Ernst-Abbe-Hochschule Jena
University of Applied Sciences

Course Manual
of Master's Degree Programme

Scientific Instrumentation

The Department of SciTec

With nearly one thousand students, a total of 21 professors, about 25 academic and technical collaborators, the Department of SciTec is the largest of its kind at this university. The name **SciTec** stands for the link between **science** and **technology**. The subtitle "Precision, Optics, Materials" names the focal points in its teaching and research. The Department of SciTec was founded in 2005 from the former Precision Engineering, Physics Engineering and Materials Engineering Departments. This merger has produced a new engineering science entity with a wide-ranging spectrum of scientific and technical expertise and well equipped modern laboratories. The working fields of the department are: teaching, research and further education.

Teaching:

The Department of SciTec offers the following degree programmes:

Bachelor degree programmes

- Laser- and Optotechnologies
- Materials Engineering
- Microtechnology/ Physics Engineering
- Optometry/ Ophthalmic Optics
- Precision Engineering

Master degree programmes

- Laser- and Optotechnologies
- Materials Engineering
- Optometry/ Ophthalmo-Technology/ Vision Science
- Scientific Instrumentation

Research:

The focal points of research projects operated at the Department of SciTec can be described with the following key words:

- laser technique and optics
- materials science
- optometry
- precision and micro technologies

Further education:

The Department of SciTec offers further education in special fields (i.a. optometry, production engineering, laser technique, optics, optical design) for industrial establishments.

International contacts:

The Department of SciTec maintains contacts to universities all over the world. Numerous students use this chance to complete a part of study abroad (U.S.A., France, Japan, China, Australia etc.). Numerous international students are enrolled in the master programme „Scientific Instrumentation“, which is taught in English.

The Master’s degree programme Scientific Instrumentation

The international Master’s degree programme of Scientific Instrumentation taught in English language is designed for graduates in science and engineering disciplines and provides advanced qualification for employment in the research and development branches of various fields. Building on the competence acquired during the Bachelor’s degree programme, the course of study enables students to independently design and develop scientific instruments and manage development and research projects.

Scientific instruments are highly specialized devices for measuring physical or chemical quantities, carrying out special processes or creating defined test conditions. These instruments are used in fields that include research in physics and sciences, advanced technology, biomedical engineering, and aeronautics.

Jena’s reputation as a centre of technology specializing in optics and scientific instrument manufacturing dates back over a hundred years. Industrial firms and research institutes are engaged in the fields of applied physics, technologies in the field of physics, optics, high-precision mechanics, metrology, sensors, micro-engineering and nanotechnology, as well as biomedical engineering. The development of high-tech processes, of innovative measuring techniques and instruments is crucial for this sector to remain globally competitive.

Employment opportunities

The Master’s degree in Scientific Instrumentation qualifies its holders for the employment in industry, research institutes and engineering firms. Holders of the Master’s degree mediate between pure science and engineering disciplines and consequently apply scientific knowledge to find appropriate, effective solutions to engineering problems.

Typical examples of employment opportunities in industry and research institutes can be found in the research and development of new instrumentation, in monitoring high-tech processes, as well as in solving metrological problems and problems relating to the technical aspects of instruments arising in interdisciplinary research projects, such as biomedical engineering, geotechnics, environmental engineering and the aerospace industries.

Entrance Requirements

The entry requirement for the Master’s degree programme is a university degree with competent final degree grades in physics, science or a scientific engineering discipline whose curriculum covers the subject entry

requirements (e.g. physics, physics engineering, microtechnology, precision engineering, mechanical engineering, mechatronics, electrical engineering, electronics). English proficiency is also mandatory.
The postgradual basis modules in semester one are assigned to the students depending on their Bachelor course to bring all the students with their different background to a comparable level.
The Master's degree programme is offered at every winter semester.

Programme overview

The programme has been designed to equip students with both the technical and interdisciplinary qualifications necessary for the successful pursuit of their future careers.
Apart from contents of the course in physics and engineering science, this also includes the so-called key qualifications. In the first semester in addition to the compulsory modules a selection of postgradual basis modules in the fields of applied physics or precision engineering is offered to bring students from different disciplines up to the same level. In the second semester, students select four fields of specialization from a choice of eight (see next page).

Graduation

The internationally recognized academic degree of Master of Science (M.Sc.) will be conferred on students by the Ernst-Abbe-Hochschule Jena – University of Applied Sciences Jena, upon successful completion of the programme.

Professional perspectives

In the actual scenario of the increasing shortage of highly qualified personnel in technical and scientific sectors, there are excellent career prospects for graduates of the Master's degree programme in scientific instrumentation both nationally and internationally.
The industries and research institutes in the region of Jena provide excellent employment opportunities for graduates in the particular specializations which they have opted for. Many companies are engaged into the fields of metrology and sensors, optics, analytical techniques, micro engineering and medical engineering. The close contacts that the teaching staff possesses with the industrial firms and research institutes ensure that the training is practically oriented and is up-to-date with the course contents. Looking at the current scenario for interns and graduates of the scientific engineering courses, the demand is greater than the supply. The Master's degree in Scientific Instrumentation also qualifies its holder to pursue a PhD.

Contact person

For any specific question on the **Master's degree programme Scientific Instrumentation** please contact Mr Prof. Dr. Ploss (course director/ study programme advisor):

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Internet: www.scitec.eah-jena.de

Module descriptions

In this chapter you will find all module descriptions of **Master's study programme Scientific Instrumentation** in chronological order of curriculum.

Following **module table** gives an overview of curriculum according to Study and Examination Regulations from 21.03.2018 (**EP-version 38**):

ER-version 38	module 1	module 2	module 3	module 4	module 5	credit hours
1st Semester	Postgradual Basis Module*		Physical Materials Diagnostics	Scientific Writing and Presentation	Non-technical compulsory optional module I**	
			SciTec.2.195 SP 90, SL	SciTec.2.196 SL		
			3 0 0 1	1 2 0 0		21
			SI	SI		
			Teichert/ Wilde	N.N.		
2nd Semester	Compulsory Optional Module			Soft Skills	Non-technical compulsory optional module II**	
				ST.2.502 SL		
				0 2 0 0		23
				SI, WT		
				div. lecturers		
3rd Semester	Research Internship					
	SciTec.2.625		AP			
						0
	SI					
	lecturers of degree programme SI, duration: 5 months					
4th Semester	Master Thesis				Colloquium	
	SciTec.2.712		AP		ST.2.804 AP	
						0
	SI				LOT,OOVS, SI, WT	
	5 months					

Postgraduale Basis Modules* *Classification is carried out by course director.				
	for graduates in e.g. Precision Engineering *	Solid State Physics	Microsystems Engineering	Electronic Hardware Systems
		SciTec.2.197 SP 90	ST.2.198 SP90	ET.2.504 SP 90, SL
		3 0 1 0	2 0 1 0	3 0 0 1
		SI	SI	SI
		Ploss	Rüb	Hoffmann, Kämpfe (ET/IT)
	for graduates in e.g. Physics Engineering*	Design of Precision Devices	Introduction to FEM	Electronic Hardware Systems
		SciTec.2.199 AP, SL	ST.2.172 AP, SL	ET.2.504 SP 90, SL
		2 0 0 2	2 0 0 1	3 0 0 1
		SI	LOT, SI	SI
		Pfaff	Dienerowitz	Hoffmann, Kämpfe (ET/IT)
	for graduates in e.g. Electrical Engineering *	Solid State Physics	Introduction to FEM	Design of Precision Devices
		SciTec.2.197 SP 90	ST.2.172 AP, SL	SciTec.2.199 AP, SL
		3 0 1 0	2 0 0 1	2 0 0 2
		SI	LOT, SI	SI
		Ploss	Dienerowitz	Pfaff

Compulsory Optional Modules in 2nd semester				
	Materials for Sensors and Electronics	Micro- and Nanotechnology	Optical Instruments	Gas Sensing and Aerosol Measurement
	SciTec.2.223 SP 90, SL	SciTec.2.203 SP 90, SL	SciTec.2.200 SP 90, SL	WI2.904 SP 90, SL
	4 0 0 1	4 0 0 1	3 0 0 1	3 0 0 1
	SI, WT	SI, WT	SI	SI, WT
	Ploss, Töpfer	Konovalov	Brunner	Schleicher
	FEM and Simulation	Advanced 3D-Design	Precision Instrumentation	Scientific Computing
	SciTec.2.171 AP, SL	SciTec.2.201 AP, SL	SciTec.2.204 SP 90	GW.2.403 SP 90, SL
	2 0 0 2	2 0 0 2	4 0 0 0	4 0 0 2
	SI	SI,(WT)	SI, WT	SI, WT
	Dienerowitz	Pfaff -> ST02	Schröck	Kempka (GW)

Non-technical Compulsory optional module I**	German as Foreign Language I GW.2.177 AP 0 0 4 0 SI Düring	English for Specific Purposes I GW.2.175 AP 0 0 3 0 OOVS, SI, WT Schuhknecht	Further Foreign Language GW.2.179 AP 0 0 3 0 LOT.OOVS.SI.WT SLZ	Intercultural Communi-cation BW.2.911 AP 0 2 0 0 SI, WT lecturer BW	Business Administra-tion OCM BW.2.912 AP 0 2 0 0 SI, WT lecturer BW	**Students who cannot prove an appropriate knowledge of German are required to attend "German as a Foreign Language". The course will be offered in the first two semesters. Other student are required to take non-technical courses other than "German as a Foreign Language".
Non-technical Compulsory optional module II**	German as Foreign Language II GW.2.178 AP 0 0 4 0 SI Düring	English for Specific Purposes II GW.2.176 AP 0 0 3 0 SI, WT Schuhknecht	Further Foreign Language GW.2.179 AP 0 0 3 0 LOT.OOVS.SI.WT SLZ	Intercultural Communi-cation BW.2.911 AP 0 2 0 0 SI, WT lecturer BW	Business Administra-tion OCM BW.2.912 AP 0 2 0 0 SI, WT lecturer BW	

Following **legend** explains the module table and makes the reading of it easier:

legend:	*wholes module (6 Cd.):* module name module-no. PL L S E P participating study programmes lecturer	*half module (3 Cd.):* module name module-no. PL L S E P part.stud.prog. lecturer	*course type:* L - lecture S - seminar E - exercise P - practical course *Assessment (PL):* SP written examination MP oral examination AP alternative examination	*colour code of departments:* BW ET/IT GP GW MB MT/BT SciTec SW WI external of university

Following **table of contents** makes the searching of module descriptions easier:

Department	SciTec
Degree programme	SI
Module name	**Solid State Physics**
Module number	**SciTec.2.197**
Study and Examination Regulations	ER-version 38 (of 21.03.2018)
Compulsory/ compulsory optional/ optional module	compulsory optional module
Module coordinator	Prof. Dr. Bernd Ploss
Module content	Bindings in solid materials, crystalline structure and crystallographic systems, diffraction and reciprocal lattice, Brillouin-zone, lattice vibrations, thermal properties, electron gas and band structure, semiconductors, superconductivity, dielectric properties of materials, ferroelectricity, magnetic properties.
Learning objectives	After completion of this module the students have a comprehensive understanding of the fundamental properties of condensed matter and of the essential experimental techniques. The students are able, to use the acquired relations and laws qualitatively and quantitatively to execute problems in the field of solid state physics.
Course type (lecture, seminar, exercises, practical course)	3 L – 0 S – 1 E – 0 P
Recommended literature	▪ C. Kittel: Introduction to Solid State Physics (John Wiley & Sons, 2004) ▪ H. Ibach, H. Lüth: Solid-State Physics: An Introduction to Principles of Materials Science, (Springer-Verlag, 2003). ▪ H.P. Myers: Introductory Solid State Physics (Taylor & Francis 2009)
Learning materials	Handouts, revision notes.
Method(s) of instruction/ media being used	Lecture and tutorial.
Level/ category	Master (category: 2)
Which semester (winter/ summer term)	Winter term
Which semester during the programme	1
Requirements for attendance, necessary knowledge	Mathematics and Physics at the level BSc or BEng
Assessment (written/ oral test, paper, etc.)	Written examination (90 minutes)
ECTS credits	6
Work load in:	180 h of total work load, therefrom ▪ 60 h of presence at university ▪ 120 h of self-study
Usability of this module	Materials for Sensors and Electronics
Frequency of offer	Every study year
Duration of module	1 semester
Place/ room	Ernst-Abbe-Hochschule Jena - University of Applied Sciences Jena
Time	According to schedule
Language(s)	English

Department	SciTec
Degree programme	SI
Module name	**Microsystems Engineering**
Module number	**SciTec.2.198**
Study and Examination Regulations	ER-version 38 (of 21.03.2018)
Compulsory/ compulsory optional/ optional module	compulsory optional module
Module coordinator	Prof. Dr. Michael Rüb
Module content	Definition of Microsystems Engineering, latest state of the art and future developments. Process based presentation of the Microsystems Engineering topic: Materials of Microsystem Engineering: Manufacturing and properties of silicon wafers, ideal and real materials, silicon compounds Thin Film Technology: Thermal deposition, CVD, sputtering Basics of Lithography: Process based generic presentation of important lithography techniques Surface Micromachining: Sacrificial layer technology, silicon foundries, SOI technology Clean Rooms and Yield: Properties of clean rooms, effect of defects on volume yield, root causes of defects, removal of defects Volume Micromachining: 3-dim patterning by anisotropic wet chemical etching LIGA: x-ray lithography, galvanic deposition, moulding, examples Assembly Technology: Wafer sawing, mounting techniques, reliability, bonding techniques Examples of micromechanical devices: DLP chip, Acceleration and rate sensors
Learning objectives	The students learn to know the important components of microsystems and their manufacturing techniques.
Course type (lecture, seminar, exercises, practical course)	2 L – 0 S – 1 E – 0 P
Recommended literature	▪ Büttgenbach; Mikromechanik; Teubner-Verlag 1991 ▪ Madou; Fundamentals of Microfabrication; CRC Press 1997 ▪ Menz, Mohr; Mikrosystemtechnik für Ingenieure; VCH-Verlag 1997 ▪ Völklein, Zetterer; Einführung in die Mikrosystemtechnik; Vieweg 2000
Learning materials	Lecture slides
Method(s) of instruction/ media being used	Lecture and seminar
Level/ category	Master (category: 2)
Which semester (winter/ summer term)	Winter term
Which semester during the programme	1
Requirements for attendance, necessary knowledge	Basic knowledge on physics, optics, vacuum and thin film technology
Assessment (written/ oral test, paper, etc.)	written examination (90 minutes)
ECTS credits	3
Work load in:	90 h of total work load, therefrom ▪ 45 h of presence at university ▪ 45 h of self-study
Usability of this module	Micro- and Nanotechnology
Frequency of offer	Every study year
Duration of module	1 semester
Place/ room	Ernst-Abbe-Hochschule Jena - University of Applied Sciences Jena
Time	According to schedule
Language(s)	English

Department	SciTec
Degree programme	SI
Module name	**Electronic Hardware Systems**
Module number	**ET.2.904**
Study and Examination Regulations	ER-version 38 (of 21.03.2018)
Compulsory/ compulsory optional/ optional module	compulsory optional module
Module coordinator	Prof. Dr. Martin Hoffmann, Prof. Dr. Jürgen Kampe
Module content	Part 1: Complex analogue hardware systems ▪ analogue system design ▪ simulation methods and analysis of electronic circuits Part 2: Complex digital hardware systems ▪ methodologies for the design of complex electronic systems; ▪ concepts of hardware modelling and the design flow based on hardware description languages including special concepts of behavioural modelling of heterogeneous systems; ▪ high-level synthesis and modelling according to abstraction levels and verification
Learning objectives	Part 1: Complex analogue hardware systems At the end of the module students are able to design electronic circuits with respect to practical requirement. The students will know the most common simulation methods of electronic circuits as there are Transient Analysis, DC-Analysis and Frequency Analysis and they have practical experience with simulation software. Part 2: Complex digital hardware systems At the end of the module students are able to create models of complex electronic systems with respect to the levels of abstraction of the Y-diagram of Gajski and Kuhn. The students understand the main concepts of modelling hardware based on hardware description languages. The students remember the specifics of complex electronic hardware systems as well as the general requirements, and they remember the design flow starting from a more abstract behavioural description down to the circuit topology
Course type (lecture, seminar, exercises, practical course)	3 L – 0 S – 0 E – 1 P
Recommended literature	▪ Dennis Fitzpatrick: Analog Design and Simulation Using Orcad Capture and PSPICE, Newnes, 2017 ▪ P. Marwedel: Embedded System Design. Springer Verlag, 2011 ▪ D. Gajski et al: Specifications and Design of Embedded Systems. Addison Wesley, 1994
Learning materials	Lecture notes, examples
Method(s) of instruction/ media being used	Talk, case study, lectures, interactive tutorials/ practical courses
Level/ category	Master (category: 2)
Which semester (winter/ summer term)	winter term
Which semester during the programme	1
Requirements for attendance, necessary knowledge	none
Assessment (written/ oral test, paper, etc.)	written examination (90 minutes), course achievement: successful attendance of practical course
ECTS credits	6
Work load in:	180 h of total work load, therefrom ▪ 60 h of presence at university ▪ 120 h of self-study
Usability of this module	Master thesis
Frequency of offer	Every study year
Duration of module	1 semester
Place/ room	Ernst-Abbe-Hochschule Jena - University of Applied Sciences Jena
Time	According to schedule
Language(s)	English

Department	SciTec
Degree programme	SI
Module name	**Design of Precision Devices**
Module number	**SciTec.2.199**
Study and Examination Regulations	ER-version 38 (of 21.03.2018)
Compulsory/ compulsory optional/ optional module	compulsory optional module
Module coordinator	Prof. Dr. Mirko Pfaff
Module content	▪ Requirements for designs of precision devices ▪ dimensional tolerance, fits, shape and position tolerances ▪ design methodology ▪ selected design elements ▪ creating parts, assemblies and technical drawings using 3D-CAD-software
Learning objectives	The students: ▪ can apply the design methodology to a specific task and formulate the specific requirements for a precision device. ▪ are able to select and calculate required design elements. ▪ can create concepts on basis of the elaborated requirements and finalise a detailed design using 3D-CAD-software.
Course type (lecture, seminar, exercises, practical course)	2 L – 0 S – 0 E – 2 P
Recommended literature	▪ Pahl, G.; Beitz, W.; Feldhusen, J.; Grote, K.-H.: Engineering Design, Springer ▪ Hoischen: Technisches Zeichnen, Cornelsen Verlag ▪ Krause, W.: Konstruktionselemente der Feinmechanik, Hanser
Learning materials	Script, worked examples, 3D-CAD-software, additional papers
Method(s) of instruction/ media being used	Lecture, practical course (3D-CAD-software)
Level/ category	Master (category: 2)
Which semester (winter/ summer term)	winter term
Which semester during the programme	1
Requirements for attendance, necessary knowledge	Basic knowledge of mathematics, physics, materials science, production engineering
Assessment (written/ oral test, paper, etc.)	alternative examination course achievement: successful attendance of practical course
ECTS credits	6
Work load in:	180 h of total work load, therefrom ▪ 60 h of presence at university ▪ 120 h of self-study
Usability of this module	Advanced 3D-Design
Frequency of offer	Every study year
Duration of module	1 semester
Place/ room	Ernst-Abbe-Hochschule Jena - University of Applied Sciences Jena
Time	According to schedule
Language(s)	English

Department	SciTec
Degree programme	LOT, SI
Module name	**Introduction to FEM**
Module number	**SciTec.2.172**
Study and Examination Regulations	ER-version 38 (of 21.03.2018)
Compulsory/ compulsory optional/ optional module	compulsory optional module
Module coordinator	Prof. Dr.-Ing. Frank Dienerowitz
Module content	▪ Introduction to FEM ▪ FEM procedure ▪ modelling structural mechanics problems ▪ overview on types of elements ▪ discretisation of the model (meshing) ▪ application of boundary conditions ▪ solving and post-processing
Learning objectives	The students: ▪ are able to categorise simple structural mechanical problems (statics) with regards to FE analysis. ▪ are able to implement the problems using computer based tool. ▪ are able to name and explain essential aspects of FE analysis (model simplification, stress concentration and singularities, mesh convergence, verification, limitations of FE analysis). ▪ are able to evaluate the results (deformation, stress, safety factor reaction forces).
Course type (lecture, seminar, exercises, practical course)	2 L – 0 S – 0 E – 1 P
Recommended literature	▪ Gebhardt, C., Praxisbuch FEM mit ANSYS Workbench: Einführung in die lineare und nichtlineare Mechanik, Carl Hanser Verlag, 2014 ▪ Lee, H.-H., Finite Element Simulations with ANSYS Workbench 14, SDC Publications, 2012 sowie aktuelle Fassung ▪ Mac Donald, B. J., Practical Stress Analysis with Finite Elements, GLASNEVIN Publishing, 2011
Learning materials	hand-outs supporting lecture and tutorial contents
Method(s) of instruction/ media being used	Lecture, practical course (tutorial)
Level/ category	Master (category: 2)
Which semester (winter/ summer term)	Winter term
Which semester during the programme	1
Requirements for attendance, necessary knowledge	statics, mechanics of materials
Assessment (written/ oral test, paper, etc.)	alternative examination course achievement: successful attendance of practical course
ECTS credits	3
Work load in:	90 h of total work load, therefrom ▪ 45 h of presence at university ▪ 45 h of self-study
Usability of this module	FEM and Simulation, Advanced 3D-Design
Frequency of offer	Every study year
Duration of module	1 semester
Place/ room	Ernst-Abbe-Hochschule Jena - University of Applied Sciences Jena
Time	According to schedule
Language(s)	German/ English

Department	SciTec
Degree programme	SI
Module name	**Physical Materials Diagnostics**
Module number	**SciTec.2.195**
Study and Examination Regulations	ER-version 38 (of 21.03.2018)
Compulsory/ compulsory optional/ optional module	Compulsory module
Module coordinator	Prof. Dr. Steffen Teichert, Dr. Lutz Wilde
Module content	Overview on typical methods of physical materials analysis with special emphasis on tool setups; Selection of methods: SEM, XRD, SPM, MS, ES, synchrotron experiments
Learning objectives	The students acquire knowledge on the most important methods of physical materials analysis. They understand the physical background of the methods as well as the technical basics of the corresponding tools. The students get an overview on the fields of application of the physical material analysis methods. Furthermore, they also gain knowledge on the technical and physical limitations of the methods.
Course type (lecture, seminar, exercises, practical course)	3 L – 0 S – 0 E – 1 P
Recommended literature	▪ Surface Analysis: The Principle Techniques J. C. Vickerman, Wiley –VCH ▪ Microstructural Characterization of Materials, D. Brandon, W.D. Kaplan, Wiley-VCH ▪ Introduction to Diffraction in Materials Science and Engineering, A.D. Krawitz, John Wiley & Sons
Learning materials	lecture notes
Method(s) of instruction/ media being used	lecture and practical course
Level/ category	Master (category: 2)
Which semester (winter/ summer term)	winter term
Which semester during the programme	1
Requirements for attendance, necessary knowledge	experimental physics, basics of materials science
Assessment (written/ oral test, paper, etc.)	Written examination (90 minutes), course achievement: certificate for practical course
ECTS credits	6
Work load in:	180 h of total work load, therefrom ▪ 60 h of presence at university ▪ 120 h of self-study
Usability of this module	The module is closely connected to solid state physics, materials science and measurement engineering.
Frequency of offer	Every study year
Duration of module	1 semester
Place/ room	Ernst-Abbe-Hochschule Jena - University of Applied Sciences Jena
Time	According to schedule
Language(s)	English

Department	SciTec
Degree programme	SI
Module name	**Scientific Writing and Presentation**
Module number	**SciTec.2.196**
Study and Examination Regulations	ER-version 38 (of 21.03.2018)
Compulsory/ compulsory optional/ optional module	compulsory module
Module coordinator	N.N.
Module content	▪ Scientific Writing ▪ Presentation of a scientific work ▪ Research scientific topics ▪ Software for scientific purposes (proprietary, free) ▪ Good scientific practice
Learning objectives	After completion of this module the students are able to understand the necessity of a scientific approach to working, writing and presenting. The students can deduce and apply the techniques of scientific writing and communication.
Course type (lecture, seminar, exercises, practical course)	1 L – 2 S – 0 E – 0 P
Recommended literature	▪ R.E. Berger: A Scientific Approach to Writing for Engineers and Scientists, Wiley, 2014 ▪ M. Alley: The Craft of Scientific Writing, Springer, 1996 ▪ M. Alley: The Craft of Scientific Presentations, Springer, 2013
Learning materials	Presentation, lecture notes, teaching aids
Method(s) of instruction/ media being used	Interactive lecture, seminar
Level/ category	Master (category: 2)
Which semester (winter/ summer term)	winter term
Which semester during the programme	1
Requirements for attendance, necessary knowledge	(Basic) Knowledge in scientific working.
Assessment (written/ oral test, paper, etc.)	course achievement: successful attendance with paper and presentation
ECTS credits	6
Work load in:	180 h of total work load, therefrom ▪ 45 h of presence at university ▪ 135 h of self-study
Usability of this module	The module is of relevance for all other subjects requiring knowledge in scientific writing and communication. It can be used in undergraduate as well as in master courses. For courses with a teaching language other than English a translation might be necessary.
Frequency of offer	Every study year
Duration of module	1 semester
Place/ room	Ernst-Abbe-Hochschule Jena - University of Applied Sciences Jena
Time	According to schedule
Language(s)	English

Department	SciTec
Degree programme	SI
Module name	**German as Foreign Language I**
Module number	**GW.2.177**
Study and Examination Regulations	ER-version 38 (of 21.03.2018)
Compulsory/ compulsory optional/ optional module	compulsory optional module
Module coordinator	Michael Düring
Module content	Main topics: ▪ Information/ talk about people ▪ Describe daily routines, studies, leisure time activities ▪ Manage daily routines (post office, bank, phone calls, visit the doctor) Statements and discussions on distinctive cultural features of different countries including Germany
Learning objectives	Students learn to understand and use the German language in everyday situations. They obtain the ability to pronounce the German words in the right way, in order to make themselves understood in everyday life. They can use basic grammar structures. They are able to write short texts in German.
Course type (lecture, seminar, exercises, practical course)	0 L – 0 S – 4 E – 0 P
Recommended literature	▪ Hueber - Verlag : Dreyer/Schmidt „Lehr – und Übungsbuch der deutschen Grammatik“ , ISBN 3-19-007255-8 ▪ Fabouda - Verlag: Lodevik „DHS & Studienvorbereitung (Deutsch als Fremdsprache für Studentinnen und Studenten)“ ISBN 3-930861-40-2 ▪ Klett - Verlag: „Pons - Großwörterbuch - Deutsch als Fremdsprache„ ISBN 3-12-517043-5
Learning materials	Schubert-Verlag: Begegnungen A1 - Deutsch als Fremdsprache ISBN 978-3-929526-86-8
Method(s) of instruction/ media being used	Teacher-centred teaching and group work, work with audio-visual media, work (partially self-studies) in the media-pool (language department)
Level/ category	Master (category: 2)
Which semester (winter/ summer term)	Winter term
Which semester during the programme	1
Requirements for attendance, necessary knowledge	none
Assessment (written/ oral test, paper, etc.)	alternative examination
ECTS credits	3
Work load in:	90 h of total work load, therefrom ▪ 60 h of presence at university ▪ 30 h of self-study
Usability of this module	Everyday life during the stay for studying Scientific Instrumentation.
Frequency of offer	Every study year
Duration of module	1 semester
Place/ room	Ernst-Abbe-Hochschule Jena - University of Applied Sciences Jena
Time	According to schedule
Language(s)	German

Department	SciTec
Degree programme	SI, WT
Module name	**English for Specific Purposes I**
Module number	**GW.2.175**
Study and Examination Regulations	ER-version 38 (of 21.03.2018)
Compulsory/ compulsory optional/ optional module	compulsory optional module
Module coordinator	Ulrich Schuhknecht
Module content	▪ Aspects of Materials Technology, Nanotechnology and Optometry/ Ophthalmotechnology ▪ Scientific texts and articles taken from journals, books and the internet ▪ Complex listening texts on academic and scientific topics
Learning objectives	The students extend their ESP knowledge (vocabulary in particular) and skills (in particular reading and speaking) and use them in study and work-related situations. They acquire strategies to deal effectively with listening tasks taking the form of longer talks and lectures and develop their note-taking skills. The course is set at level C1 of the Common European Framework.
Course type (lecture, seminar, exercises, practical course)	0 L – 0 S – 3 E – 0 P
Recommended literature	▪ Ibbotson, M.: Cambridge English for Engineering. CUP, 2008 ▪ Campbell, C. et al: English for Academic Study: Listening. Garnet Education, 2009 ▪ Ashby, M.: Materials Selection in Mechanical Design. Elsevier, 2007
Learning materials	Reader
Method(s) of instruction/ media being used	Interactive, audio and video recordings, e-learning platform
Level/ category	Master (category: 2)
Which semester (winter/ summer term)	Winter term
Which semester during the programme	1 SI, WT 3 OOVS
Requirements for attendance, necessary knowledge	Successful completion of the module “Technical English” or equivalent (Level B2 of the Common European Framework)
Assessment (written/ oral test, paper, etc.)	Alternative examination
ECTS credits	3
Work load in:	90 h of total work load, therefrom ▪ 45 h of presence at university ▪ 45 h of self-study
Usability of this module	All study programmes containing a C1 level ESP module
Frequency of offer	Every study year
Duration of module	1 semester
Place/ room	Ernst-Abbe-Hochschule Jena - University of Applied Sciences Jena
Time	According to schedule
Language(s)	English

Department	SciTec
Degree programme	LOT, OOVS, SI, WT
Module name	**Further Foreign Language**
Module number	**GW.2.179**
Study and Examination Regulations	ER-version 38 (of 21.03.2018)
Compulsory/ compulsory optional/ optional module	compulsory optional module
Module coordinator	Appropriate language teacher
Module content	▪ every day language ▪ leisure ▪ studying ▪ general professional situations
Learning objectives	Students become familiar with the French, Portuguese, Russian or Spanish language and acquire basic vocabulary and grammar.
Course type (lecture, seminar, exercises, practical course)	0 L – 0 S – 3 E – 0 P
Recommended literature	▪ Libre Echange 1, Courtillon et al, Hatier/Didier, 1991 ; ▪ Studio 60 Niveau 1, Lavenne et al, Didier, 2001 ; ▪ Studio 100 Niveau 1 ▪ Taxi 1, Capelle et al, Hachette/Langenscheidt, 2004 ▪ „Projekty“ Hueber-Verlag ▪ „Kljutschi“ Hueber-Verlag ▪ „Mosty“ Klett-Verlag ▪ „Mirada“ Hueber-Verlag ▪ „Gramática Ativa“, Lidel, 2016
Learning materials	French: Le Nouvel Espaces 1 Portuguese: Power-Sprachkurs, Pons, 2015 Russian: Workbook, scripts, handouts, dictioonary Spanish: Work book, handouts, dictionary
Method(s) of instruction/ media being used	Multimedia, Video, Audio
Level/ category	Master (category: 2)
Which semester (winter/ summer term)	Winter or summer term
Which semester during the programme	1, 2 SI, WT 1 LOT 3 OOVS
Requirements for attendance, necessary knowledge	None or basic knowledge
Assessment (written/ oral test, paper, etc.)	Alternative examination
ECTS credits	3
Work load in:	90 h of total work load, therefrom ▪ 45 h of presence at university ▪ 45 h of self-study
Usability of this module	-
Frequency of offer	Every study year
Duration of module	1 semester
Place/ room	Ernst-Abbe-Hochschule Jena - University of Applied Sciences Jena
Time	According to schedule
Language(s)	French, Portuguese, Russian or Spanish

Department	SciTec
Degree programme	SI, WT
Module name	**Intercultural Communication**
Module number	**BW.2.911**
Study and Examination Regulations	ER-version 38 (of 21.03.2018)
Compulsory/ compulsory optional/ optional module	compulsory optional module
Module coordinator	Prof. Dr. Heiko Haase
Module content	The course "Intercultural Communication" is arranged decided interdisciplinary. The course covers besides cultural and communication-theoretical plus socio-scientific questions of intercultural action as well as aspects of international management and marketing. structure: 1. definition and models of communication 2. definition and models of culture 3. stereotype 4. culture-specific form of thought 5. verbal communication 6. non-verbal communication 7. culture-comparative studies 8. process of cultural assimilation
Learning objectives	The students understand essential culture-specific aspects of thinking, action and communication. The students are able to apply this knowledge in an intercultural context. They can analyse and evaluate culture-specific attitudes with a view to business communication and etiquette. As a result participants have the necessary intercultural skills to successfully build up business relationships in different economic regions of the world.
Course type (lecture, seminar, exercises, practical course)	0 L – 2 S – 0 E – 0 P
Recommended literature	▪ Schugk, Michael: Interkulturelle Kommunikation - Kulturbedingte Unterschiede in Verkauf und Werbung, Verlag Vahlen 2004. ▪ Bolten, Jürgen: Einführung in die Interkulturelle Wirtschaftskommunikation, UTB Verlag 2007. ▪ Heringer, Hans Jürgen: Interkulturelle Kommunikation: Grundlagen und Konzepte, UTB Verlag, 3. Auflage, 2010. ▪ Acuff, F.L.: How to negotiate anything with anyone anywhere around the world, AMACOM, 3rd ed., 2008. ▪ Morrison, T.; Conaway, W.A..: Kiss, bow, or shake hands: The bestselling guide to doing business in more than 60 countries, Adams Media, 2nd ed., 2006.
Learning materials	A script with exercises and control questions as e-learning-material is the basis for this course. Additional literature is recommended to the students.
Method(s) of instruction/ media being used	self-study with the help of the script and presence seminars
Level/ category	Master (category: 2)
Which semester (winter/ summer term)	winter term/ summer term
Which semester during the programme	1/ 2
Requirements for attendance, necessary knowledge	none
Assessment (written/ oral test, paper, etc.)	alternative examination
ECTS credits	3
Work load in:	90 h of total work load, therefrom ▪ 30 h of presence at university ▪ 60 h of self-study
Usability of this module	-
Frequency of offer	Every study year
Duration of module	1 semester
Place/ room	Ernst-Abbe-Hochschule Jena - University of Applied Sciences Jena
Time	According to schedule
Language(s)	English

Department	SciTec
Degree programme	SI, WT
Module name	**Business Administration Compulsory Optional Module**
Module number	**BW.2.912**
Study and Examination Regulations	ER-version 38 (of 21.03.2018)
Compulsory/ compulsory optional/ optional module	compulsory optional module
Module coordinator	Professor of the Department of Business Administration or lecturers. The choice of the lecturer is in accordance with available capacities in the Department of Business Administration.
Module content	The teaching offer covers all business contents: investment and finance, marketing, accounting and controlling, taxes and auditing, personnel management and organisation, business informatics and economic law. This range is supplemented by special events such as founder seminars, corporate strategic planning simulations, international business, European integration, logistics, and innovation management.
Learning objectives	The students should be given the opportunity to broaden their business knowledge according to their personal interests. Every student has specific ideas of his later professional activity. It is therefore not appropriate to prescribe a concrete business module for students in the context of a specialisation. While one student sees its future in the founding of a company, the other intends to operate international as an employee in a large company. The training needs of students varies accordingly. The introduction of this "Business Administration Compulsory Optional Module" allows the students to choose a business module that best meets its needs.
Course type (lecture, seminar, exercises, practical course)	0 L – 2 S – 0 E – 0 P
Recommended literature	▪ Topic oriented.
Learning materials	Lecture script, exercise papers
Method(s) of instruction/ media being used	Lecture with in-depth case studies and exercises
Level/ category	Master (category: 2)
Which semester (winter/ summer term)	winter term/ summer term
Which semester during the programme	1/ 2
Requirements for attendance, necessary knowledge	Commercial basic knowledge that can be acquired through professional practice or the module "Business Administration". In particular, special knowledge may be required (e.g. for the module "International Tax Law").
Assessment (written/ oral test, paper, etc.)	alternative examination
ECTS credits	3
Work load in:	90 h of total work load, therefrom ▪ 30 h of presence at university ▪ 60 h of self-study
Usability of this module	-
Frequency of offer	Every study year
Duration of module	1 semester
Place/ room	Ernst-Abbe-Hochschule Jena - University of Applied Sciences Jena
Time	According to schedule
Language(s)	German/ English

Department	SciTec
Degree programme	SI, WT
Module name	**Materials for Sensors and Electronics**
Module number	**SciTec.2.223**
Study and Examination Regulations	ER-version 38 (of 21.03.2018)
Compulsory/ compulsory optional/ optional module	optional compulsory module
Module coordinator	Prof. Dr. Bernd Ploss, Prof. Dr. Jörg Töpfer
Module content	▪ Dielectrics, pyro-, piezo- und ferroelectrics and applications, inhomogeneous materials and composites, smart materials, ▪ charge transport in solid state materials and applications, ▪ magnetic properties of dia-, para- and ferromagnetic materials, ▪ permanent magnets, soft magnets, magnetic recording media, XMR technologies.
Learning objectives	Fundamental understanding of concepts, physics and applications of new electronic, dielectric and magnetic materials. Insight into the current research in the area of new materials for electronics and sensors.
Course type (lecture, seminar, exercises, practical course)	4 L – 0 S – 0 E – 1 P
Recommended literature	▪ M.E. Lines, A.M. Glass, Principles and Applications of Ferroelectrics (Oxford University Press, 2001) ▪ N. Spaldin, Magnetic Materials (Cambridge University Press, 2003) ▪ R. O'Handley, Modern Magnetic Materials (J. Wiley, 2000) ▪ actual publications (are provided).
Learning materials	Hand-outs, publications, lab instructions.
Method(s) of instruction/ media being used	Lecture and laboratory.
Level/ category	Master (category: 2)
Which semester (winter/ summer term)	Summer term
Which semester during the programme	2
Requirements for attendance, necessary knowledge	Solid State Physics
Assessment (written/ oral test, paper, etc.)	written examination (90 minutes), course achievement: successful attendance of practical course
ECTS credits	6
Work load in:	180 h of total work load, therefrom ▪ 75 h of presence at university ▪ 105 h of self-study
Usability of this module	Research Internship and Master Thesis in the field of the module.
Frequency of offer	Every study year
Duration of module	1 semester
Place/ room	Ernst-Abbe-Hochschule Jena - University of Applied Sciences Jena
Time	According to schedule
Language(s)	English

Department	SciTec
Degree programme	SI, WT
Module name	**Micro- and Nanotechnology**
Module number	**SciTec.2.203**
Study and Examination Regulations	ER-version 38 (of 21.03.2018)
Compulsory/ compulsory optional/ optional module	compulsory optional module
Module coordinator	Prof. Dr. Igor Konovalov
Module content	**Lecture:** Micro- Nanotechnology: Moore´s Law, ITRS Roadmap, Top down and bottom up approach Optical Lithography: Lithography techniques, maximum pattern resolution, resist chemistry- and kinetics, resolution enhancement techniques (Immersion lithography, OPC, Phase Shift Masks, etc.) Electron Beam Lithography: Imaging process with electrons; proximity effects, limitations Next Generation Lithography: Comparison of techniques discussed in latest ITRS Roadmap, e.g. nanoimprint, EUV lithography. Device Physics, Technology and Scaling: Basic device physics, like p-n junction, MOS capacitor; scaling of MOS transistors; Link to ITRS roadmap, post-CMOS devices. Nanotechnology: Fundamental principles of nanotechnology, self-organisation, nanowires, nanotubes, outlook to nano devices **Laboratory course:** ▪ Process sequence pattern transfer (e.g. image reversal resist and lift-off) in clean room (I+II) ▪ Simulation (Device, Technology or Lithography (I+II) ▪ (Electron Beam Lithography)
Learning objectives	The student should be able to apply the latest pattern generation and transfer techniques in research and industrial production. He should be able to interpret and apply the current developments and trends in research in the field, including the emerging “bottom-up” nanotechnology.
Course type (lecture, seminar, exercises, practical course)	4 L – 0 S – 0 E – 1 P
Recommended literature	▪ Bushan; Handbook of Nanotechnology, Springer 2007 ▪ Madou; Fundamentals of Microfabrication; CRC Press 1997 ▪ Mack; Fundamental Principles of Optical Lithography, Wiley 2007 ▪ S.M. Sze; Semiconductor Devices – Physics and Technology, Wiley Interscience 1985 ▪ Zeng Cui; Micro- Nanofabrication, Technologies and Applications, Springer
Learning materials	Lectures slides, laboratory instructions
Method(s) of instruction/ media being used	Lecture and small group laboratory experiments
Level/ category	Master (category: 2)
Which semester (winter/ summer term)	summer term
Which semester during the programme	2
Requirements for attendance, necessary knowledge	Basic knowledge on microsystems engineering, physics, optics and vacuum technology
Assessment (written/ oral test, paper, etc.)	written examination (90 minutes) Successful participation in laboratory course
ECTS credits	6
Work load in:	180 h of total work load, therefrom ▪ 75 h of presence at university ▪ 105 h of self-study
Usability of this module	-
Frequency of offer	Annually
Duration of module	1 semester
Place/ room	Ernst-Abbe-Hochschule Jena - University of Applied Sciences Jena
Time	According to schedule
Language(s)	English

Department	SciTec
Degree programme	SI
Module name	**Optical Instruments**
Module number	**SciTec.2.200**
Study and Examination Regulations	ER-version 38 (of 21.03.2018)
Compulsory/ compulsory optional/ optional module	compulsory optional module
Module coordinator	Prof. Dr. Robert Brunner
Module content	Fundamentals in ray-optics as a basis for the understanding of the working principle of optical instruments: ▪ Fresnel-Principle (principle of least time) ▪ imaging-equation, optical properties of a lens-makers formula ▪ aperture and field stop, pupils and windows ▪ aberrations (chromatic, spherical, coma, astigmatism, distortion, field curvature) correction of aberrations Wave optics: ▪ Huygens-Principle, grating equation, Abbe-theory ▪ Maxwell-Equations, Fourier-Optics, Fraunhofer-Diffraction, Rayleigh-Criterion, DOF Introduction into the structure and working principles of optical instruments: ▪ Eye and visual perception, microscopy (bright-field – dark-field, phase-contrast, Fluorescence-Microscope) ▪ optical Lithography (deep-UV – EUV, illumination systems phase masks) ▪ spectral sensors (Czerny-Turner, imaging spectrometer) special modern optical elements: ▪ diffractive optical elements ▪ switchable elements
Learning objectives	After completing the module the students are able to: ▪ explain the basic principle of ray optics and apply the competency to simple optical systems. ▪ transfer basic optical concepts to application oriented problems. ▪ to describe the basic wave optical aspects, in particular to explain the wave-optical influence on optical resolution. ▪ to compare different optical instruments such as microscopes, projection units, telescopes and spectroscopic systems.
Course type (lecture, seminar, exercises, practical course)	3 L – 0 S – 0 E – 1 P
Recommended literature	▪ Pedrotti: Introduction to Optics. Addison-Wesley; 3rd edition, 2006 ▪ Hecht: Optics. Addison-Wesley; 4th edition, 2001 ▪ Born, Wolf: Principles of Optics; Cambridge University Press; 7th edition, 1999 ▪ Goodman: Introduction to Fourier Optics; McGraw-Hill, 1996
Learning materials	self-provided manuscript/ CD with lecture transparencies
Method(s) of instruction/ media being used	lecture and practical course
Level/ category	Master (category: 2)
Which semester (winter/ summer term)	summer term
Which semester during the programme	2
Requirements for attendance, necessary knowledge	Basic courses in Physics and Mathematics
Assessment (written/ oral test, paper, etc.)	Written examination (90 minutes), course achievement: practical course
ECTS credits	6
Work load in:	180 h of total work load, therefrom ▪ 60 h of presence at university ▪ 120 h of self-study
Usability of this module	Micro- and Nanostructures, Precision Instrumentation, Research Internship, Master Thesis
Frequency of offer	Every study year
Duration of module	1 semester
Place/ room	Ernst-Abbe-Hochschule Jena - University of Applied Sciences Jena

Time	According to schedule
Language(s)	English

Department	SciTec
Degree programme	SI, WT
Module name	**Gas Sensing and Aerosol Measurement**
Module number	**WI.2.904**
Study and Examination Regulations	ER-version 38 (of 21.03.2018)
Compulsory/ compulsory optional/ optional module	compulsory optional module
Module coordinator	Prof. Dr. Andreas Schleicher
Module content	1. Introduction: Conditions, requirements and strategies of gas and particulate measurement in Ambient Air and Emission Monitoring, Occupational Health and Safety Monitoring and Process Measurement 2. Principles and Instrumentation for Gas Sensing ▪ Spectroscopic Methods o Fundamentals of IR and UV/ Vis-Spectroscopy o Absorption Photometry o Fluorescence and Chemoluminescence o Electrochemical Methods o Semiconductor Gas Sensor o Thermal Gas Sensors o Paramagnetic Gas Sensor o Flame Ionisation Detector 3. Principles and Instrumentation for Aerosol Measurement ▪ Fundamental Properties of Aerosols ▪ Measurement of Mass Concentrations ▪ Particle Counting ▪ Particle Size Measurement ▪ Chemical Characterisation of Aerosol Particles ▪ Sampling of Aerosols 4. Temperature, Pressure and Flow measurement 5. Applications ▪ Ambient Air Measurement ▪ Continuous Emission Monitoring ▪ Remote Sensing of Atmospheric Pollutants ▪ Vehicle Emission Measurement
Learning objectives	The student knows and understands the most common methods, the instrumentation and the underlying principles of gas and aerosol measurement used in ambient air, occupational health, safety and emission monitoring and process metrology. He is able to assess the strengths and weaknesses of different methods, to select the best suited instrumentation and to identify options for improvement.
Course type (lecture, seminar, exercises, practical course)	3 L – 0 S – 0 E – 1 P
Recommended literature	▪ Siegrist, M.W.: Air Monitoring by Spectroscopic Techniques; Wiley 1993 ▪ Willeke, K; Baron, A. (Hrsg): Aerosol Measurement; Principles, Techniques and Applications; Van Nostrand Reinhold, 1992 ▪ Friedlander: Smoke, Dust, and Haze; Fundamentals of Aero-sol Dynamics, Oxford Univ. Press, 2000 ▪ Staab, J.: Industrielle Gasanalyse Oldenbourg Verlag 1994 ▪ Douglas O.J. de Sá: Instrumentation Fundamentals for Process Control, Taylor and Francis London 2001 ▪ VDI, DIN-und ISO Normen der unterschiedlichen Messverfahren
Learning materials	Power point presentation and literature references as download
Method(s) of instruction/ media being used	Interactive lecture and practical course at laboratory
Level/ category	Master (category: 2)
Which semester (winter/ summer term)	summer term
Which semester during the programme	2
Requirements for attendance, necessary knowledge	Basics of Physics and Optics
Assessment (written/ oral test, paper, etc.)	written examination (90 minutes), course achievement: successful attendance of practical course
ECTS credits	6

Work load in:	180 h of total work load, therefrom ▪ 60 h of presence at university ▪ 120 h of self-study
Usability of this module	-
Frequency of offer	Every study year
Duration of module	1 semester
Place/ room	Ernst-Abbe-Hochschule Jena - University of Applied Sciences Jena
Time	According to schedule
Language(s)	English

Department	SciTec
Degree programme	SI
Module name	**FEM and Simulation**
Module number	**SciTec.2.171**
Study and Examination Regulations	ER-version 38 (of 21.03.2018)
Compulsory/ compulsory optional/ optional module	compulsory optional module
Module coordinator	Prof. Dr. Frank Dienerowitz
Module content	FEM-analysis for the following structural mechanics problems: ▪ buckling (linear and non-linear) ▪ contact mechanics ▪ modal analysis ▪ harmonic analysis introduction to optimisation: ▪ parameterisation of problems ▪ sensitivity analysis (design of experiments, evaluation of results, deriving meta model) ▪ optimisation (design space, objective function, optimisation methods, robust optimisation)
Learning objectives	The students: ▪ are able to categorise problems of "buckling", "contact mechanics", "modal analysis" and "harmonic analysis" ▪ to implement and analyse them using computer-based tools ▪ are able to cross check results of simple problems by means hand calculation ▪ are knowledgeable about key limitations and challenges for these problems ▪ are able to implement and conclude optimisation problems (mathematical model is given, up to around 10 parameters) using computer-based tool, performing sensitivity analysis and optimisation
Course type (lecture, seminar, exercises, practical course)	2 L – 0 S – 0 E – 2 P
Recommended literature	▪ Gebhardt, C., Praxisbuch FEM mit ANSYS Workbench: Einführung in die lineare und nichtlineare Mechanik, Carl Hanser Verlag, 2014 ▪ Lee, H.-H., Finite Element Simulations with ANSYS Workbench 14, SDC Publications, 2012 ▪ Mac Donald, B. J., Practical Stress Analysis with Finite Elements, GLASNEVIN Publishing, 2011
Learning materials	hand-outs supporting lecture and tutorial contents
Method(s) of instruction/ media being used	Lecture and practical course (tutorials)
Level/ category	Master (category: 2)
Which semester (winter/ summer term)	summer term
Which semester during the programme	2
Requirements for attendance, necessary knowledge	Introduction into Finite-Elements-Method
Assessment (written/ oral test, paper, etc.)	alternative examination course achievement: successful attendance of practical course
ECTS credits	6
Work load in:	180 h of total work load, therefrom ▪ 60 h of presence at university ▪ 120 h of self-study
Usability of this module	Advanced 3D-Design
Frequency of offer	Every study year
Duration of module	1 semester
Place/ room	Ernst-Abbe-Hochschule Jena - University of Applied Sciences Jena
Time	According to schedule
Language(s)	English

Department	SciTec
Degree programme	SI
Module name	**Advanced 3D-Design**
Module number	**SciTec.2.201**
Study and Examination Regulations	ER-version 38 (of 21.03.2018)
Compulsory/ compulsory optional/ optional module	compulsory optional module
Module coordinator	Prof. Dr. Ronny Gerbach
Module content	▪ Repetition of basics of mechanical design and presentation of advanced and extended approaches for 3d design and modelling ▪ Design and construction of complex of precision instruments as well as optical and opto-mechanical systems ▪ Investigation of additional aspects in the product design (e.g. manufacturing and cost specific design, quality management during product design)
Learning objectives	With completion of the module, the students are able to name important relations during design and construction of precision and opto-mechanical systems and to explain their need for the product development. In addition, the students can design and model components and assemblies by means of 3D-CAD systems and can generate technical drawings and bill of materials.
Course type (lecture, seminar, exercises, practical course)	2 L – 0 S – 0 E – 2 P
Recommended literature	▪ Pahl et. al.: Engineering Design, Springer Verlag 2007 ▪ Boothroyd et. al.: Product Design for Manufacture and Assembly, CRC Press, 2010 ▪ Pahl et. al.: Konstruktionslehre, Springer Verlag, 2007 ▪ Krause: Gerätekonstruktion in Feinwerktechnik und Elektronik, Fachbuchverlag Leipzig, 2000
Learning materials	Lecture notes, exercises, literature recommendations
Method(s) of instruction/ media being used	Lecture, practical course with computer
Level/ category	Master (category: 2)
Which semester (winter/ summer term)	summer term
Which semester during the programme	2
Requirements for attendance, necessary knowledge	Technical mechanics and dynamics, basic principle of mechanical design an design engineering, knowledge of machine elements for mechanical and/or precision engineering
Assessment (written/ oral test, paper, etc.)	alternative examination course achievement: successful attendance of practical course
ECTS credits	6
Work load in:	180 h of total work load, therefrom ▪ 60 h of presence at university ▪ 120 h of self-study
Usability of this module	modules regarding system engineering
Frequency of offer	Every study year
Duration of module	1 semester
Place/ room	Ernst-Abbe-Hochschule Jena - University of Applied Sciences Jena
Time	According to schedule
Language(s)	English

Department	SciTec
Degree programme	SI, WT
Module name	**Precision Instrumentation**
Module number	**SciTec.2.204**
Study and Examination Regulations	ER-version 38 (of 21.03.2018)
Compulsory/ compulsory optional/ optional module	compulsory optional module
Module coordinator	Prof. Dr. Martin Schröck
Module content	Introduction, classification with respect to other technological fields, function and structure of instruments, design development process, design principles, i.e.: functional separation, functional integration; accuracy enhancement by error minimisation, innocence principle, invariance principle, error compensation, adjustment; DOF in joints, degree of mobility, over determinacy and its effects; special bearings and guideways for precision instruments, drive units for precision devices, positioning systems, reliability of precision instruments
Learning objectives	After completion of the module the students are able to implement fundamental principles for the design of precision instruments as well as the rules to facilitate the accuracy of precision devices. They are enabled to perform the practical application of these rules. Furthermore they compare up-to-date elements and modules of precision instruments. Finally we evaluate possibilities to improve the reliability of precision devices.
Course type (lecture, seminar, exercises, practical course)	4 L – 0 S – 0 E – 0 P
Recommended literature	▪ Blackburn, J. A.: Modern instrumentation for scientists and engineers, New York, Springer, 2001 ▪ Krause, W.: Konstruktionselemente der Feinmechanik, Hanser, 2004 ▪ Krause, W.: Gerätekonstruktion, Verlag Technik Berlin, 1986 ▪ Ringhardt, H.: Feinwerkelemente, Hanser, 1992
Learning materials	Lecture script, additional worksheets
Method(s) of instruction/ media being used	Lecture and applied project work
Level/ category	Master (category: 2)
Which semester (winter/ summer term)	Summer term
Which semester during the programme	2
Requirements for attendance, necessary knowledge	Basic knowledge in design, engineering mechanics and mechanical components
Assessment (written/ oral test, paper, etc.)	written examination (90 minutes)
ECTS credits	6
Work load in:	180 h of total work load, therefrom ▪ 60 h of presence at university ▪ 120 h of self-study
Usability of this module	All design-oriented modules.
Frequency of offer	Every study year
Duration of module	1 semester
Place/ room	Ernst-Abbe-Hochschule Jena - University of Applied Sciences Jena
Time	According to schedule
Language(s)	English

Department	SciTec
Degree programme	SI, WT
Module name	**Scientific Computing**
Module number	**GW.2.403**
Study and Examination Regulations	ER-version 38 (of 21.03.2018)
Compulsory/ compulsory optional/ optional module	compulsory optional module
Module coordinator	Prof. Dr. Henning Kempka
Module content	Fundamentals: ▪ Matrix Analysis ▪ Condition and well posedness of problems ▪ Stability of numerical algorithms Solving linear systems: ▪ Gauss elimination method ▪ various factorizations ▪ iterative methods Nonlinear equations: ▪ Newton's method ▪ Fixed Point methods Interpolation and Approximation: ▪ Polynomial interpolation ▪ Least squares approximation Differential equations: ▪ Basics on ODE ▪ Numerical solutions of ODE ▪ Boundary value problems
Learning objectives	The students know the fundamental theories and algorithms of scientific computing. They are able to analyse, identify, formulate, and solve numerical problems and define the computing requirements appropriate to their solutions. They also get to know and are able to use current techniques, skills, and tools necessary for computing numerical problems.
Course type (lecture, seminar, exercises, practical course)	4 L – 0 S – 0 E – 2 P
Recommended literature	▪ A. Quarteroni, R. Sacco, F. Saleri: Numerical Mathematics, Texts in applied mathematics 37, Springer. ▪ A. Quarteroni, F. Saleri, P. Gervasio: Scientific Computing with MATLAB and Octave, Texts in Computational Science and Engineering 2, Springer. ▪ H. P. Langtangen: A Primer on Scientific Programming with Python, Texts in Computational Science and Engineering 6, Springer.
Learning materials	Working sheets and self-created manuscript.
Method(s) of instruction/ media being used	Data projector, blackboard and computers in lab.
Level/ category	Master (category: 2)
Which semester (winter/ summer term)	summer term
Which semester during the programme	2
Requirements for attendance, necessary knowledge	Successfully completed basic calculus courses thought during Bachelors studies.
Assessment (written/ oral test, paper, etc.)	written examination (90 minutes), course achievement: successful attendance of practical course
ECTS credits	6
Work load in:	180 h of total work load, therefrom ▪ 90 h of presence at university ▪ 90 h of self-study
Usability of this module	-
Frequency of offer	Every study year
Duration of module	1 semester
Place/ room	Ernst-Abbe-Hochschule Jena - University of Applied Sciences Jena
Time	According to schedule
Language(s)	English

Department	SciTec
Degree programme	SI, WT
Module name	**Soft Skills**
Module number	**SciTec.2.502**
Study and Examination Regulations	ER-version 38 (of 21.03.2018)
Compulsory/ compulsory optional/ optional module	Compulsory module
Module coordinator	coordination by a professor of SciTec Department, lecturer with relevant professional experience
Module content	Often block course with seminars or workshops with following topics: ▪ project management ▪ rhetoric ▪ presentation techniques ▪ How to hold a conversation. ▪ How to effect negotiations. ▪ corporate strategic planning simulations
Learning objectives	After completion of this module the students obtain knowledge of relevant professional key skills in the field of: ▪ social competences especially ability to communicate ▪ interdisciplinary method competence.
Course type (lecture, seminar, exercises, practical course)	0 L – 2 S – 0 E – 0 P
Recommended literature	Belongs to the topic
Learning materials	Belongs to the topic
Method(s) of instruction/ media being used	Different instruction methods
Level/ category	Master (category: 2)
Which semester (winter/ summer term)	summer term
Which semester during the programme	2 SI 4 WT
Requirements for attendance, necessary knowledge	none
Assessment (written/ oral test, paper, etc.)	course achievement: paper or presentation (it belongs to the topic)
ECTS credits	3
Work load in:	90 h of total work load, therefrom ▪ 30 h of presence at university ▪ 60 h of self-study
Usability of this module	The students can use the acquired abilities and knowledge for the master thesis and for their professional career.
Frequency of offer	Every study year
Duration of module	1 semester
Place/ room	Ernst-Abbe-Hochschule Jena - University of Applied Sciences Jena
Time	According to schedule
Language(s)	German/ English

Department	SciTec
Degree programme	SI
Module name	**German as Foreign Language II**
Module number	**GW.2.178**
Study and Examination Regulations	ER-version 38 (of 21.03.2018)
Compulsory/ compulsory optional/ optional module	compulsory optional module
Module coordinator	Michael Düring
Module content	Main topics: ▪ Information/ talk about people ▪ Describe daily routines, studies, leisure time activities ▪ Manage daily routines (post office, bank, phone calls, visit the doctor) Statements and discussions on distinctive cultural features of different countries including Germany
Learning objectives	Students learn to understand and use the German language in everyday situations. They obtain the ability to pronounce the German words in the right way, in order to make themselves understood in everyday life. They can use basic grammar structures. They are able to write short texts in German.
Course type (lecture, seminar, exercises, practical course)	0 L – 0 S – 4 E – 0 P
Recommended literature	▪ Hueber - Verlag : Dreyer/Schmidt „Lehr – und Übungsbuch der deutschen Grammatik“ , ISBN 3-19-007255-8 ▪ Fabouda - Verlag: Lodevik „DHS & Studienvorbereitung (Deutsch als Fremdsprache für Studentinnen und Studenten)“ ISBN 3-930861-40-2 ▪ Klett - Verlag: „Pons - Großwörterbuch - Deutsch als Fremdsprache„ ISBN 3-12-517043-5
Learning materials	Schubert - Verlag: „Begegnungen A2 – Deutsch als Fremdsprache“ ISBN – Lehr-und Arbeitsbuch: 978-3-929526-89-9
Method(s) of instruction/ media being used	Teacher-centred teaching and group work, work with audio-visual media, work (partially self-studies) in the media-pool (language department)
Level/ category	Master (category: 2)
Which semester (winter/ summer term)	summer term
Which semester during the programme	2
Requirements for attendance, necessary knowledge	none
Assessment (written/ oral test, paper, etc.)	alternative examination
ECTS credits	3
Work load in:	90 h of total work load, therefrom ▪ 60 h of presence at university ▪ 30 h of self-study
Usability of this module	Everyday life during the stay for studying Scientific Instrumentation.
Frequency of offer	Every study year
Duration of module	1 semester
Place/ room	Ernst-Abbe-Hochschule Jena - University of Applied Sciences Jena
Time	According to schedule
Language(s)	German

Department	SciTec
Degree programme	SI, WT
Module name	**English for Specific Purposes II**
Module number	**GW.2.176**
Study and Examination Regulations	ER-version 38 (of 21.03.2018)
Compulsory/ compulsory optional/ optional module	compulsory optional module
Module coordinator	Ulrich Schuhknecht
Module content	▪ Meetings and discussions on study and work-related topics, e.g. research projects ▪ 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
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 acquire business-related vocabulary and language skills relevant for engineers. The course is set at level C1 of the Common European Framework.
Course type (lecture, seminar, exercises, practical course)	0 L – 0 S – 3 E – 0 P
Recommended literature	▪ Dunn, M. et al: English for Mechanical Engineering in Higher Education Studies. Garnet Education, 2010 ▪ Comfort, J.: Effective Meetings. OUP, 2005 ▪ Billet, D.: Technical Writing Today. Media Corporation, 2005 ▪ Cotton, D. et al: Market Leader Upper Intermediate. Longman, 2011
Learning materials	Reader
Method(s) of instruction/ media being used	Interactive, audio and video recordings, e-learning platform
Level/ category	Master (category: 2)
Which semester (winter/ summer term)	Summer term
Which semester during the programme	2
Requirements for attendance, necessary knowledge	Successful completion of the module “Technical English” or equivalent (Level B2 of the Common European Framework)
Assessment (written/ oral test, paper, etc.)	Alternative examination
ECTS credits	3
Work load in:	90 h of total work load, therefrom ▪ 45 h of presence at university ▪ 45 h of self-study
Usability of this module	All study programmes containing a C1 level ESP module
Frequency of offer	Every study year
Duration of module	1 semester
Place/ room	Ernst-Abbe-Hochschule Jena - University of Applied Sciences Jena
Time	According to schedule
Language(s)	English

Department	SciTec
Degree programme	SI
Module name	**Research Internship**
Module number	**SciTec.2.625**
Study and Examination Regulations	ER-version 38 (of 21.03.2018)
Compulsory/ compulsory optional/ optional module	compulsory module
Module coordinator	The respective academic supervisor and the internal mentor.
Module content	The student shall solve a particular task in a running research or development project in the fields of “Micro- and Nanotechnology”, “Smart Materials and Sensors”, “Scientific Computing”, “Metrology and Analytics” or “Industrial Design”. After a short introduction an overview of the state of the art has to be achieved and the student shall be familiar with the experimental equipment. Using scientific skills, the research problems have to be discussed and provided with possible solutions. The results have to be presented and explained in a scientific way.
Learning objectives	After completion of this module the students are able to apply the skills and knowledge acquired in the Master programme to the independent processing of a clearly defined scientific problem. The students can apply scientific skills to the presentation of the results. This presentation shall comply with the requirements of a scientific publication.
Course type (lecture, seminar, exercises, practical course)	5 month
Recommended literature	Topic oriented.
Learning materials	Topic oriented.
Method(s) of instruction/ media being used	Individual research work.
Level/ category	Master (category: 2)
Which semester (winter/ summer term)	Winter term
Which semester during the programme	3
Requirements for attendance, necessary knowledge	Pass of all respective modules according to the examination order. Scientific principles for the topic from the relevant modules (semester 2).
Assessment (written/ oral test, paper, etc.)	alternative examination
ECTS credits	30
Work load in:	900 h of total work load, therefrom ▪ 0 h of presence at university ▪ 900 h of self-study
Usability of this module	The acquired ability and knowledge can be used in the Master’s thesis as well as in the professional life.
Frequency of offer	Every study year
Duration of module	1 semester
Place/ room	Ernst-Abbe-Hochschule Jena - University of Applied Sciences Jena, a research institute or an R+D department in industry.
Time	According to schedule
Language(s)	English/ German

Department	SciTec
Degree programme	SI
Module name	**Master Thesis**
Module number	**SciTec.2.712**
Study and Examination Regulations	ER-version 38 (of 21.03.2018)
Compulsory/ compulsory optional/ optional module	compulsory module
Module coordinator	The respective academic supervisor and the internal mentor.
Module content	The student shall process a subject-specific scientific task independently. The student will be supported by the respective academic supervisor and the internal mentor. Appropriate topics are from the fields of "Micro- and Nanotechnology", "Smart Materials and Sensors", "Scientific Computing", "Metrology and Analytics" and "Industrial Design". The work will include the investigation and presentation of the state of science, compilation of the theoretical principles, problem oriented approaches and suggestions to solve the problem, independent development of alternative solutions, presentation and interpretation of the results of the work as well as their assessment and contextual evaluation.
Learning objectives	The students are introduced into the work as a scientist or engineer by scientific participation in research institutes or in industry.
Course type (lecture, seminar, exercises, practical course)	5 months
Recommended literature	▪ The Master's Thesis shall comply with the directives according to the following DIN standards: DIN 1301, DIN 1338, DIN 1421, DIN 1422, DIN 1505, DIN 5478. ▪ Kate L. Turabian: A Manual for Writers of Research Papers, University of Chicago Press 2007 ▪ Wayne C. Booth, Gregory G. Colomb, Joseph M. Williams: The Craft of Research, University of Chicago Press 2008 ▪ Margaret Cargill, Patrick O'Connor: Writing Scientific Research Articles, Wiley-Blackwell 2013
Learning materials	Instructions for the Master's thesis, scientific literature, company notes.
Method(s) of instruction/ media being used	Individual research work on an assigned task with scientific methods.
Level/ category	Master (category: 2)
Which semester (winter/ summer term)	Summer term
Which semester during the programme	4
Requirements for attendance, necessary knowledge	Pass of all modules of semesters 1 to 3 according to the examination regulations. Scientific principles for the topic from the Research Internship and the relevant compulsory optional modules (semester 2).
Assessment (written/ oral test, paper, etc.)	alternative examination: Master thesis
ECTS credits	27
Work load in:	810 h of total work load, therefrom ▪ 0 h of presence at university ▪ 810 h of self-study
Usability of this module	The acquired competence and knowledge can be used in the professional career and they are the base for further qualification in research.
Frequency of offer	Every study year
Duration of module	1 semester
Place/ room	Ernst-Abbe-Hochschule Jena - University of Applied Sciences Jena, a research institute or an R+D department in industry.
Time	According to schedule
Language(s)	English, German

Department	SciTec
Degree programme	LOT, OOVS, SI, WT
Module name	**Colloquium**
Module number	**SciTec.2.804**
Study and Examination Regulations	ER-version 38 (of 21.03.2018)
Compulsory/ compulsory optional/ optional module	compulsory module
Module coordinator	The respective academic supervisor and the internal mentor.
Module content	In the colloquium the student shall present the results of his or her Master's thesis by giving a lecture and defending it against expert criticism. To prepare the colloquium the student will practise the following topics: ▪ Presentation techniques ▪ Job application training ▪ Rhetoric ▪ Scientific discussion ▪ Design of a lecture ▪ Precise and comprehensible presentation of a topic A poster presentation is also required.
Learning objectives	The student is able to give a presentation of acquired knowledge and results.
Course type (lecture, seminar, exercises, practical course)	2 weeks
Recommended literature	▪ Michael Alley: The Craft of Scientific Presentations: Critical Steps to Succeed and Critical Errors to Avoid, Springer Science + Business Media 2013 ▪ Rossig, W.E./ Prätsch, J.: Wissenschaftliche Arbeiten; Verlag Weyhe ▪ Krämer. K.L.: Paper, Poster und Projekte, Novartis Pharma GmbH 1998 ▪ Nicol: Wissenschaftliche Arbeiten schreiben mit Word – formvollendete normgerechte Examens-, Diplom- und Doktorarbeiten (für Word 97, 2000, 2002). München: Addison-Wesley, 2002
Learning materials	Topic oriented.
Method(s) of instruction/ media being used	Independent elaboration and presentation of the results of the Master's thesis with scientific methods and scientific discussion.
Level/ category	Master (category: 2)
Which semester (winter/ summer term)	Summer term
Which semester during the programme	4
Requirements for attendance, necessary knowledge	Pass of all modules offered.
Assessment (written/ oral test, paper, etc.)	alternative examination: colloquium (presentation, discussion, poster)
ECTS credits	3
Work load in:	90 h of total work load, therefrom ▪ 0 h of presence at university ▪ 90 h of self-study
Usability of this module	The colloquium will complete the Master's thesis and the course of study.
Frequency of offer	Every study year
Duration of module	1 semester
Place/ room	Ernst-Abbe-Hochschule Jena - University of Applied Sciences Jena
Time	According to schedule
Language(s)	English/ German

Ernst-Abbe-Hochschule Jena
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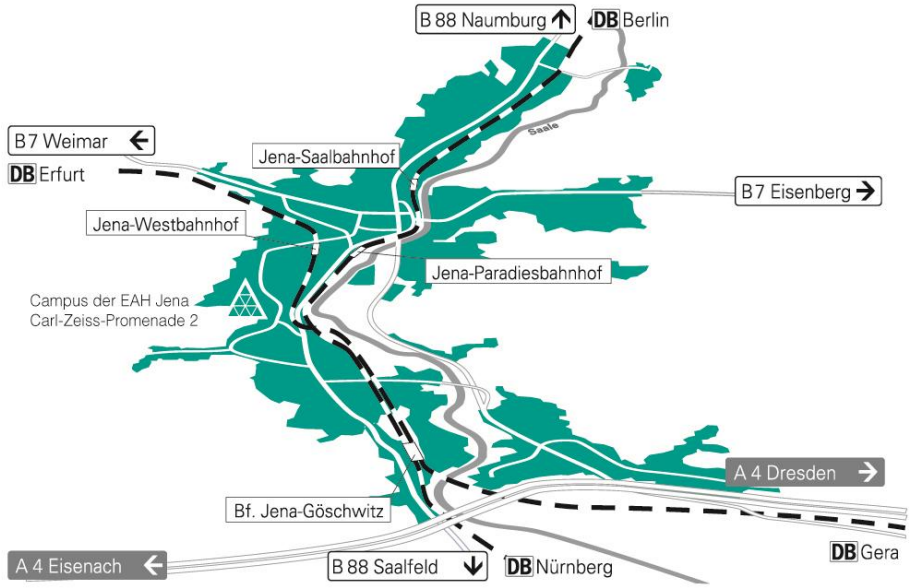
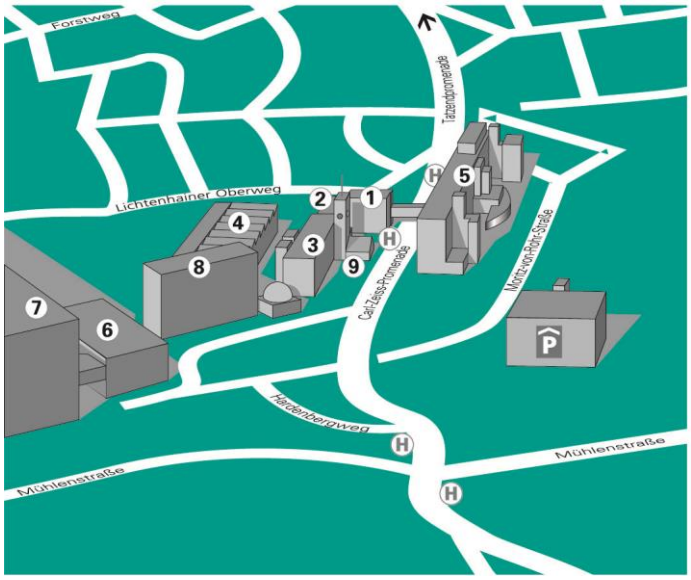
Driving map



Campus map



Legende:

1 Haus 1
2 Haus 2
3 Haus 3
4 Haus 4
5 Haus 5
6 Mensa
7 Carl Zeiss Jena GmbH
8 Studentenwohnheim
9 Hochschulsportzentrum
P Parkhaus

Imprint:
Publisher: Rector of Ernst-Abbe-Hochschule Jena, University of Applied Sciences
Editorial staff: Guddei, von Nordheim
Editorial deadline: 05/ 2018

All status and function designations used in this brochure refer to both genders. This brochure confers no legally binding requirements.