usage of module in other study courses: Mechatronics
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	DeutschGerman
Last modification	02/04/2020

Module number	**ET.1.701**
Module name	**Industrial Internship**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Module coordinator	Prof. Dr. Matthias Förster
Compulsory/ optional/ elective	Compulsory
Learning objectives	In industrial practice, the students should learn engineering activities The students get an insight into the work of an engineer and the technical and social requirements.
Module content	Students will receive practical training on specific projects that correspond to the content of each selected focus of the main study and perform engineering activities independently. The practical training can be done,. B. In the fields of electronics, hardware, and software development as well as for tasks of designing, manufacturing, assembly, testing, production planning, quality assurance in Electrical Engineering / Information Technology.
Course type	(Lecture, Exercises, Seminar, practical course)
Recommended literature	A general bibliographical reference cannot be given because it depends on the topic.
Method(s) of instruction/ media being used	Industrial practice
Level/ category	1 (Bachelor=1, Master=2)
Summer/ Winter	winter term
Term	7th term
Compulsory requirements	All examinations of the first to sixth term up to 3 must be passed. The internship contract between student and company must be approved by the Internship Office of the university.
Assessment	Laboratory internship report, presentation
Assessment modalities	SL - ungraded course work during the lecture period
ECTS credits	12
Workload	12 Weeks = 450 h
Duration of module	12 Weeks
Language	German

Module number	**ET.1.702**
Module name	**bachelor thesis**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Module coordinator	Prof. Dr.-Ing. Oliver Jack
Compulsory/ optional/ elective	Compulsory
Learning objectives	At the end of the module students are able: - to discretely create a scientific report - to determine a scientific problem - to plan and conduct a scientific task to solve a scientific problem - to evaluate a scientic problem
Module content	Scientific report in order to finish the Bachelor Degree. The subject of the Bachelor Thesis may be issued by the university or an external organisation, e. g. an industry company.
Course type	(Lecture, Exercises, Seminar, practical course)
Recommended literature	Scheld, G;Anleitung zur Anfertigung von PrakCEAlums-, Seminar- und Diplomarbeiten sowie Bachelor- und Masterarbeiten
Method(s) of instruction/ media being used	independent editing of the final thesis, review of the literature, interviews with the supervisor of the thesis
Level/ category	1 (Bachelor=1, Master=2)
Summer/ Winter	Winter term
Term	7. term
Compulsory requirements	All compulsory and elective modules, Internship
Assessment	Scientific work
Assessment modalities	Final examination
Further Information	The processing time of the final thesis is 9 weeks and can be extended max. 3 weeks (see §23 PO). The Bachelor's thesis must be submitted to deliver in duplicate together with the theses (6x) a poster (A4) on the main results in the deanery. The poster must be signed by the company supervisor. Please note the opening hours of the dean's office.
ECTS credits	15
Workload	450 h
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

Module number	**ET.1.703**
Module name	**Colloquium**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Module coordinator	Prof. Dr.-Ing. Oliver Jack
Compulsory/ optional/ elective	Compulsory
Learning objectives	At the end of the module students are able: - to explain a discretely generated scientific report - to defend scientific solutions and results
Module content	Presentation of the Bachelor Thesis, discussion of the scientific results
Course type	(Lecture, Exercises, Seminar, practical course)
Learning Material	Technical literature, patents, special application software, technical manufacturer information
Recommended literature	Leopold-Wildburger; Schütze: Verfassen und Vortragen - wissenschaftliche Arbeiten und Vorträge leicht gemacht. Berlin: Springer, 2002 Franck: Rhetorik für Wissenschaftler - selbstbewusst auftreten, selbstsicher reden. München : Vahlen, 2001 Huth: Duden - Reden gut und richtig halten! -Ratgeber für wirkungsvolles und modernes Reden. Mannheim: Dudenverlag, 2000 Lucas: Überzeugend reden - mehr Erfolg durch richtige Rhetorik. Düsseldorf: Econ-Taschenbuch-Verlag, 1999
Method(s) of instruction/ media being used	Independent scientific work, Presentation
Level/ category	1 (Bachelor=1, Master=2)
Summer/ Winter	Winter
Term	7. Term
Compulsory requirements	Successful completion of all compulsory modules and selected elective modules of the course, timely submission of the thesis and supervisor reports
Recommended requirements	
Assessment	presentation
Assessment modalities	Final Exam
ECTS credits	3
Workload	90 h Preparation
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

Module number	**ET.1.900**
Module name	**Elective Modules**
Department	Electrical Engineering and Information Technology
Compulsory/ optional/ elective	Compulsory
Learning objectives	The concrete learning objectives can be found in the accordant module description.
Module content	Altogether 12 ECTS have to be accomplished within the fith and sixth term. The publication of the technical elective modules which are offered each term occurs by a written announcement. The following listing of the technical elective modules is not final. The technical elective modules allow the students to choose from a range of different technical elective modules according to their interests and inclinations. The following modules are available: - ET.1.901 Filter Design (Sp: CCT) - ET.1.902 Signal Processors (Sp: CEAI, CCT) - ET.1.903 Power Electronics (Sp: AER, CCT) - ET.1.904 Immersive Media Technology (Sp: CEAI, CCT) - ET.1.905 Selected Sections on Analogue Circuitry (Sp: CCT) - ET.1.906 Autonomous model vehicles (Sp: AER, CEAI) - ET.1.908 Motion Control (Sp: AER) - ET.1.911 Sensor Technology (Sp: AER) - ET.1.912 Stochastics (EE/IE) - ET.1.914 Intercultural Engineering Project Autonomous Systems (EE/IE) - ET.1.605 Microcomputer Design (Sp: CEAI) - ET.1.9XX List to be continued The concrete module content can be found in the accordant module description.
Course type	(Lecture, Exercises, Seminar, practical course)
Level/ category	1 (Bachelor=1, Master=2)
Summer/ Winter	winter term or summer term
Term	5th or 6th term
Compulsory requirements	compulsory modules of 1st to 4th term
ECTS credits	overall min. 12 ECTS
Workload	360 h
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

Module number	**ET.1.901**
Module name	**Filter Design**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Module coordinator	Prof. Dr.-Ing. Frank Giesecke
Compulsory/ optional/ elective	Compulsory
Learning objectives	The students are able to choose an adequate filter technology for a given filter problem and to find an optimal problem solution.
Module content	Types of filters and applications - analysis of filters in s- and z-domain - analog filter design by standard approximations - design of digital FIR-filters - design of digital IIR-filters - digital filter realizations
Course type	2L - 0E - 0S - 1P (Lecture, Exercises, Seminar, practical course)
Learning Material	lecture scripts, textbooks, tasks and solutions, software MATLAB
Recommended literature	- Achenbach, J.-J.: System-Synthese, VDI-Verlag - Achenbach, J.-J.: Analoge und digitale Filter und Systeme (Band 1: Grundlagen), BI-Wissenschaftsverlag - Achenbach, J.-J.: Analoge und digitale Filter und Systeme (Band 2: Übungsaufgaben mit Lösungen), BI-Wissenschaftsverlag
Method(s) of instruction/ media being used	simulations by software tool MATLAB/SIMULINK
Level/ category	1 (Bachelor=1, Master=2)
Summer/ Winter	winter term
Term	5. term
Compulsory requirements	none
Recommended requirements	Mathematics, Basics of Electrical Engineering, Basics of Computer Science, Theory of Signals and Systems, Digital Signal Processing, Analog and Digital Circuit Design
Assessment	term paper
Assessment modalities	APL – assessment during the term period (graded)
ECTS credits	3
Workload	90 h of total work load, thereof - 45h of contact hours and - 45h of self-study, consisting of: preparation and rework lecture 4 h exercise 4 h practical training 2 h (preparation and evaluation) exam preparation 35 h
Usability of this module	Control engineering, measurement technology, audio and video processing, communication technology, computer sciences and signal processors
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

Module number	**ET.1.902**
Module name	**Digital Signal Processors**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Module coordinator	Prof. Dr.-Ing. Burkart Voß
Compulsory/ optional/ elective	elective
Learning objectives	After successful completion of the module the students are able to: - understand the working principles and typical fields of application of digital signal processors - evaluate signal processing algorithms regarding their suitability to solve a given problem - adopt the algorithms to suit the given problem and implement them on a digital signal processor - implement fixed point arithmetics in a digital signal processor
Module content	- Architecture of DSP micro processors - Implementation of signal processing algorithms on a digital signal processor in Assembler and C - Analysis and optimization of program runtime - Influence of characteristics of signal processing algorithms on the architecture of digital signal processors
Course type	2L - 0E - 0S - 1P
Learning Material	Lecture script, Lab instruction sheets
Recommended literature	Smith, Steven W.: „The Scientist and Engineer's Guide to Digital Signal Processing“. California Technical Publishing, 1997
Method(s) of instruction/ media being used	Interactive lecture, practical course, work in little teams, self-study
Level/ category	1
Summer/ Winter	Sommer- oder Wintersemester
Term	5. oder 6. Semester
Compulsory requirements	none
Recommended requirements	Programming skills, knowledge of programming language C, basic knowledge in signal and system theory, basic skills in programming microcontrollers
Assessment	term paper
Assessment modalities	APL – assessment during the term period (graded)
Further Information	The ability to chose suitable digital signal processing algorithms for a given problem, to modify the chosen algorithm and to implement it on a DSP is proven by the documentation of the results of a project.
ECTS credits	3
Workload	90h of total work load, thereof 45h of contact hours and 45h of self-study, consisting of work on an individually assigned project
Usability of this module	-
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	DeutschGerman
Last modification	08/24/2021

Module number	**ET.1.903**
Module name	**Power Electronics**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Module coordinator	Prof. Dr.-Ing. Matthias Förster
Learning objectives	The students will understand the basic structure, the static behaviour, the switching characteristic and the limits of the devices. This will give them the possibility for the choice and the rating of the elements. They will also know the generic power electronic circuits and their simulation. After successfully participating in this course, students are able to select power electronic devices for spezial power electronics circuits and the students are able to calculate and simulate the behavior of the power electronic circuits.
Module content	The topics of the lecture are - Introduction with an overview of the tasks, the principles and the components of power electronics - Power semiconductor switches with power diodes, power MOSFET and IGBT - Heat transfer, snubber circuits, power modules - Dc-dc switch mode converter with step-down, step up, buck-boost, flyback and forward converters - Application of power electronics (power factor correction) Typical problems like EMC-problems will be explained. In the practical course the students work with the following experiments: - Semiconductor power switch with inductive load - dc-dc converter - simulation of power electronic circuits with SIMPLORER.
Course type	2L - 0E - 0S - 1P (Lecture, Exercises, Seminar, practical course)
Learning Material	lecture papers and experiment instructions
Recommended literature	Michel, M: Leistungselektronik Specovius, J.: Grundkurs Leistungselektronik Schröder, D.: Leistungselektronische Bauelemente Schröder, D.: Leistungselektronische Schaltungen
Method(s) of instruction/ media being used	lecture and experiment
Level/ category	1 (Bachelor=1, Master=2)
Summer/ Winter	winter term
Term	5. term
Compulsory requirements	none
Recommended requirements	Electronic Components, Electrical Drives
Assessment	exam 90 min
Assessment modalities	PL – exam during audit period(graded)
ECTS credits	3
Workload	90h of total work load, thereof 45h of contact hours and 45h of self-study, consisting of: 25 h lecture (preparation and rework) 15 h practical training (preparation and evaluation) 10 h exam preparation
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

Module number	**ET.1.904**
Module name	**Immersive Media Technology**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Module coordinator	Prof. Dr.Sebastian Knorr
Compulsory/ optional/ elective	elective
Learning objectives	The students know: – the theoretical foundations, the development and the application areas of immersive imaging technologies. – the technical basics of 3D, VR, AR and MR and can apply these in own projects. – the camera equipment, post-production tools and graphics engines. – Display technologies such as passive and interactive head-mounted displays (HMDs) and their advantages and disadvantages. the industry-specific and economic aspects of immersive media production.
Module content	• History, development and trends of Videos/Films, 3D, 360° Video , VR and Light Fields • Theoretical and technical basics of Video/Films, 3D, 360° Video , VR and Light Fields - Video editing and compositing - Selected Computer Vision chapters (including Feature Extraction, Stereo Geometry, Stereo Image Analysis, Free-Viewpoint Video, 2D-3D Conversion) - Selected chapters of Computer Graphics (including Stereo Image Synthesis, Light Fields) - Display technologies (passive and active 3D display technology, head-mounted displays, holographic displays, light field displays • Applications (including entertainment, industry, medicine, rehabilitation, tourism, music) • Perception and psychological aspects Dramaturgical and film-educational basics for immersive media content Economic and social aspects of 3D, 360° Video , VR and Light Fields
Course type	2L – 0E – 0S – 2P
Learning Material	Lecture slides
Recommended literature	• Ulrich Schmidt (2013). Professionelle Videotechnik, Springer Vieweg, Berlin. • Richard Hartley und Andrew Zisserman (2004). Multiple View Geometry, Cambridge University Press • Bernard Mendiburu,3D Movie Making, Focal Press, 2009 Oliver Schreer (2005). Stereoanalyse und Bildsynthese, Springer-Verlag Berlin Heidelberg
Method(s) of instruction/ media being used	Lecture, Exercises
Level/ category	1
Summer/ Winter	SoSe
Term	6. Semester
Compulsory requirements	none
Recommended requirements	Programming skills (Matlab/C++), basic knowledge in digital image processing, good knowledge of mathmatics, in particular linear algebra and geometry.

Assessment	Oral examination
Assessment modalities	APL – alternative exam during semester (graded)
Further Information	
ECTS credits	6
Workload	180h of total work load, thereof 60h of contact hours and 120h of self-study, consisting of: 40 h lecture (preparation and rework) 40 h practical training (preparation and evaluation) 40 h exam preparation
Usability of this module	
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German
Last modification	16.01.2023

Module number	**ET.1.905**
Module name	**Selected Sections on Analogue Circuitry**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Module coordinator	Prof. Dr.-Ing. Thomas Reuter
Compulsory/ optional/ elective	elective
Learning objectives	The student should familiarise with special analog circuit organisation and get to know possible applications of operational amplifiers. The main aim if the knowledge of methods for circuit analysis and synthesis.
Module content	Multiplier, negative-inpedance-converters, gyrators, lock-in amplifier, phase detector, voltage controlled oscillator, phase-locked loop, dc-supply, analog filters
Course type	0L - 0E - 2S - 1P (Lecture, Exercises, Seminar, practical course)
Learning Material	exercises, lab instruction sheets
Recommended literature	- Tietze. U.; Schenk. C.: Halbleiterschaltungstechnik - Bystron/Borgmeyer: Grundlagen der technischen Elektronik - Morgenstern, B: Elektronik, Band II: Schaltungen
Method(s) of instruction/ media being used	Lecture: work on the blackboard, Tutorial exercises experiments at the laboratory after instruction with written preparations
Level/ category	1 (Bachelor=1, Master=2)
Summer/ Winter	summer term
Term	6th term
Compulsory requirements	none
Recommended requirements	Electrical Engineering 1 and 2, Mathematics, Electronic Components, Electronics
Assessment	Laboratory internship certificate, Laboratory internship report
Assessment modalities	SL - ungraded course work during the lecture period
ECTS credits	3
Workload	90h of total work load, thereof 45h of contact hours and 45h of self-study, consisting of: 20 h lecture (preparation and rework) 15 h practical training (preparation and evaluation) 10 h exam preparation
Usability of this module	Master EE/IEund ME
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

Module number	**ET.1.906**
Module name	**Autonomous model vehicles**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba), FT (Ba), LOT (Ba), MiPT (Ba), WT (Ba)
Module coordinator	Prof. Dr.-Ing. Burkart Voß (EE/IE) and Prof. Dr.-Ing. Dienerowitz (SciTec)
Compulsory/ optional/ elective	elective
Learning objectives	After successful completion of the module the students are able to: • see the cooperation in a team as efficient method of solving complex problems • recognize and analyze challenges in the development of an autonomous model vehicle and develop solutions • plan a well-defined technical project (project duration approx. 1/2 year, team size approx. 5-10 members) • analyze a control system with a system model that is not fully known and to design a digital controller realize and test the prototype of a controlled electromechanical system
Module content	• Conceptual design and implementation of a compact autonomous model vehicle • Introduction into mathematical modelling of autonomous vehicles • Developtment of a mechatronic system • Design and implementation of a control system in an embedded system for an autonomous model vehicle. • Software design for an embedded system Experimental evaluation of developed solutions
Course type	0L - 0E - 1S - 1P
Learning Material	
Recommended literature	
Method(s) of instruction/ media being used	Interactive lecture, practical course, work in little teams, self-study
Level/ category	1
Summer/ Winter	winter
Term	5th Semester
Compulsory requirements	EE/IE: Microprocessor technology, control technology and basic subjects SciTec: Basics of construction/CAD and general basic subjects
Recommended requirements	Experience in project work and a basic technical understanding of all project-related disciplines
Assessment	Project work
Assessment modalities	APL - during term(graded)
ECTS credits	3
Workload	90h of total work load, thereof 45h of contact hours and 45h of self-study, consisting of work on an individually assigned project
Usability of this module	Ability to work in projects, so the skills gained can be used for final theses
Time	According to time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German
Last modification	03/03/2023

Module number	**ET.1.908**
Module name	**Motion Control**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Module coordinator	Prof. Dr.-Ing. Matthias Förster
Compulsory/ optional/ electiv	elective
Learning objectives	The knowledge in the areas of electrical drives, power electronics, electromagnetic compatibility, motion control and automatic control will be improved. The students test in practice how the different components work together. After attending the event, the students are able to put electric drives into operation and understand and measure power flows, additional students can present their results together in lectures.
Module content	Induction machines and D.C. brush machines with rated outputs of 3 kW to 5 kW together with frequency converters and phase controlled rectifiers are tested. The converters are linked with PC. Topics are the parameterization of the converters, the power flow in the arrangement, problems of electromagnetic compatibility, vector control of induction machines and the behavior in open- and closed loop control. The work is done in groups. The students will explain and discuss their results in oral presentations.
Course type	0L - 0E - 0S - 2P (Lecture, Exercises, Seminar, practical course)
Learning Material	Lab instruction sheet
Recommended literature	Manuals of the used components
Method(s) of instruction/ media being used	Practical course
Level/ category	1 (Bachelor=1, Master=2)
Summer/ Winter	winter term
Term	5. term
Compulsory requirements	none
Recommended requirements	Electrical Drives
Assessment	term paper
Assessment modalities	APL - during term(graded)
ECTS credits	6 for complete module control systems (ET.1.405)
Workload	90h of total work load, thereof 30h of contact hours and 60h of self-study, consisting of: 40 h practical training (preparation and evaluation) 20 h exam preparation
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

Module number	**ET.1.910**
Module name	**Analog and Mixed-Signal System Modelling**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Specialization	CCT
Module coordinator	Prof. Dr.-Ing. habil. Jürgen Kampe
Compulsory/ optional/ elective	Compulsory
Learning objectives	The student will be familiarized with the model concepts of heterogeneous systems. The focus is on the basic concepts for graph-based, formally symbolic and numeric evaluation of the system behavior for analog, digital, and mixed analog-digital systems. At the end of the module students are able to create system and domain-compliant models for heterogeneous subsystems, apply them in system modeling and evaluate the simulation results. The students know the requirements for the modeling of heterogeneous systems and understand the various modeling concepts and calculation paradigms in the hardware description language SystemC-AMS. Depending on the application, they can select the most suitable method and use it for a given task.
Module content	- Modeling of analog and heterogeneous systems on different levels of abstraction; - Modeling and simulation of digital systems with SystemC; - Modeling and simulation of analog systems with SystemC-AMS, its modeling formalisms and calculation methods including: * time-discrete and time-continuous models in timed data flow, * models in linear signal flow, * models as electrical linear network; - Examples for creating models and test environments.
Course type	2L - 0E - 2S - 0P
Learning Material	Literature, lecture notes, seminar exercises, project instructions
Recommended literature	- Black, D.C. et al: SystemC: From the Ground Up. Springer, 2010. - Grötker, T.: System design with SystemC. Kluwer Academic Publ., 2003. - Einwich K., Schwarz P., Grimm C., Meise C.: SystemC-AMS: Rationales, State of the Art, and Examples. In: Müller W., Rosenstiel W., Ruf J. (eds) SystemC. Springer, Boston, MA. 2003. - Barnasconi, M. - Introduction to SystemC-AMS.
Method(s) of instruction/ media being used	Talk, individual work, case study, hands-on training, self-study
Level/ category	1
Summer/ Winter	summer
Term	6th semester
Compulsory requirements	none
Recommended requirements	Signals and Systems, Analog Circuitry, Integrated Circuits
Assessment	exam 90 min, project work

Assessment modalities	PL – exam during audit period(graded)
Further information	examination (50%), presentation of project work (50%)
ECTS credits	6
Workload	180h of total work load, thereof 60h of contact hours and 120h of self-study, consisting of: 25 h lecture (preparation and rework), 25 h seminar (preparation and rework), 55 h project work, 15 h exam preparation
Usability of this module	Bachelor thesis
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German
Last modification	9/16/2021

Module number	**ET.1.911**
Module name	**Sensor Technology**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Module coordinator	Prof. Dr. Alexander Richter
Compulsory/ optional/ elective	elective
Learning objectives	The students acquire knowledge of the operating conditions of sensoric basic components. This enables them to design and develop simple sensoric assemblies and systems. Due to the intensive study of the basics of sensor technology, graduates are able to familiarize themselves with new tasks in sensor system development at short notice.
Module content	Physical and technological basics and applications of modern electronic and optoelectronic sensors
Course type	2L - 0E - 0S - 1P (Lecture, Exercises, Seminar, practical course)
Learning Material	Lecture transparencies, lab instruction sheets (on the internet)
Recommended literature	H.-R. Tränkler, E. Obermeier (Herausg.) "Sensortechnik" Handbuch für Praxis und Wissenschaft, Springer-Verlag 1998 W. Heiwang (Herausg.) "Sensorik", Reihe: Halbleiter-Elektronik Bd. 17, Springer-Verlag 1993 (4. Auflage) P. Hauptmann "Sensoren: Prinzipien und Anwendungen" C. Hanser-Verlag München, Wien 1990
Method(s) of instruction/ media being used	lecture, practical course
Level/ category	1 (Bachelor=1, Master=2)
Summer/ Winter	summer or winter term
Term	5th or 6th term
Compulsory requirements	none
Recommended requirements	Basic knowledge in Physics, Microtechnology and Optoelectronics, Basic Measurement Techniques
Assessment	exam 90 min
Assessment modalities	PL – exam during audit period(graded)
Further information	
ECTS credits	3
Workload	90h of total work load, thereof 45h of contact hours and 45h of self-study, consisting of: 20 h lecture (preparation and rework) 15 h practical training (preparation and evaluation) 10 h exam preparation
Usability of this module	Master programme Scientific Instrumentation (sub-modules)
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German
Last modification	

Module number	**ET.1.912**
Module name	**Stochastics**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Module coordinator	Prof. Dr. Mario Walther
Compulsory/ optional/ elective	elective
Learning objectives	- Fundamentals of probabilities - Confidence limits and tests for normal and binomial distributions - Experimental design - Nonparametric methods - Mathematical techniques and methods which are important for solving linear and nonlinear optimization problems - Using statistical toolboxes of MATLAB, R or Python
Module content	Probability, Random variables, Distributions, Limit theorems Confidence limits, Parametric significance tests Nonparametric methods for location measures and proportions, Testing goodness of fit and independence
Course type	2L - 1E - 0S - 0P (Lecture, Exercises, Seminar, practical course)
Learning Material	Script for lecture, additional transparencies, exercises with solutions, worksheets
Recommended literature	Fahrmeir, L. u.a. StatisCEAI, Springer 2003 Kühlmeyer, M., Statistische Auswertungsmethoden für Ingenieure, Springer 2001 Kähler, W., Statistische Datenanalyse, Vieweg+Teubner, 2010 Beichelt, StochasCEAI für Ingenieure Beucher, O., Wahrscheinlichkeitsrechnung und StatisCEAI mit MATLAB, Springer 2007 Papula, L. MathemaCEAI für Ingenieure, Bd. 3, Vieweg
Method(s) of instruction/ media being used	Lecture and tutorial for deepening the material dealt with in the lecture and discussion on tasks given for individual work. Solving tasks using MATLAB (Optimization Toolbox)
Level/ category	1 (Bachelor=1, Master=2)
Summer/ Winter	summer term
Term	6st term
Recommended requirements	Mathematics 1 and Mathematics 2
Assessment	exam 90 min
Assessment modalities	PL – exam during audit period(graded)
ECTS credits	6
Workload	180h of total work load, thereof 60h of contact hours and 120h of self-study, consisting of: 75 h lecture (preparation and rework) 20 h practical training (preparation and evaluation) 25 h exam preparation
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

Module number	**ET.1.914**
Module name	**Intercultural Engineering Project Autonomous Systems**
Department	Electrical and Computer Engineering
Degree program	ET/ IT (Ba), FT (Ba), LOT (Ba), PT (Ba), WT (Ba)
Module coordinator	Prof. Voß (EE/IE), Prof. Dienerowitz (SciTec)
Compulsory/ optional/ elective	elective
Learning objectives	After successful participation in the module, students are able to: • Use cooperation in a team as an efficient working method to solve complex problems • Plan a well-defined technical project (project duration approx. 1 month, team size approx. 3-4 members) Communicate technical issues in an international interdisciplinary team in English.
Module content	Using the example of a relatively simple development task, students from the EE/IE and SciTec departments practice working with students from Wenzhou University in an international interdisciplinary development project. The focus is on the following points: • Developing communication strategies to make technical ideas understandable to non-German speaking team partners. • Learning and trying out techniques to successfully work on a development project in a team on schedule Deepening of the technical knowledge and skills necessary for successful project processing.
Course type	0V - 0Ü - 2S - 0P
Learning Material	Lecture notes and instructions for hardware and software are provided
Recommended literature	primarily data sheets on the hardware components used and textbooks on sub-disciplines according to the required modules
Method(s) of instruction/ media being used	Blackboard, projector, programming environment, student workshops
Level/ category	1
Summer/ Winter	Winter term
Term	5th semester (Ba), limited to a maximum of 20 students per semester
Compulsory requirements	EE/IE: Microprocessor technology, control technology and general basic subjects SciTec: Basics of construction/CAD and general basic subjects
Recommended requirements	Experience in project work and a basic technical understanding of all project-related disciplines
Assessment	Project
Assessment modalities	SL
Further information	The ability to work on a complex problem in an international interdisciplinary team is tested by presenting the project results.
ECTS credits	3
Workload	90 h total workload, of which 30 h attendance hours and 60 h self-study portion, which includes the preparation and follow-up of the seminars and the processing of the project task.
Usability of this module	Ability to work in projects, thus above all skills gained can be used for study and final theses
Time	According timetable
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German/ English
Last modification	

Module number	**ET.1.915**
Module name	**Integrated Circuits**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ba)
Module coordinator	Prof. Dr.-Ing. habil. Jürgen Kampe
Compulsory/ optional/ elective	elective
Learning objectives	The student will be introduced to the design of integrated analog circuits. The constructive understanding of circuits, the assessment of structural alternatives and the dimensioning of integrated bipolar circuits is emphasized. The students will be familiar with integrated analog function blocks and their application. At the end of the module students are able to understand the principle of operation of almost any complex integrated subcircuit on the basis of the knowledge about the basic and elementary circuit configurations and characteristics. The students are able to adapt integrated subcircuits to different semiconductor technologies.
Module content	- Construction principles for integrated analog circuits (degrees of freedom, composability, basic principles of circuitry, realisation principles of circuitry); - analysis of electrical networks, functional analysis, symbolic analysis and empiric sizing methods; - basic circuit configurations, negative feedback and its principle effects; - elementary circuits, there properties and application requirements; - circuit technology of integrated analog function blocks (which typical quality parameters characterise the function block? Which basic principles can be chosen? What does the most simple realisation of the basic principles look like? Which circuit principles are used to increase the performance?); - systemisation of circuit principles.
Course type	2L - 0E - 1S - 2P
Learning Material	Literature, lecture notes, exercises, examples, practical training instructions
Recommended literature	Hering, E.,K. Bressler und J. Gutekunst: Elektronik für Ingenieure. Springer Verlag, 1998. Tietze, U. und C. Schenk: Halbleiterschaltungstechnik. Springer Verlag, 2002. Köstner und Möschwitzer: Elektronische Schaltungstechnik. Hanser Verlag, 1993. Goerth, J.: Bauelemente und Grundschaltungen. Teubner-Verlag, 1999. Lindner, Brauer und Lehmann: Elektrotechnik — Elektronik. Fachbuchverlag, Leipzig, 1998. Koss, G. und W. Reinhold: Lehr- und Übungsbuch Elektronik. Fachbuchverlag Leipzig, 1998. Seifahrt: Analoge Schaltungen und Schaltkreise. Verlag Technik, Berlin, 2001. Hartl, H., E. Krasser, G.Winkler et al.: Elektronische Schaltungstechnik mit Beispielen in PSpice. Pearson Studium, München, 2008. Riedel, F.: MOS-Analogtechnik. Akademischer Verlag, Berlin, 1988. Allen, P. E. and D. R. Holberg: CMOS analog circuit design. Oxford University Press, New York, 2002.
Method(s) of instruction/	Talk, peer instruction, individual work, case study, self-study

media being used	
Level/ category	1
Summer/ Winter	Winter
Term	5th semester
Compulsory requirements	None
Recommended requirements	Electrical Engineering I and II, Electronic Components, Signals and Systems, Analog Circuit Design
Assessment	Project work, written test 75 min
Assessment modalities	APL – assessment during the term period (graded)
Further information	Projekt work (50%) and written test (50%)
ECTS credits	6
Workload	150h of total work load, thereof 75h of contact hours and 75h of self-study, consisting of: 20 h lecture (preparation and rework) 20 h seminar (preparation and rework) 25 h practical training (report) 10 h exam preparation
Usability of this module	Applicable in the Master Courses: Module Integration of mixed-signal circuits, Module Analog Design, Bachelor thesis
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German
Last modification	9/16/2021

Module number	**ET.2.101**
Module name	**Theoretical Information Sciences**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ma)
Specialization	CEAI
Module coordinator	Prof. Dr.-Ing. Oliver Jack
Compulsory/ optional/ elective	elective
Learning objectives	At the end of the module students are able: - to assess the Chomsky-Hierarchy of formal languages - to assess the concept of computability - to distinguish complexty classes - to aply logic calculus, specifically the resolution calculus - to construct concurrent systems using Petri-Nets
Module content	Theoretical Foundations of Computer Science, Automata Theory, Formal Languages, Graph Theory, Complexity Theory, Logic Calculus, Computability, Decidability
Course type	0L - 0E - 3S - 0P (Lecture, Exercises, Seminar, practical course)
Learning Material	Literature recommendation specific to the seminar sessions
Recommended literature	- John E. Hopcroft, Rajeev Motwani, Jerey D. Ullman: Einführung in Automatentheorie, Formale Sprachen und Berechenbarkeit, 3., aktualisierte Au age, Pearson Studium 2011. - Dirk W. Hoffmann: Theoretische InformaCEAI, Hanser, 2009. - Michael Sipser: Introduction to the Theory of Computation, 3rd Edition, Cengage Learning 2013. - Michael Schenke: Logikkalk□ule in der InformaCEAI: Wie wird Logik vom Rechner genutzt?, Springer 2013. - Wolfgang Reisig: Petrinetze: Modellierungstechnik, Analysemethoden,Fallstudien, Vieweg 2010.
Method(s) of instruction/ media being used	Seminar, Exercisises
Level/ category	2 (Bachelor=1, Master=2)
Summer/ Winter	winter term
Term	2. term
Compulsory requirements	None
Recommended requirements	Computer science basic knowledge, programming skills in at least one common programming language, basic knowledge in discrete mathematics
Assessment	term paper
Assessment modalities	APL – assessment during the term period (graded)
Further Information	The students have to prepare a report according to one of the session topics
ECTS credits	6
Workload	180h of total work load, thereof 45h of contact hours and 135h of self-study, consisting of: 100 h lecture (preparation and rework) 35 h exam preparation
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

Module number	**ET.2.102**
Module name	**Software Engineering**
Department	Electrical Engineering and Information Technology
Degree program	ET/ IT (Ma)
Specialization	CEAI
Module coordinator	Prof. Dr.-Ing. Oliver Jack
Compulsory/ optional/ elective	elective
Learning objectives	At the end of the module students are able: - to apply methods for model-based software development - to apply requirements analysis and system design methods using UML to selected application examples - to assess an object-oriented system design - to plan a software development project
Module content	Model based software development, Unified Modelling Language, Application modelling, Class and state modelling, Modelling of system dynamics
Course type	(Lecture, Exercises, Seminar, practical course)
Recommended literature	- Helmut Balzert. Lehrbuch der Objektmodellierung - Analyse und Entwurf. Spektrum Akademischer Verlag, Heidelberg Berlin, 2. edition, 2004. - Helmut Balzert. Lehrbuch der Software-Technik, Band 1. Software Entwicklung. Spektrum Akademischer Verlag, Heidelberg Berlin, 2. Aufl., 2000. - Wolfgang Zuser, Thomas Grechenig, and Monika Köhle. Software-Engineering mit UML und dem Unified Process. Pearson Studium, München [u.a.], 2., überarb. Aufl., 2004. - Harald Störrle. UML2 für Studenten. Pearson Studium, München [u.a.], 2005.
Method(s) of instruction/ media being used	2L - 0E - 0S - 2P
Level/ category	2 (Bachelor=1, Master=2)
Summer/ Winter	summer term
Term	1. term
Compulsory requirements	none
Recommended requirements	Computer Science, Software Engineering
Assessment	term paper
Assessment modalities	APL – assessment during the term period (graded)
Further Information	The students have to conduct an extensive software design project.
ECTS credits	6
Workload	180h of total work load, thereof 60h of contact hours and 120h of self-study, consisting of: 50 h lecture (preparation and rework) 45 h practical training (preparation and evaluation) 25 h exam preparation
Usability of this module	Embedded Systems
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

Module number	**ET.2.104**
Module name	**Reliability Theory**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ma), ME (Ma)
Specialization	SE
Module coordinator	Prof. Dr.-Ing. Frank Giesecke
Compulsory/ optional/ elective	elective
Learning objectives	Learning of basics and methods for reliability of complex technical systems.
Module content	Introduction and terms of reliability – mathematical basics and parameters – analysis and proof of reliability – mean time to failure – development of model and planning of reliability – series-, parallel- and mixed series-parallel-systems – parallel systems with hot and cold redundancy – exemplary solutions for reliability of circuit components, devices and systems
Course type	(Lecture, Exercises, Seminar, practical course)
Recommended literature	Meyna, A.; Pauli, B.: Taschenbuch der Zuverlässigkeits- und Sicherheitstechnik, C. Hanser Verlag, München/Wien, 2003 Birolini, A.: Zuverlässigkeit von Geräten und Systemen, Springer- Verlag, Berlin/Heidelberg, 4. Auflage, 1997 Deutsche Gesellschaft für Qualität: Zuverlässigkeit komplexer Systeme aus Hardware und Software, DGQ- Band 17-01, Frankfurt/M., 1998
Method(s) of instruction/ media being used	1L - 1E - 0S - 0P
Level/ category	2 (Bachelor=1, Master=2)
Summer/ Winter	summer term
Term	1. term
Compulsory requirements	none
Recommended requirements	Mathematics
Assessment	exam 90 min
Assessment modalities	PL – exam during audit period(graded)
ECTS credits	3
Workload	90 h of total work load, thereof - 45 h of contact hours and - 45 h of self-study, consisting of: preparation and rework lecture 15 h exercise 15 h exam preparation 15 h
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

Module number	**ET.2.105**
Module name	**Analog Design**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ma)
Specialization	CCT
Module coordinator	Prof. Dr.-Ing. habil. Jürgen Kampe
Compulsory/ optional/ elective	elective
Learning objectives	The student will be familiarized with the design of integrated analog circuits. The basic steps for the design of integrated circuits, the constructive understanding of circuits as well as the evaluation of structure alternatives for complex integrated bipolar circuits are emphasized. At the end of the module students are able to use behavioural and structural models on different levels of abstraction and to rate them. The students understand the principle of operation of a phase-locked loop and they are able to evaluate the PLLs properties. The students are able to evaluate and choose the best component implementation and to adopt it to a given application. For this purpose, the students are able to recognise basic principles of circuitry and to understand there principles of operation. The students are able to apply methods for analysis and sizing of linear and non-linear analog circuits.
Module content	- Systematisation of the design development, traditional and top-down design methodology for mixed-signal systems, structural synthesis for analog circuits, modelling on different levels of abstraction; - PLL principles of operation, abstract modeling schemata, and applications; - non-linear circuitry for integrated analog systems, integrated analog functional blocks and their usage for PLL applications (regulated and unregulated amplifiers, phase detektors, oscillators and VCO).
Course type	2L - 0E - 2S - 1P
Learning Material	Literature, lecture notes, seminar exercises, laboratory instructions
Recommended literature	- Tietze, U.; Schenk, C.: Halbleiterschaltungstechnik. - Meier, U.; Nerreter, W.: Analoge Schaltungen: Entwurf, Berechnung und Simulation. - Baker, R.J.: Mixed-signal circuit design. - Kurz, C.; Mathis, W.: Oszillatoren. - Best, R.: Phase-locked Loops: Design, Simulation, and Applications
Method(s) of instruction/ media being used	Talk, individual work, case study, hands-on training, self-study
Level/ category	2
Summer/ Winter	summer
Term	1st semester
Compulsory requirements	none
Assessment	Project work, written test 75 min
Assessment modalities	PL – exam during audit period(graded)
Further information	Projekt work (50%) and written test (50%)
ECTS credits	6
Workload	180h of total work load, thereof 75h of contact hours and 105h of self-study, consisting of: 20 h lecture (preparation and rework),

	25 h seminar (preparation and rework), 50 h project work (incl. report), 15 h exam preparation
Usability of this module	Integration of mixed-signal circuits, Complex Lab Session, IC-Design, Master thesis
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German
Last modification	9/16/2021

Module number	**ET.2.106**
Module name	**Electromagnetic Fields**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ma)
Module coordinator	Prof. Dr.-Ing. Martin Hoffmann
Compulsory/ optional/ elective	Compulsory
Learning objectives	The students acquire advanced and applicable knowledge at electromagnetic fields. They are able to solve the Maxwell equations for selected field problems. They have learned different strategies to solve electromagnetic problems and can apply these practically. Students are familiar with ANSYS Maxwell analysis software for the simulation of electromagnetic fields and can apply them.
Module content	The lecture teaches basic strategies and tools for the treatment of electrical and magnetic field systems: - Maxwell equations in differential and integral form - static electric and magnetic fields - scalar fields / vector fields - mirroring method, field analogies - boundary value problem, material properties - dynamic electromagnetic fields, electromagnetic waves - wave propagation in conductive medium - wave propagation in waveguides - FEM analysis of electrical and magnetical problems
Course type	2L - 0E - 1S - 2P (Lecture, Exercises, Seminar, practical course)
Learning Material	Literature, lab instruction sheets, handouts
Recommended literature	Recommended literature will be announced in the lecture.
Method(s) of instruction/ media being used	lecture, practical course, self-study
Level/ category	2 (Bachelor=1, Master=2)
Summer/ Winter	summer term
Term	1. term
Compulsory requirements	None
Recommended requirements	Electrical Engineering 1/2, Analysis 1/2, Physiks
Assessment	exam 90 min, Laboratory internship certificate
Assessment modalities	PL - test performance (graded)
ECTS credits	6
Workload	180h of total work load, thereof - 60h of contact hours and - 120h of self-study, consisting of: - 35h lecture (preparation and rework) - 35h practical training (preparation and evaluation) - 50h exam preparation
Usability of this module	Complex Lab Session, Design of Electronic Systems, Applied Actuators
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

Module number	**ET.2.107**
Module name	**Servo Drive Systems and Components**
Department	Electrical Engineering and Information Technology
Degree program	Me (Ma), EE/IE (Ma)
Specialization	AER
Module coordinator	Prof. Dr.-Ing. Matthias Förster
Compulsory/ optional/ elective	elective
Learning objectives	Based on the basics of electric machines and field-oriented control, in-depth mathematical and systemic knowledge of the control and control of electric drives will be imparted. Additionally the communication – and control possibilities for electric drives are to be learned. After successfully participating in this course, students are able to develop, design and simulate an electric drive with a wide variety of types of control.
Module content	The topics of the lecture are - Introduction and describtion of electrival drive systems - repeat the construction and operation of dc- and ac- motors - mathematical description of DC- and AC-machines (especially with field-oriented control) - calculation and description of speed- and positioncontrol - introduction into the control- and commmunication technology of electrical drives In the practical course the students work with the following experiments: - Simulation of DC- and AC-machines - Positioning System - Drive control
Course type	2L - 0E - 0S - 2P (Lecture, Exercises, Seminar, practical course)
Learning Material	lecture papers and experiment instructions
Recommended literature	Brosch, P.: Antriebspraxis Schulze, M.:Elektrische Servoantriebe Schröder, D.: Elektrische Antriebe – Regelung von Antriebssystemen
Method(s) of instruction/ media being used	lecture and experiment
Level/ category	2 (Bachelor=1, Master=2)
Summer/ Winter	summer term
Term	1. term
Compulsory requirements	none
Recommended requirements	Electrical Drives
Assessment	exam 60 min
Assessment modalities	PL – exam during audit period(graded)
ECTS credits	6
Workload	180h of total work load, thereof 60h of contact hours and 120h of self-study, consisting of: 35h lecture (preparation and rework) 60 h practical training (preparation and evaluation) 25 h exam preparation
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

Module number	**ET.2.110**
Module name	**Nontechnical elective modules**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ma), Me (Ma)
Compulsory/ optional/ elective	elective
Module content	The Nontechnical elective modules (3 ECTS-credits) allow a selection of 1 module according to your interests. The following list ist not complete. These modules are available: M-GM-UF1.2.1 – Formation Management (only german description) M-GM-UF1.2.2 – Project Management (only german description) ET.2.113 – English for Specific Purposes You can find the concrete module content in the relevant module description.
Course type	(Lecture, Exercises, Seminar, practical course)
Level/ category	2 (Bachelor=1, Master=2)
Summer/ Winter	summer term or winter term
Term	1st or 2nd term
Compulsory requirements	none
ECTS credits	3
Workload	90 h
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

Module number	**ET.2.113**
Module name	**English for Specific Purposes**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ma), ME (Ma)
Module coordinator	Herr Ulrich Schuhknecht
Compulsory/ optional/ elective	elective
Learning objectives	The students are enabled to participate actively in meetings and discussions on study and work-related topics. This involves giving information and explaining, expressing opinions and reacting appropriately. They develop their writing skills relating to study and work-related text types, e.g. summaries, reports and abstracts. They are able to listen to lectures for gist and detail and to use the information gathered in follow-up speaking and writing activities. They acquire business-related vocabulary and language skills relevant for engineers. The course is set at level C1 of the Common European Framework.
Module content	- Meetings and discussions on study and work-related topics, e.g. research projects - Listening to lectures in English, Negotiations and Project work - Scientific texts and articles taken from journals, books and the internet as input for writing tasks - Business English for engineers, e.g. company structure, start-ups, financial matters, marketing
Course type	0L - 0E - 3S - 0P (Lecture, Exercises, Seminar, practical course)
Learning Material	Reader
Recommended literature	- Dunn, M. et al: English for Electrical Engineering in Higher Education Studies. Garnet Education, 2014 - Hughes, J.: Successful Meetings. OUP, 2013 - Billet, D.: Technical Writing Today. Media Corporation, 2005 - Armer: Cambridge English for Scientists. CUP, 2011 - Engine. EnglischfürIngenieure, Weka Business Medien - Inch. Technical English inch by inch. Matthias Meier Verlag - Research EU. Results Magazine. EU publications - Cotton, D. et al: Market Leader Upper Intermediate. Longman, 2011
Method(s) of instruction/ media being used	Interactive, audio and video recordings, e-learning platform
Level/ category	2 (Bachelor=1, Master=2)
Summer/ Winter	summer term
Term	1st term
Recommended requirements	Successful completion of the module “Technical English” or equivalent (Level B2 of the Common European Framework)
Assessment	oral exam, written test
Assessment modalities	APL – assessment during the term period (graded)
ECTS credits	3
Workload	90h of total work load, thereof 45h of contact hours and 45h of self-study, consisting of: 35 h lecture (preparation and rework) 0 h practical training (preparation and evaluation) 10 h exam preparation
Usability of this module	All study programmes containing a C1 level ESP module
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German/ English

Module number	**ET.2.115, ME.2.105**
Module name	**3D Robot Vision**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ma), Me (Ma)
Module coordinator	Prof. Dr. Sebastian Knorr
Compulsory/ optional/ elective	Compulsory (ME) and elective (EE/IE)
Learning objectives	At the end of the module students are able to implement SLAM und 3D reconstruction appoaches including methods for Structure from Motion, Structure from Stereo, Depth from Focus/Defocus as well as methods with active sensors like time-of-flight cameras, LiDAR and coded light. Furthermore, students will have basic knowledge about Epipolar Geometry, Multiple View Geometry, feature extraction and matching.
Module content	Fundamentals of • Camera modell • Epipolar Geometry • Multiple View Geometry • Segmentation • Camera calibration • Registration and Rectification • Disparity estimation, Random Sample Consensus (RANSAC) Depth estimation from images: • Structure from Motion • Structure from Stereo and trifocal camera • Depth from coded (structured) light • Depth from Focus/Defocus • Deep learning based depth estimation Depth estimation and localization using depth sensors: • Time-of-Flight (ToF) cameras • LiDAR (Light Detection and Ranging) cameras • SLAM (Simmulataneous Localization and Mapping)
Course type (Lecture, Exercises, Seminar, practical course)	2L – 0E – 0S – 1P
Learning Material	Literature recommendation specific to the seminar sessions
Recommended literature	• Richard Hartley und Andrew Zisserman (2004). Multiple View Geometry, Cambridge University Press • Olivier Faugeras (2004). The Geometry of Multiple Images: The Laws That Govern the Formation of Multiple Images of a Scene and Some of Their Applications, MIT Press • Richard Szeliski (2011). Computer Vision: Algorithms and Applications, Springer • Marc Pollefeys (2000). Tutorial on 3D Modeling from Images, Lecture Notes, ECCV • Intel RealSense, Technische Handbücher
Method(s) of instruction/ media being used	Seminar, Exercises
Level/ category	2
Summer/ Winter	Summer

Term	1st term
Compulsory requirements	none
Recommended requirements	Programming skills (Matlab/C++), basic knowledge in digital image processing, good knowledge of mathmatics, in particular linear algebra and geometry.
Assessment	Oral examination
Assessment modalities	APL – assessment during the term period (graded)
Further information	
ECTS credits	3
Workload	120h of total work load, thereof 35h of contact hours and 85h of self-study, consisting of: 20h lecture (preparation and rework), 40h practical training (preparation and evaluation) 25h exam preparation
Usability of this module	
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German
Last modification	06.08.2021

Module number	**ET.2.120**
Module name	**Optimal control**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ma), Me (Ma)
Module coordinator	Prof. Dr.-Ing. habil. Klaus-Peter Döge
Compulsory/ optional/ elective	Compulsory (ME)/ elective (EE/IE)
Learning objectives	The students have a basic understanding of the optimal control of physical processes. The students are able to design simple optimal control systems.
Module content	- parameteroptimization and structure optimization - quality criterions - basic principle of the variational calculus - Euler-Lagrange equation - maximum principle of Pontryagin
Course type	1L - 1E - 1S - 0P (Lecture, Exercises, Seminar, practical course)
Learning Material	- graphical material of the lecture - transformation table - excercises
Recommended literature	H. Gassmann, (1998) Theorie der Regelungstechnik, Verlag Harry Deutsch O. Föllinger (1994) Optimale Regelung und Steuerung, Oldenbourg Verlag
Method(s) of instruction/ media being used	lecture, excercise, blackboard and graphical material via data projector
Level/ category	2 (Bachelor=1, Master=2)
Summer/ Winter	summer term
Term	1. term
Compulsory requirements	none
Recommended requirements	- basics of control engineering and systems theory - differential and integral calculus - state space representation - partial derivatives
Assessment	written university exam 90 min
Assessment modalities	PL – during period of exams (graded)
ECTS credits	6
Further information	
Workload	180h of total work load, thereof 45h of contact hours and 135h of self-study, consisting of: 115 h lecture (preparation and rework) 20 h exam preparation
Usability of this module	
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German
Last modification	

Module number	**ET.2.121**
Module name	**Design of Spaceborne Electronics**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ma)
Specialization	SE
Module coordinator	Prof. Dr.-Ing. Burkart Voß
Compulsory/ optional/ elective	elective
Learning objectives	After successful completion of the module the students are able to: - understand a given requirement specification - develop electronics in consideration of the environmental conditions of space applications - complete the required analyses - create the required documentation
Module content	- Special requirements for electronic circuits targeted to space application - Selection of electronic components - redundancy concepts - EMC- centric Design - Verification and test requirements - Special requirements for the design of electronic circuits targeted to space application – required analyses - Radiation analysis - Risk and failure analysis - Derating analysis -Worst-Case analysis
Course type	0L - 0E - 2S - 2P
Learning Material	Lecture slides are provided via the Internet.
Recommended literature	The Space Environment by Alan C. Tribble Electronics System Design Techniques for Safety Critical Applications by Luca Sterpone Spacecraft Thermal Control Handbook by David G. Gilmore The Design of an Efficient, Elegant, and Cubic Pico-satellite Electronics System by Christopher Alan Day
Method(s) of instruction/ media being used	Seminar
Level/ category	2
Summer/ Winter	Wintersemester
Term	2. Semester
Compulsory requirements	Knowledge in analog and digital circuit design checked via the admission process to the master course
Recommended requirements	Module “space systems” is strongly linked to this module and should be taken.
Assessment	Documentation and review of project results
Assessment modalities	APL – assessment during the term period (graded)
Further Information	The ability to systematically design an electronic circuit for use in a space application is shown with the documentation of a design project. The project results have to get defended in a design review.
ECTS credits	6
Workload	180h of total work load, thereof 60h of contact hours and 120h of self-study, consisting of: 0 h lecture (preparation and rework) 0 h practical training (preparation and evaluation) 0 h exam preparation
Usability of this module	
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena

Frequency of offer	Annually
Language	DeutschGerman
Last modification	08/24/2021

Module number	**ET.2.122**
Module name	**Space Travel Systems**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ma)
Specialization	SE
Module coordinator	Prof. Dr.-Ing. Burkart Voß, Prof. Dr.-Ing. habil. Klaus-Peter Döge
Compulsory/ optional/ elective	elective
Learning objectives	use the terminology specific for space problems. Analysis and solution of problems to the position and location change of spacecraft understand the behaviour of satellites (orbits, fuel needs, etc.)
Module content	Orbital mechanics Environmental space conditions Introduction to remote sensing of the earth Mathematical modeling of orbit perturbations Coordinate systems Mathematical attitude description Sensors and actuators for attitude control
Course type	0L - 0E - 3S - 0P
Learning Material	Seminar slides (in English) are provided via the Internet.
Recommended literature	H. J. Kramer: „Observation of the Earth and Its Environment – Survey of Missions and Sensors“ Springer 2002 W. Steiner und M. Schagerl: „Raumflugmechanik – Dynamik und Steuerung von Raumfahrzeugen“ Springer 2004 W. Hallmann und W. Ley et al.: „Handbuch Raumfahrttechnik“ Hanser 1999 J. R. Wertz: “Spacecraft Attitude Determination and Control” Kluwer Academic Publishers
Method(s) of instruction/ media being used	Black board, data projector and simulation software
Level/ category	2
Summer/ Winter	Sommersemester
Term	1. Semester
Compulsory requirements	none
Recommended requirements	none
Assessment	oral exam - 30 min
Assessment modalities	PL
Further information	The ability to use space related terminology, to understand the behaviour of satellites and to use mathematical formalisms to calculate the position and change of position of space objects is shown in an oral examination.
ECTS credits	3
Workload	90h of total work load, thereof 45h of contact hours and 45h of self-study, consisting of: 0 h lecture (preparation and rework) 0 h practical training (preparation and evaluation) 0 h exam preparation
Usability of this module	
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	Deutsch German
Last modification	08/24/2021

Module number	**ET.2.200**
Module name	**Numerical Mathematics/Optimization**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ma), Me (Ma)
Module coordinator	Prof. Dr. Christopher Schneider
Compulsory/ optional/ elective	Compulsory Me (Ma), Elective EE/IE (Ma)
Learning objectives	Mathematical techniques and methods which are important for solving linear and nonlinear optimization problems and problems of optimal control.
Module content	Linear programming, duality in linear programming, nonlinear optimization, Karush-Kuhn-Tucker-theory, case studies on optimal control, models, Hamilton function, maximum principle, numerical methods for solving optimization problems and problems of optimal control
Course type	3L - 1E - 0S - 1P (Lecture, Exercises, Seminar, practical course)
Learning Material	Exercises with solutions, worksheets
Recommended literature	- Schwarz, H.R.;Köckler, N.(2011): Numerische MathemaCEAI. 8. Aufl., Springer Vieweg Verlag. - Alt, Walter(2011): Nichtlineare Optimierung. 2. Aufl., Vieweg Verlag. - Alt, Walter(2013): EAGLE-STARTHILFE, Optimale Steuerung, Theorie und numerische Verfahren, Edition am Gutenbergplatz Leipzig,1. Aufl. - Zimmermann, H.-J.(2008) : Operations Research, 2. Aufl., Vieweg Verlag. - Unbehauen, H.(2011) : Regelungstechnik III, 7. Aufl., Identifikation, Adaption, Optimierung, Vieweg Verlag.
Method(s) of instruction/ media being used	Lecture and tutorial for deepening the material dealt with in the lecture and discussion on tasks given for individual work. Solving tasks using MATLAB (Optimization Toolbox)
Level/ category	2 (Bachelor=1, Master=2)
Summer/ Winter	winter term
Term	2. term
Compulsory requirements	none
Recommended requirements	Linear algebra, differential and integral calculus for functions of several variables, differential equations, basic knowledge of MATLAB
Assessment	exam 90 min
Assessment modalities	PL – exam during audit period(graded)
Further information	
ECTS credits	6
Workload	180h of total work load, thereof 75h of contact hours and 105h of self-study, consisting of: 60 h lecture (preparation and rework) 25 h practical training (preparation and evaluation) 20 h exam preparation
Usability of this module	
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German
Last modification	

Module number	**ET.2.201**
Module name	**Satellite communication**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ma)
Specialization	CCT, SE
Module coordinator	Prof. Dr.-Ing. Johannes Trabert
Compulsory/ optional/ elective	Elective
Learning objectives	Upon completion of the module, students - understands special characteristics of telecommunication in case of satellite systems - are able to use relevant standards - understands the sections of information transmission - are able to use selected methodes for information transmission - are able to calculate radio links between earth and satellite
Module content	Special conditions for telecommunication between earth and space Relevant groups of standards Selected parts from the fields of communication networks, RF techniques and information and coding theory
Course type	2L - 1E - 0S - 1P (Lecture, Exercises, Seminar, practical course)
Learning Material	Books, script, exercises and lab instruction sheets on the internet
Recommended literature	Ernst Messerschmid, Stefanos Fasoulas: Raumfahrtsysteme, Springer 2008 Werner Mansfeld: Satellitenortung und Navigation, Vieweg+Teubner Verlag 2003 Bossert, M.: Einführung in die Nachrichtentechnik, Oldenbourg Verlag 2012 Hermann Weidenfeller, Anton Vlcek: Digitale Modulationsverfahren mit Sinusträger, Springer 1996 Rudolf Greif: Bodenantennen für Flugsysteme, Oldenbourg 1974
Method(s) of instruction/ media being used	seminar, demonstration, practical course, self-study
Level/ category	2 (Bachelor=1, Master=2)
Summer/ Winter	winter term
Term	2nd term
Compulsory requirements	none
Recommended requirements	
Assessment	written test
Assessment modalities	APL – assessment during the term period (graded)
Further information	
ECTS credits	6
Workload	150h of total work load, thereof 45h of contact hours and 105h of self-study, consisting of: 40 h seminar (preparation and rework) 35 h practical training (preparation and evaluation) 30 h exam preparation
Usability of this module	
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German
Last modification	

Module number	**ET.2.202**
Module name	**Design of Electronic Systems**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ma)
Module coordinator	Prof. Dr. Martin Hoffmann
Compulsory/ optional/ elective	Compulsory
Learning objectives	The Students know advanced principles of construction for fail-safe electronic systems, detection and elimination of EMI-sources. They are able to apply the learned methods and strategies for electronic system design.
Module content	Characterization of inteSErences EMC-conform circuit design and layout Interaction of analog and digital units Optimization of shematics, criterias and strategies Power supply for analoge and digital units Connections and grounding design Simulation of complex electronic circuits, practical training Related regulatory standards
Course type	2L - 0E - 1S - 2P
Learning Material	Literature, lab instruction sheets, handouts
Recommended literature	Recommended literature will be announced in the lecture.
Method(s) of instruction/ media being used	lecture, practical course, self-study LTSpice
Level/ category	2
Summer/ Winter	winter term
Term	2. Semester
Compulsory requirements	none
Recommended requirements	Digital Systems, Analog Circuit Design, Electronic Components, Circuit Design, Digital Signal Processing
Assessment	Exam 90 min, Laboratory internship certificate
Assessment modalities	PL - test performance (graded) Laboratory (audited)
Further information	
ECTS credits	6
Workload	180h of total work load, thereof 75h of contact hours and 105h of self-study, consisting of: 15 h lecture (preparation and rework) 15 h seminar (preparation and rework) 45 h practical training (preparation and evaluation) 30 h exam preparation
Usability of this module	Complex Lab Session
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German
Last modification	05/08/2021

Module number	**ET.2.209**
Module name	**Specialising module**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ma)
Compulsory/ optional/ elective	Elective
Module content	This outline lists all technical elective modules directly offered by the department EE/ IE for the master´s degree EE/ IE. A profil of specialization such as „Automation Engineering and Robotics" (AER=1), "Communication- and Circuit Technology" (CCT=2), "Computer Engineering and Artificial Intelligence" (CEAI=3) or "Sapce electronics" (SE=4) can be designated on the master´s certificate if at least 24 ECTS are from modules belonging to this certain profil. The publication of the technical elective modules which are offered each term occurs by a written announcement. Furthermore all modules of the master´s degrees offered by the department EE/ IE can be chosen as technical elective modules. Althogether 42ECTS have to be accomplished. The allocation of each module to its specific profil is noted as an abbreviation behind the module name. ET.2.224 - Intelligent Systems (AER, CEAI) ET.2.211 - Advanced Control Systems (AER) ET.2.120 - Optimal Control (AER) ET.2.233 - Applied RF- and Microwave Engineering (CCT) ET.2.232 - Augmented Reality/ Virtual Reality (AER, CEAI) ET.2.102 - Software Engineering (CEAI) ET.2.101 - Theoretical Information Sciences (CEAI) ET.2.230 - Processor Design for AI centric algorithms (CEAI) ET.2.212 - Embedded Systems (CCT) ET.2.107 - Servo Drive Systems and Components (AER) ET.2.220 - Optical and Optoelectronical Sensors (SE) ET.2.218 - Optoelectronics II ET.2.221 - Integration of mixed-signal circuits (CCT) ET.2.104 - Reliability Theory (SE) ET.2.105 - Analog Design (CCT) ME.2.203.1 - Actuators (AER) ME.2.203.2 - Simulation of electromechanical Systems (AER) ET.2.122 - Space Travel Systems (SE) ET.2.280 - Autonomous Missions ME.2.105 - 3D Robot Vision (AER) ET.2.225 - Data Sciene (AER, CEAI) ET.2.200 - Numerical Mathematics/Optimization ET.2.201 - Satellite communication (CCT, SE) ET.2.234 - Optoelectronic systems (SE) ET.2.121 - Design of Spaceborne Electronics (SE) You can find the concrete module content in the relevant module description.
Course type	(Lecture, Exercises, Seminar, practical course)
Level/ category	2 (Bachelor=1, Master=2)
Summer/ Winter	Summer term or winter term
Term	1st or 2nd term
ECTS credits	42
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

Module number	**ET.2.211, ME.2.211**
Module name	**Advanced Control Systems**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ma)
Specialization	AER
Module coordinator	Prof. Dr.-Ing. Jörg Müller
Compulsory/ optional/ elective	compulsory ME (Ma), elective EE/IE (Ma)
Learning objectives	The student is able to describe complex process-sequences methodically and to implement them into distributed systems
Module content	- State description - Petri-nets - Process sequence schedule - object-oriented programming (OOP) for process control - distributed systems
Course type	2L - 0E - 0S - 1P
Learning material	Lecture script, lab instruction sheets, extracts of standards
Recommended literature	von Aspern, J.: SPS-Steuerungsentwicklung mit Petri-Netzen; Berlin: VDE Lewis, R.: Modelling control systems using IEC 61499; London: The Inst. of Electrical Engineers Vyatkin, V.: IEC Function Blocks for Embedded and Distributet Control Systems Design; Research Triangle Park, NC: ISA-Instrumentation, Systems, and Automation Society IEC 61499
Method(s) of instruction/ media being used	teamwork, reflections in plenum, practical course
Level/ category	2
Summer/ Winter	winter term
Term	2nd term
Compulsory requirements	none
Recommended requirements	none
Assessment	Laboratory internship certificate, seminar paper
Assessment modalities	APL – assessment during the semester period (graded)
Further information	
ECTS credits	3
Workload	90h of total work load, thereof 45h of contact hours and 45h of self-study, consisting of: 25 h lecture (preparation and rework) 10 h practical training (preparation and evaluation) 10 h exam preparation
Usability of this module	
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German
Last modification	08/10/2021

Module number	**ET.2.212**
Module name	**Embedded Systems**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ma)
Specialization	CCT
Module coordinator	Prof. Dr.-Ing. habil. Jürgen Kampe
Compulsory/ optional/ elective	elective
Learning objectives	At the end of the module students are able to create models of embedded systems with respect to the levels of abstraction of the Y-diagram of Gajski and Kuhn. The students understand the main concepts of modeling hardware based on the hardware description languages VHDL, Verilog, and SystemC including there specifics. The students remember the specifics of embedded systems as well as the general requirements, and they remember the design flow starting from a more abstract behavioural description down to the IC layout and they are able to apply the design flow based on Cadence Encounter design tools for simulation, verification, structural and layout synthesis. The students are able to evaluate the result of the design process and they are able to inteSEre into the automated design process.
Module content	- Embedded and real-time system specifics; - methodologies for the design of embedded systems; - concepts of hardware modeling and the design flow based on VHDL, Verilog, and SystemC including special concepts of behavioural modeling of concurrent systems; - high-level synthesis and modeling according to abstraction levels; - design tools for structural and layout synthesis; Cadence Encounter Design Flow; - adapted systems for embedded system and system-on-programmable-chip based applications; - verification, test benches, and design for test; - implementation of a microcontroller core in a CMOS technology.
Course type	2L - 0E - 0S - 2P
Learning Material	Lecture notes, laboratory instructions, examples
Recommended literature	- P. Marwedel: Embedded System Design. Springer Verlag, 2011 - D. Gajski et al: Specifications and Design of Embedded Systems. AddisonWesley, 1994 - W. Wolf: Computers as Components - Principles of Embedded System Design. Morgan Kaufman Publ. 2012 - J. Teich: Digitale Hardware/Software Systeme. Springer 2007 - N. Weste et al: Principles of CMOS VLSI Design. Addison Wesley Publishing Company - N. Sherwani: Algorithms for VLSI Physical Design Automation. Kluwer Academic Publishers - T. Kropf: Introduction to Formal Hardware Verification. Springer Verlag - G. Herrmann, D. Müller: ASIC Entwurf und Test. Fachbuchverlag Leipzig, 2004 - D. Gajski et al: High-Level-Synthesis: Introduction to Chip and System Design. Kluwer Academic Publishers, 1992 - T. Kropf: VLSI-Entwurf. Vorgehen, Methoden, Automatisierung. Int. Thomson Publishing, 1995 - K. ten Hagen: Abstrakte Modellierung digitaler Schaltungen. Springer 1995 - A. A. Jerraya et al: Behavioral Synthesis and Component Reuse with VHDL. Kluwer Academic Publisher - D. C. Black et al: SystemC: From the Ground Up. Springer, 2010 - R. Brück: Entwurfswerkzeuge für VLSI-Layout. Carl Hanser Verlag

Method(s) of instruction/ media being used	Talk, group work, hands-on training, case study
Level/ category	2
Summer/ Winter	winter
Term	2nd semester
Compulsory requirements	none
Recommended requirements	Digital Systems, Digital Design, Information Technology
Assessment	Laboratory internship report
Assessment modalities	APL – assessment during the semester period (graded)
Further information	
ECTS credits	6
Workload	180h of total work load, thereof 60h of contact hours and 120h of self-study, consisting of: 35 h lecture (preparation and rework) 85 h practical training (report)
Usability of this module	Master thesis
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German
Last modification	9/16/2021

Module number	**ET.2.218**
Module name	**Optoelectronics 2**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ma)
Specialization	
Module coordinator	Prof. Dr. Alexander Richter
Compulsory/ optional/ elective	elective
Learning objectives	After successful participation of the module, the students are able to - Know of the effect conditions of special optoelectronic components in recessed way; - create concepts of simple optoelectronic transmission systems under consideration of disturbance variables and the dynamic behaviour; - construct and test of simple optoelectronic systems - use measurement techniques of fiber optics
Module content	- Mediation of the theoretical bases to photonics, dynamic events in semiconductor structures; - Fiber optics - Photonic transmission technology
Course type	2L - 0E - 0S - 1P (Lecture, Exercises, Seminar, practical course)
Recommended literature	Paul: „Optoelektronische Halbleiterbauelemente“, Teubner-Verlag, 1992 Jansen: „Optoelektronik“, Vieweg, 1993 Jones: „Optoelektronik“, VCH, 1992 Ramaswami, „Optical Networks“, Morgan Kaufmann Publishers, 1998
Method(s) of instruction/ media being used	
Level/ category	2 (Bachelor=1, Master=2)
Summer/ Winter	winter term
Term	2. term
Compulsory requirements	none
Assessment	oral exam
Assessment modalities	PL – exam during audit period(graded)
Further Information	In the exsam, students create solutions for selected optoelectronic questions, and calculate various technically relevant variables and parameters based on given practical examples.
ECTS credits	6
Workload	90h of total work load, thereof 45h of contact hours and 45h of self-study, consisting of: 20 h lecture (preparation and rework) 15 h practical training (preparation and evaluation) 10 h exam preparation
Usability of this module	
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German
Last modification	

Module number	**ET.2.220**
Module name	**Optical and Optoelectronical Sensors**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ma)
Specialization	SE
Module coordinator	Prof. Dr. Alexander Richter
Compulsory/ optional/ elective	elective
Learning objectives	After successful participation of the module, the sudents are able to - use modern optical sensor technologies (micro-optics, fibre optics, integrated optics) - select components (optoelectronic light sources/detectors - define properties, topologies, classification - select working principles (intensity modulation, spectral encoding, inteSErometry, and other) - use signal processing concepts, multiplexing (sensor systems and networks) - define practial applications
Module content	- Modern optical sensor technologies (micro-optics, fibre optics, integrated optics) - Components (optoelectronic light sources/detectors - Properties, topologies, classification - Working principles (intensity modulation, spectral encoding, inteSErometry, and other) - Signal processing concepts, multiplexing (sensor systems and networks) - Applications
Course type	2L - 0E - 0S - 1P (Lecture, Exercises, Seminar, practical course)
Recommended literature	H.-R. Tränkler, E. Obermeier (Herausg.) "Sensortechnik" Handbuch für Praxis und Wissenschaft, Springer, 1998 W. Heiwang (Herausg.) "Sensorik", Reihe: Halbleiter-Elektronik Bd. 17, Springer 1993 P. Hauptmann "Sensoren: Prinzipien und Anwendungen" C. Hanser, 1990
Level/ category	2 (Bachelor=1, Master=2)
Summer/ Winter	winter term
Term	2nd term
Compulsory requirements	none
Recommended requirements	
Assessment	oral exam
Assessment modalities	PL – exam during audit period(graded)
Further Information	In the exsam, students create solutions for selected optoelectronic questions, and calculate various technically relevant variables and parameters based on given practical examples.
ECTS credits	6
Workload	90h of total work load, thereof 45h of contact hours and 45h of self-study, consisting of: 20 h lecture (preparation and rework) 15 h practical training (preparation and evaluation) 10 h exam preparation
Usability of this module	
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German
Last modification	

Module number	**ET.2.221**
Module name	**Integration of mixed-signal circuits**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ma)
Specialization	CCT
Module coordinator	Prof. Dr.-Ing. habil. Jürgen Kampe
Compulsory/ optional/ elective	elective
Learning objectives	The student will be introduced to circuit design, to the automated design of complex integrated CMOS circuits and to related design tools. Sizing as well as layout synthesis will be emphasized. At the end of the module students are able to recognize the main basic and elementary circuit configurations for integrated CMOS circuits and to evaluate them on the base of there characteristics. The students are able to remember complex analog CMOS circuit configurations, used for signal conditioning and converting purposes in the interface region of integrated systems on chip. The students are able to find out the principle of operation of new circuit configurations and to size them with respect to a given application. The students are able to understand CMOS layouts and to synthesize, to verify and to rate layouts by the use of design tools.
Module content	- CMOS technology; - IC layout, layout design and verification; - basic and elementary circuit configurations of integrated CMOS design (i.e. current sources and mirrors, cascade, transfer switches, differential amplifier, output and bias stages); - complex integrated circuits (i.e. reference sources, OTA, optical receivers, comparators, VCO, AD and DA converters); - systematic design methodology for analog integrated circuits; - functional analysis of complex circuits, symbolic analysis, sizing, design space centering, trade-off curves and Pareto optimality; - design tools for integrated circuits (system level to layout, pre- and post-layout simulation and layout verification).
Course type	2L - 0E - 0S - 21P (Lecture, Exercises, Seminar, practical course)
Learning Material	Literature, lecture notes, lab instruction sheets
Recommended literature	Allen, P. E., Holberg, D. R.: CMOS analog circuit design. Baker, R. J.: CMOS: circuit design, layout, and simulation. Maloberti, F.: Analog design for CMOS VLSI systems Fischer, W.-J., Schüffny, R.: MOS-VLSI-Technik: Eine Einführung in Technologie, Entwurf, CAD-Systeme, Schaltkreise Gielen, G.: Symbolic Analysis for Automated Design of Analog Integrated Circuits. Gräb, H. E.: Analog design centering and sizing. Lienig, J.: Layoutsynthese elektronischer Schaltungen
Method(s) of instruction/ media being used	Talk, peer instruction, hands-on training, individual work, case study, self-study
Level/ category	2 (Bachelor=1, Master=2)
Summer/ Winter	winter term, summer term
Term	2nd term
Compulsory requirements	Analogdesign
Recommended requirements	Analog Circuit Design, Signals and Systems, Integrated Circuits
Assessment	Laboratory internship report
Assessment modalities	APL – assessment during the term period (graded)
Further information	
ECTS credits	6
Workload	180h of total work load, thereof 60h of contact hours and

	120h of self-study, consisting of: 35 h lecture (preparation and rework) 35h seminar (preparation and rework) 50 h practical training (preparation and evaluation)
Usability of this module	
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German
Last modification	

Module number	**ET.2.224**
Module name	**Intelligent Systems**
Department	Electrical Engineering and Information Technology
Degree program	ME (Ma), EE/IE (Ma)
Specialization	AER, CEAI
Module coordinator	Prof. Dr.-Ing. habil. Klaus-Peter Döge
Compulsory/ optional/ elective	elective
Learning objectives	The students master the basics of strategies and algorithms of artifical intelligence. They are able to applicate these algorithms for concrete technical systems.
Module content	- Design of Fuzzy-Systems (control systems and data mining) - Artificial Neural Networks (Topologie, Training, Simulation and Design Tools) - Neuro Fuzzy Systems - Evolutionary Algorithms: Strategies, Optimization for Fuzzy and Neural Network Systems.
Course type	2L - 0E - 0S - 1P (Lecture, Exercises, Seminar, practical course)
Learning Material	Lecture script
Recommended literature	Keller, H.B.: Maschinelle Intelligenz, F.Vieweg-Verlag, Braunschweig/Wiesbaden 2000 Ertel, W.: Grundkurs Künstliche Intelligenz, Vieweg und Teubner, Wiesbaden 2009 Alpaydin, E.: Maschinelles Lernen, Oldenbourg- Verlag, München 2008
Method(s) of instruction/ media being used	CAE-Tools (MATLAB/Simulink)
Level/ category	2 (Bachelor=1, Master=2)
Summer/ Winter	winter term
Term	2. term
Compulsory requirements	none
Recommended requirements	Automatic Control, Digital Control Systems
Assessment	exam 90 min
Assessment modalities	PL – university written exam during period of lectures (graded)
Further information	
ECTS credits	3
Workload	90h of total work load, thereof 45h of contact hours and 45h of self-study, consisting of: 20 h lecture (preparation and rework) 10 h practical training (preparation and evaluation) 15 h exam preparation
Usability of this module	
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German
Last modification	

Module number	**ET.2.230**
Module name	**Processor Design for AI centric algorithms**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ma)
Specialization	CEAI
Module coordinator	Prof. Dr.-Ing. Burkart Voß
Compulsory/ optional/ elective	elective
Learning objectives	After successfully completing the module students are able to: - understand the functional principle and possible applications of microcontrollers. - derive principles of assembler programming. - understand the interaction between hardware and software. - derive the consequences of design decisions. - systematically plan and design a digital processor.
Module content	Within the scope of this module the fundamental functional principle of a digital processor is covered in detail. Based on the knowledge acquired in the courses „Digital Circuit Design“ and „Microprocessor Technology“ a RISC processor with a given instruction set is designed by the students and implemented on a FPGA. Programs to run on this self-developed processor can be assembled with a provided Assembler tool. If the instruction set is extended by the students, they can adapt the Assembler accordingly. Based on the knowledge gained in this project processor architecture alternatives are introduced, e.g. VLIW and multi core processors.
Course type	1L - 0E - 0S - 3P
Learning Material	
Method(s) of instruction/ media being used	
Level/ category	Lecture with practical course
Summer/ Winter	2
Term	Wintersemester
Compulsory requirements	2. Semester
Recommended requirements	none
Assessment	Programming skills and knowledge of digital circuit design, VHDL
Assessment modalities	term paper, seminar paper, project work
Further Information	APL – assessment during the term period (graded)
ECTS credits	The deep understanding of basic processor principles and the ability to systematically design a processor and program the designed processor is demonstrated with the design and documentation of a functional processor followed by a project review.
Workload	6
Usability of this module	180h of total work load, thereof 60h of contact hours and 120h of self-study, consisting of: 110h design and test of Processor in VHDL 10h documentation of design
Time	
Duration of module	According time table
Place/ room	1 term
Frequency of offer	EAH Jena
Language	Annually
Last modification	DeutschGerman

Module number	**ET.2.232**
Module name	**Augmented Reality / Virtual Reality**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE(Ma), Me (Ma)
Specialization	AER, CEAI
Module coordinator	Prof. Dr.-Ing. Sebastian Knorr
Compulsory/ optional/ elective	Elective
Learning objectives	At the end of the module students are able: • to distinguish between Virtual, Mixed und Augmented Reality • to digitalise information and present it user-friendly in VR, augment reality • to recognise application domains of this technology and implment it pototypicaly • to implement and apply interfaces • to assess limitations and requirements of AR / VR
Module content	• Camera modell and projective Geometry • Introduction to Computergrafik • Hardware: GPUs and HMDs • Introduction to Unity • Camera Calibration/ 2-View-Geometry/ Parameter estimation • Structure-from-Motion/ SLAM, Visual Hull/ Free Viewpoint Video • Depth Estimation/ Depth-Image-based-Rendering • 360°-Video/ VR-Film
Course type	2L – 0E – 2S – 1P
Learning Material	Lecture slides, literature recommendation specific to the seminar sessions
Recommended literature	• Dörner, R., Broll, W., Grimm, P., Jung, B. (Hrsg.): Virtual und Augmented Reality (VR / AR), Springer Verlag, 2013 • Marcus Tönnis: Augmented Reality: Einblicke in die Erweiterte Realität, Springer Verlag, 2010 • Richard Hartley und Andrew Zisserman (2004). Multiple View Geometry, Cambridge University Press • Richard Szeliski (2011). Computer Vision: Algorithms and Applications, Springer • Marc Pollefeys (2000). Tutorial on 3D Modeling from Images, Lecture Notes, ECCV • Intel RealSense, Technische Handbücher
Method(s) of instruction/ media being used	Lecture, Seminar, Exercisises
Level/ category	2
Summer/ Winter	Wintersemester
Term	2. Semester
Compulsory requirements	none
Recommended requirements	Computer science basic knowledge, programming skills in at least one common programming language, basic knowledge in digital image processing
Assessment	Oral examination (50%), seminar thesis and presentation (50%)
Assessment modalities	APL – assessment during the term period (graded)
Further information	
Workload	6
Usability of this module	180h of total work load, thereof 45h of contact hours and 135h of self-study, consisting of: 100 h seminar thesis 0 h practical training (preparation and evaluation) 35 h exam preparation

Duration of module	According time table
Time	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German
Last modification	06.08.2021

Module number	**ET 2.233**
Module name	**Applied RF- and Microwave Engineering**
Department	Electrical Engineering and Information Technology
Degree programme	EE/IE (Ma)
Specialization profile	CCT
Module coordinator	Prof. Dr.-Ing. Johannes Trabert
Compulsory/ optional/ elective	elective
Learning objectives	Upon successful completion of the module, students will be able to - distinguish and design waveguide structures and determine the associated field distributions, as well as their technological realisation possibilities in organic and ceramic circuit boards, - identify HF and microwave system components and understand the structure and function of technical systems realised from them, - get to know microwave-compatible packaging and interconnection technology for the realisation of high-performance radio systems, - analyse assemblies with RF and microwave measurement technology and evaluate relevant parameters, - design simple building blocks and antenna structures themselves.
Module content	- Fundamentals: transmission line theory, field distribution in waveguides, microwave networks, n-gates, scattering matrix, signal flow graph, filters, - System considerations: passive and active components and subsystems (power transmission via linear two-port networks, amplifiers and associated RF transistors (BJT, FET), amplifier classes, non-linear signal distortion, noise, dynamic range, frequency synthesis, frequency conversion/mixing, de/modulation; software-defined functions) - Hybrid integration of active electronic circuits in multilayer circuit boards (thin- and thick-film technology/ electronics technology) - Design of RF and microwave antennas, analysis and evaluation of associated directional diagrams, propagation path characteristics - practical application of RF and microwave measurement techniques: spectral and modulation analysis, power measurement, vector network analysis (scattering parameters), directional diagrams of antennas - practical. Application of CAD tools for circuit design and 3D modelling of electromagnetic fields for PCB design, antennas, etc.
Course type (Lecture, Exercises, Seminar, Practical course/ Lab)	2L - 0E - 1S - 2P
Learning material	Books, script/ set of slides, summary sheets, exercises, follow-up questions and laboratory instructions
Recommended books and bibliographical references	- S.C. Cripps: RF Power Amplifiers for Wireless Communications. Artech - J. P. Dunsmore: Handbook of Microwave Component Measurements - with Advanced VNA Techniques. Wiley - Robert E. Collin: Foundations for microwave engineering. McGraw Hill - H. + P. Eskelinen: Microwave Component Mechanics, Artech House - G. Gronau: Höchstfrequenztechnik. Springer Publishing House, Berlin - H. H. Meinke, F.W. Gundlach: Taschenbuch der Hochfrequenztechnik, Band 1: Grundlagen, Band 2: Komponenten und Band 3: Systeme. Spring. - S. Orfanidis: https://www.ece.rutgers.edu/~orfanidi/ewa/, Website with his book „Electromagnetic Waves and Antennas“ - D. M. Pozar: Microwave engineering. Wiley - A. J. Schwab: Begriffswelt der Feldtheorie. Springer Publishing H., Berlin - M. Thumm , W. Wiesbeck , S. Kern: Hochfrequenzmesstechnik-Verfahren und Messsysteme. Springer Publishing House, Berlin
Method(s) of instruction/ media being used	Seminar-based lectures, exercises and simulation tasks, practical laboratory experiments and self-study
Level/ category (Ba=1, Ma=2)	2

Semester position (winter/ summer)	Summer term
Term during study programme	1st Semester
Requirements for attendance	No specific requirements
Recommended prior knowledge	Radio Frequency Engineering I +II, Communications Engineering and Information Transmission Technology, Electronic Measurement Eng.
Assessment	Written exam 90 min., Certificate for successfully completed laboratory experiments
Assessment modalities	PL - Assessment during the examination period (graded)
Further information	
ECTS credit points	6
Workload	180 h total workload, of which are - 70 h attendance hours (5 SWS) and - 110 h of self-study, consisting of: - 20 h preparation and follow-up of lectures - 30 h preparation and follow-up of seminars and exercises - 30 h preparation, evaluation and follow-up of laboratory experiments - 30 h exam preparation
Time	According to time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German
Last modification	08/10/2022

Module number	**ET.2.234**
Module name	**Optoelectronic systems**
Department	Electrical Engineering and Information Technology
Degree programme	EE/IE (Ma)
Specialization	SE
Module coordinator	Prof. Dr. Alexander Richter
Compulsory/ optional/ elective	elective
Learning objectives	After successful participation of the module, the students are able to - Know of the effect conditions of special optoelectronic components in recessed way; - create concepts of simple optoelectronic transmission systems under consideration of disturbance variables and the dynamic behaviour; - construct and test of simple optoelectronic systems - use measurement techniques of fiber optics
Module content	-Optoelectronics - Fiber optics - Optoelectronic Systems
Course type (Lecture, Exercises, Seminar, Practical course/ Lab)	2L - 1E - 0S - 0P
Learning material	
Recommended books and bibliographical references	Paul: „Optoelektronische Halbleiterbauelemente“, Teubner-Verlag, 1992 Jansen: „Optoelektronik“, Vieweg, 1993 Jones: „Optoelektronik“, VCH, 1992 Ramaswami, „Optical Networks“, Morgan Kaufmann Publishers, 1998 Further literature depeds on the executed projects
Method(s) of instruction/ media being used	Lecture, projects
Level/ category (Ba=1, Ma=2)	2
Semester position (winter/ summer)	Summer term
Term during study programme	2nd term
Requirements for attendance	None
Recommended prior knowledge	Physics, Optoelectronics
Assessment	Project results, talk
Assessment modalities	APL – assessment during the term period (graded)
Further information	
ECTS credit points	3
Workload	90h of total work load, thereof 45h of contact hours and 45h of self-study, consisting of: 20 h lecture (preparation and rework) 15 h practical training (preparation and evaluation) 10 h exam preparation
Usability of this module	
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German
Last modification	01/19/2023

Module number	**ET.2.280**
Module name	**Autonomous Missions**
Department	Electrical Engineering and Information Technology
Degree programme	EE/IE (Ma), LOT (Ma), Werkstofftechnik (Ma)
Module coordinator	Prof. Voß (EE/IE), Prof. Dienerowitz (SciTec)
Compulsory/ optional/ elective	elective
Learning objectives	• Mission design for autonomous systems (e.g. robots, probes) according to given objectives; ideally motivated by national / international tenders or competitions, e.g. REXUS / BEXUS of the DLR • Project planning for the realization of the system and implementation of the mission • Modeling for essential mission phases, both for the design of the electromechanical system and for the development of the control model • Design of the electromechanical structure of the system • Design of the software architecture • Realization of the system Preparation, implementation and evaluation of the mission; depending on the scope of the project only partial aspects
Module content	After successful participation in the module, students are able to: • independently use and further develop work in an interdisciplinary team as a solution strategy • carry out a technical project (concept, development, realization) that is essentially implemented using autonomous electromechanical systems in mission phases • recognize, analyze and solve the structural mechanical, electrical and software engineering aspects of the project • design and implement the software architecture of the system (EE/IE students) or the mechanical structure of the system (SciTec students). communicate the project implementation using suitable representations (report, lectures, publications)
Course type (Lecture, Exercises, Seminar, Practical course/ Lab)	0V - 0Ü - 3S - 0P
Learning material	primarily data sheets on the hardware components used and textbooks on sub-disciplines according to the required modules
Recommended books and bibliographical references	Lecture notes and instructions for hardware and software are provided
Method(s) of instruction/ media being used	Blackboard, projector, programming environment, student workshops
Level/ category (Ba=1, Ma=2)	2
Semester position (winter/ summer)	winter term
Term during study programme	1st term (Ma), limited to a maximum of 10 students per semester
Requirements for attendance	EE/IE: Ba degree in EE/IE or comparable SciTec: BA degree in FT, LOT, PT, WT or comparable
Recommended prior knowledge	Experience in project work and a basic technical understanding of all project-related disciplines
Assessment	The ability to work on a complex problem is checked using APL
Assessment modalities	APL (project work)
Further information	
ECTS credit points	3

Workload	90 hours of total workload, consisting of 45 hours of attendance and 45 hours of self-study, which includes the preparation and follow-up of the seminars and the preparation of the exam.
Usability of this module	Ability to work in projects, thus skills gained can be used for study and final theses
Time	According to the timetable
Duration of module	1 semester
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German
Last modification	

Module number	**ET.2.300**
Module name	**Complex Lab Session**
Department	Electrical Engineering and Information Technology
Degree program	EE/IE (Ma)
Specialization	AER, CCT, CEAI, SE
Module coordinator	Prof. Dr.-Ing. Frank Giesecke, Prof. Dr.-Ing. Burkart Voß
Compulsory/ optional/ elective	Compulsory
Learning objectives	After successful conclusion of this module the students will be able to: - study technical literature and do review and evaluation for a given topic. - analyze a given problem with scientific methods, develop and evaluate proposals for solutions, document and implement selected solutions as well as present and interpret of the achieved result in a written form. - visualize and accurate present technical issues. - develop and formulate consistent and logically coherent thoughts.
Module content	Within the context of an ongoing research or development project at the university a subtask has to be solved. After a short introduction, an overview of the international standard of the topic has to be provided. An experimental setup has to be developed and used. Using scientific skills, chosen research problems have to be solved. Results have to be displayed and explained. Acquired knowledge and skills are a necessary prerequisite for the Master thesis.
Course type	0L - 2E - 0S - 4P (Lecture, Exercises, Seminar, practical course)
Learning Material	Technical literature, special application software, technical manufacturer information
Recommended literature	A general bibliographical reference cannot be given because it depends on the topic.
Method(s) of instruction/ media being used	Independent scientific work
Level/ category	2 (Bachelor=1, Master=2)
Summer/ Winter	summer term, winter term
Term	2nd and 3th term
Compulsory requirements	none
Assessment	term paper
Assessment modalities	APL – assessment during the term period (graded)
Further information	
ECTS credits	6
Workload	180 h
Usability of this module	Masterarbeit
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German
Last modification	

Module number	**ET.2.301, ME.2.301**
Module name	**Master thesis**
Department	Electrical Engineering and Information Technology
Degree program	Me (Ma), EE/IE (Ma)
Specialization	AER, CCT, CEAI, SE
Module coordinator	Prof. Dr.-Ing. Burkart Voß, Prof. Dr.-Ing. Jörg Müller, Prof. Dr.-Ing. Frank Giesecke
Compulsory/ optional/ elective	Compulsory
Learning objectives	After successful conclusion of this module the students will be able to: - arrange and structure a scientific work. - study technical literature and do a review and an evaluation for a given topic. - analyze a given problem statement with scientific methods, develop and evaluate proposals for solutions, document and implement selected solutions as well as present and interpret of the achieved result in a written form. - visualize and accurately present technical issues. - develop and formulate consistent and logically coherent thoughts. - generate well-grounded scientific findings, which will be an engineering progress in this relevant field. - write orthographically and grammatically accurate text, which satisfies formal restrictions.
Module content	The topic of the master thesis has to deal with the design and evaluation of electronic systems, with information technology or with mechatronic systems. The thesis work can be done in the context of research and/or development tasks in universities as well as companies and research establishments in Germany or abroad. After an orientation phase the international state of the art in this specialized topic has to be discussed. With scientific methods the subject at hand has to get analyzed and proposals for solutions will need to be formulated. Experimental, design and/or theoretical work will have to be done to meet the goal. Furthermore a presentation and an interpretation of the results are required.
Course type	(Lecture, Exercises, Seminar, practical course)
Learning Material	Technical literature, patents, special application software, technical manufacturer information
Recommended literature	Grieb: Schreibtipps für Diplomanden und Doktoranden. Berlin: VDE-Verlag, 1993 Scholz: Diplomarbeiten normgerecht verfassen – Schreibtipps zur Gestaltung von Studien-, Diplom- und Doktorarbeiten. Würzburg: Vogel, 2001 Nicol: Wissenschaftliche Arbeiten schreiben mit Word – formvollendete und normgerechte Examens-, Diplom- und Doktorarbeiten (für Word 97, 2000, 2002). München: Addison-Wesley, 2002
Method(s) of instruction/ media being used	Independent scientific work
Level/ category	2 (Bachelor=1, Master=2)
Summer/ Winter	summertermn
Term	3th term
Compulsory requirements	Successful completion of all compulsory modules and selected optional required modules, written registration of the topic of the master thesis
Assessment	Scientific work
Assessment modalities	final examination
Further Information	Hand over of master thesis just in time and tutor’s report
ECTS credits	24
Workload	720 h
Usability of this module	Completion of second academic degree

Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	each term
Language	German
Last modification	

Module number	**ET.2.302, ME.2.302**
Module name	**Colloquium**
Department	Electrical Engineering and Information Technology
Degree program	Me (Ma), EE/IE (Ma)
Specialization	AER, CCT, CEAI, SE
Module coordinator	Prof. Dr.-Ing. Burkart Voß, Prof. Dr.-Ing. Jörg Müller, Prof. Dr.-Ing. Frank Giesecke
Compulsory/ optional/ elective	Compulsory
Learning objectives	Presentation and defense of the results in the context of a colloquium.
Module content	The master thesis is presented in a colloquium. The candidate provides the goal, the most important results and conclusions in a presentation of 20 minutes (maximum). Subsequently the topics will be discussed. The total time the colloquium takes amounts to 60 minutes (or shorter).
Course type	Presentation, Colloquium (Lecture, Exercises, Seminar, practical course)
Learning Material	Technical literature, patents, special application software, technical manufacturer information
Recommended literature	Leopold-Wildburger; Schütze: Verfassen und Vortragen - wissenschaftliche Arbeiten und Vorträge leicht gemacht. Berlin: Springer, 2002 Franck: Rhetorik für Wissenschaftler - selbstbewusst auftreten, selbstsicher reden. München : Vahlen, 2001 Huth: Duden - Reden gut und richtig halten! -Ratgeber für wirkungsvolles und modernes Reden. Mannheim: Dudenverlag, 2000 Lucas: Überzeugend reden - mehr Erfolg durch richtige Rhetorik. Düsseldorf: Econ-Taschenbuch-Verlag, 1999
Method(s) of instruction/ media being used	Independent scientific work
Level/ category	2 (Bachelor=1, Master=2)
Summer/ Winter	summer term
Term	3th term
Compulsory requirements	Successful completion of all compulsory modules and selected elective modules of the course, timely submission of the thesis and supervisor reports
Assessment	presentation, colloquium
Assessment modalities	final examination
Further information	
ECTS credits	3
Workload	90 h workloadCompletion of the second academic degree
Usability of this module	full time
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	each term
Language	German/ English
Last modification	

Module number	**ME.2.102**
Module name	**Mechatronics**
Department	Mechanical Engineering
Degree program	Me (Ma)
Module coordinator	Prof. Dr.-Ing. habil Jörg Grabow
Compulsory/ optional/ elective	Compulsory
Course type	2L - 2E - 0S - 0P (Lecture, Exercises, Seminar, practical course)
Recommended literature	Heimann, Gerth, Popp: Mechatronik. Isermann: Identifikation dynamischer Systeme I, II. Isermann: Mechatronische Systemeat. Roddeck: Einführung in die Mechatronik.
Level/ category	2 (Bachelor=1, Master=2)
Summer/ Winter	summer term
Term	1. term
Compulsory requirements	None
Assessment	exam 90 min
Assessment modalities	PL – exam during audit period(graded)
Workload	180 h of total work load, thereof 60 h of contact hours and 120 h of self-study,
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

Module number	**ME.2.108**
Module name	**Technical elective module**
Department	Electrical Engineering and Information Technology
Degree program	Me (Ma)
Module coordinator	Prof. Dr.-Ing. habil Jörg Grabow
Compulsory/ optional/ elective	elective
Module Content	Altogether 24 ECTS have to be accomplished within the first and second term. The publication of the technical elective modules which are offered each term occurs by a written announcement. The following listing of the technical elective modules is not final. Beside the exemplary noted ones down below it can as well include modules from other master´s degree of the Dept. ET/ IT. ME.2.206 - Experimental modal analysis ET.2.104 - Reliability Theory ET.2.107 - Servo Drive Systems and Components ET.2.220 - Optical and Optoelectronical Sensors ET.2.224 - Intelligent Systems ET.2.225 - Data Science ET.2.232 - Augmented Reality/ Virtual Reality Exact content: please refer to the appropriate modul discription
Course type	(Lecture, Exercises, Seminar, practical course)
Level/ category	2 (Bachelor=1, Master=2)
Summer/ Winter	summer term , winter term
Term	1. and 2. term
Compulsory requirements	none
Assessment	see module describtion
Assessment modalities	see module describtion
ECTS credits	24
Workload	720 h
Time	According time table
Duration of module	2 terms
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German
Last modification	

Module number	**ME.2.109**
Module name	**Mechatronics Project**
Department	Mechanical Engineering
Degree program	Me (Ma)
Module coordinator	Prof. Dr.-Ing. habil Jörg Grabow
Compulsory/ optional/ elective	Compulsory
Course type	0L - 1E - 0S - 2P (2. term) 0L - 1E - 0S - 2P (3. term) (Lecture, Exercises, Seminar, practical course)
Learning Material	
Recommended literature	Madauss, Bernd J.: Projektmanagement, 3. Auflage, Stuttgart 1990 Boy, J., u.a.: Projektmanagement; Bremen, 1994 Reschke, H.; Schelle, R.; Schnopp (Hrsg.): Handbuch Projektmanagement, 2 Bände, Köln, 1989 Wermter, M.: Strategisches Projektmanagement, Zürich und Köln, 1992 Wischnewski, E.: Modernes Projektmanagement, 4. Auflage, Braunschweig 1993
Level/ category	2 (Bachelor=1, Master=2)
Summer/ Winter	winter term, summer term
Term	2. and 3. term
Compulsory requirements	none
Assessment	Project
Assessment modalities	APL - during term(graded)
ECTS credits	6
Workload	180 h
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German

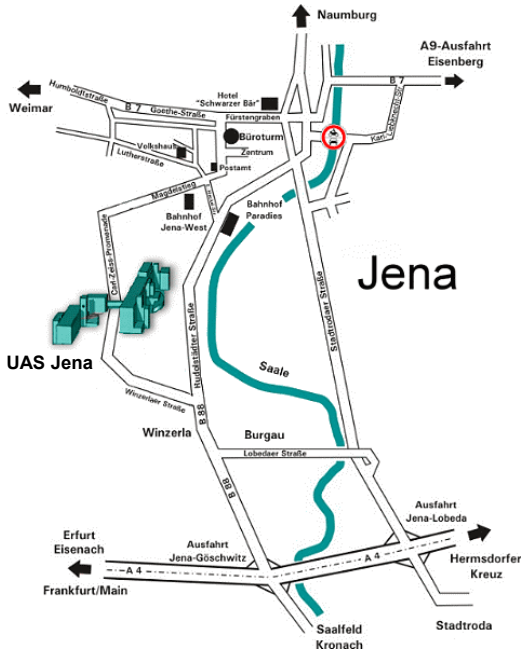
Module number	**ME.2.203**
Module name	**Actuators and Simulation of electromechanical Systems**
Department	Electrical Engineering and Information Technology
Degree program	Me (Ma), EE/IE (Ma)
Specialization	AER
Module coordinator	Prof. Dr.-Ing. Matthias Förster
Compulsory/ optional/ elective	Compulsory Me (Ma), elective EE/IE (Ma)
Learning objectives	Building on the physical principles used to convert controlled electrical energy into mechanical energy, an overview of the technically realized actuators and their laws is to be provided. The actuators should be selected for technical applications, simulated and projected in connection with control and coupled multi-mass systems. The focus is on electro-magnetic actuators and piezo actuators. After successfully participating in this course, students are able to analyze and mathematically describe the treated actuators with or without a coupled mechanical system, as well as to determine and simulate the system behavior.
Module content	The topics of the lecture actuators are: - Introduction with explanation of the principles of energy conversion and the generation of mechanical forces - Electromagnetic actuators with solenoids, stepping motors, linear motors and magnetostrictive actuators - calculation of magnetic fields - Electrostatic actuators (Piezoelectric actuators) - Electrothermic actuators (shape memory actuators) In the practical course the students work with the following experiments: - Solenoid - Stepping motor - Piezoelectric and shape memory actuators - magnetic field calculation and simulation In the lecture on the simulation of electromechanical systems, based on the knowledge of the module actuators mechatronics, the specifics of the simulation of such systems are presented. In the internship, selected systems are simulated and examined experimentally at the same time: -state size representation of a coil drive -Network simulation of a piezo actuator -Simulation and behaviour of a regulated positioning drive
Course type	2V - 0Ü - 0S - 1P (Actuators) 1V - 0Ü - 0S - 2P (Simulation) (Lecture, Exercises, Seminar, practical course)
Learning Material	lecture papers and experiment instructions
Recommended literature	Grabow, J: Verallgemeinerte Netzwerke in der Mechatronik Stölting, H.; Kallenbach, E.; Amrhein, W.: Handbuch Elektrische Kleinantriebe Kallenbach, E.; Eick, R.; Ströhla, T.; Feindt, K.; Kallenbach, M.; Radler, O.: Elektromagnete Heimann,B.; Albert,A.; Ortmaier, T.; Rissing, L.: Mechatronik
Method(s) of instruction/ media being used	lecture and experiment
Level/ category	2 (Bachelor=1, Master=2)
Summer/ Winter	winter term
Term	2. term
Compulsory requirements	none
Recommended requirements	mechatronics
Assessment	Actuators: exam 90min

	Simulation of electromechanical Systems: term paper
Assessment modalities	Actuators: PL-exam during audit period(graded) Simulation of electromechanical Systems: APL – during term(graded)
ECTS credits	6
Workload	180h of total work load, thereof 90h of contact hours and 90h of self-study, consisting of: 30 h lecture (preparation and rework) 40 h practical training (preparation and evaluation) 20 h exam preparation
Usability of this module	
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German
Last modification	

Module number	**ME.2.206**
Module name	**Experimental modal analysis**
Department	Mechanical Engineering
Degree program	Me (Ma)
Module coordinator	Prof. Dr.-Ing. habil Jörg Grabow
Course type	2L - 0E - 0S - 2P Lecture, Exercises, Seminar, practical course)
Recommended literature	Waller, H.; Reinhard, S.: Schwingungslehre für Ingenieure Inman, D.: Engineering Vibration Natke, H.G.: Experimentelle Modalanalyse Verlag Technik Berlin
Level/ category	2 (Bachelor=1, Master=2)
Assessment	term paper
Assessment modalities	APL - during term(graded)
Further information	
ECTS credits	6
Usability of this module	
Time	According time table
Duration of module	1 term
Place/ room	EAH Jena
Frequency of offer	Annually
Language	German
Last modification	

The modules with their validity are listed under exclusion of any warranty!

Map of UAS Jena campus



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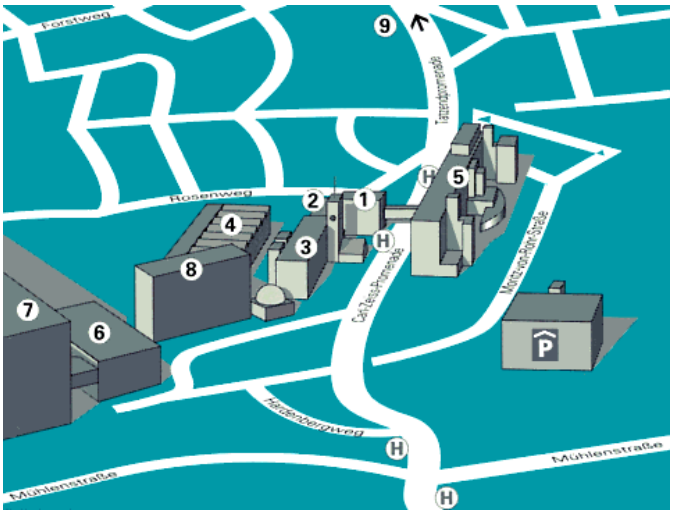

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