CARL VON OSSIETZKY universität OLDENBURG
FAKULTÄT V
INSTITUT FÜR PHYSIK

University of Applied Sciences
HOCHSCHULE EMDEN·LEER

Modulhandbuch

Bachelor Engineering Physics

Stand: 13.10.2014

Contents / Inhaltsverzeichnis

Bachelor of Engineering in Engineering Physics: Course Concept / Übersicht (from Winter Semester 14/15)

Field	1st Semester	2nd Semester	3rd Semester	4th Semester	5th Semester	6th Semester
MATHE- MATICS	Mathematical Methods for Physics and Engineering I (6/9)	Mathematical Methods for Physics and Engineering II (4/6)	Mathematical Methods for Physics and Engineering III (4/6) Computing (5/6)	Numerische Methoden der Physik (4/6)		
ENGINEE RING & PHYSICS	Mechanics (7/9)		Atom und Molekül-physik (6/6)	Thermo-dynamik & Statistik (6/6)	Control Systems (5/6)	Bachelor Thesis (2/15)
	Mechanics (5/6)	*Design Fundamentals (2/3)*			Theoretische Physik (Elek-trodynamik) (4/6)	
		Electro-dynamics and Optics (7/9) *Electrodynamics and Optics (5/6)* *Optical Systems (2/3)*				
		Electronics (4/6)		Physik. Messtechnik (5/6)	Werkstoff-kunde (6/8) *Einführung in die Festkörperphysik (2/2)* *Werkstoffkunde (4/6)*	*Praxismodul Engineering Physics (1/12) *Phase (-/10)* Seminar zur Praxisphase *(1/2)*
		Analog (2/3)	*Digital (2/3)*			
	Natural Science & Introduction to Specialisation (6/7)			*Basic Engineering (4/6) *Production Engineering (2/3)* *Applied Mechanics (2/3)*		
	Chemistry (2/2)	*Introduction to "Biomedical Physics & Acoustics" or "Laser & Optics" or "Renewable Energies" (2/3)*				
Specialisat ion	*Introduction to "Engineering Physics" (2/2)*		Speciali-sation * (2/3)	Specialisation * (4/6)	Specialisation * (4/6)	
Laboratory	Basic Laboratory (8/9)		*Laboratory Project I (5/6)		Laboratory Project II (7/9)	
	Course I (4/5)	*Course II (4/4)*				
Communi-cation & Manageme nt	*Language (4/6)				*Project (5/6)*	*Management (2/3)*
	Language I (2/3)	*Language II (2/3)*				
SWS/CP	27	31	27	33	32	30

Module (Hours per Week/ ECTS-Credit Points)
Course (Hours per Week/ ECTS-Credit Points)
Die klein und kursiv formatierten Vorlesungen stellen einzelne Modulteile dar und bilden zusammen das größer geschriebene Modul
* Professionalisierungsbereich

Subject of Specialisation:
Biomedical Physics & Acoustics, Laser & Optics, Renewable Energies

Bachelor of Engineering in Engineering Physics: Course Concept / Übersicht (up to Winter Semester 13/14)

Field	1st Semester	2nd Semester	3rd Semester	4th Semester	5th Semester	6th Semester
MATHE-MATICS	Mathematical Methods for Physics and Engineering I (6/9) Computing (5/6)	Mathematical Methods for Physics and Engineering II (4/6)	Mathematical Methods for Physics and Engineering III (4/6)	Numerische Methoden der Physik (4/6)		
ENGINEERING & PHYSICS	Mechanics (8/9)		Atomphysik (6/6)	Thermo-dynamik & Statistische Physik (6/6)	Control Systems (5/6)	Bachelor Thesis (2/15)
	Mechanics (6/6)	*Design Fundamentals (2/3)*	Theoretische Physik (Elek-trodynamik) (4/6)			
		Electro-dynamics and Optics (8/9) *Electrodynamics and Optics (6/6)* *Optical Systems (2/3)*				
		Electronics (4/6) *Analog (2/3)*	*Digital (2/3)*	Physik. Messtechnik (7/6)	Werkstoff-kunde (6/8) *Einführung in die Festkörperphysik (2/2)* *Werkstoffkunde (4/6)*	
	Natural Science & Introduction to Specialisation (6/7)		*Basic Engineering (4/6)			
	Introduction to "Engineering Physics" (2/2)	*Chemistry (2/2)*	*Applied Mechanics (2/3)*	*Production Engineering (2/3)*		
Specialisation		*Introduction to "Biomedical Physics & Acoustics" or "Laser & Optics" or "Renewable Energies" (2/3)*		Specialisation (6/9)	Specialisation * (4/6)	*Praxismodul Engineering Physics (1/12) *Phase (-/10)*
Laboratory	Basic Laboratory (8/9) *Course I (4/5)*	*Course II (4/4)*	*Laboratory Project I (5/6)		Laboratory Project II (7/9) *Project (5/6)*	
Communi-cation & Manageme nt	*Language (4/6) *Language I (2/3)*	*Language II (2/3)*			*Management (2/3)*	Seminar zur Praxisphase *(1/2)*
SWS/CP	25/31	26/33	23/30	25/30	22/29	3/27

Module (Hours per Week/ ECTS-Credit Points)
Course (Hours per Week/ ECTS-Credit Points)
Die klein und kursiv formatierten Vorlesungen stellen einzelne Modulteile dar und bilden zusammen das größer geschriebene Modul
* Professionalisierungsbereich

Subject of Specialisation:
Biomedical Physics & Acoustics, Laser & Optics, Renewable Energies

Fächermatrix:

Modul / Vorlesung	**Course number**	**Modulverantwortliche** / Dozent	Term	CP	BM	LO	RE
Einführung in die Akustik	5.04.253	Van de Par	W	3	X		
Einführung in die Biomedizinische Physik und Neurophysik	5.04.317	Kollmeier	S	6	X		
Energy Systems I (Global energy systems)	5.06.501	Heinemann	W	3			X
Energy Systems II (Technology)	5.06.407	Heinemann	S	3			X
Femtosecond Laser Technology	5.04.704	Teubner	W	3		X	
Einführung in die digitale Sprachverarbeitung	5.04.318	Gerkmann	S	6	X		
Laser Design	5.04.645	Struve	W	3		X	
Laser Physics	5.04.691	Struve	W	3		X	
Laser Spectroscopy	5.04.656	Neu	S	3	X	X	
Lasers in Medicine I	5.04.641	Neu	S	3	X	X	
Lasers in Medicine II	5.04.641	Neu	W	3	X	X	
Materialbearbeitung mit Laserstrahlen I, II	5.04.707	Schüning	S & S	3&3		X	
Micro Technology	5.04.640	Teubner	W	3		X	
Optik der Atmosphäre und des Ozeans	5.04.351	Reuter	S*	3			X
Optische Kommunikationstechnik	5.04.702	Brückner	S	3		X	
Optoelektronik	5.04.657	Brückner	W	3		X	
Photovoltaics	5.04.301	Hammer	S	3			X
Solar Energy Systems – Electric and Thermal	5.04.4245	Parisi/Holtorf	W	3			X
Wind Energy Utilization		Kühn	S	6			X

S = Sommersemester, W = Wintersemester

* wird nur jedes 2 Jahr (ungerade) angeboten

1st Semester, compulsory subjects:

Module description:	**Mathematical Methods for Physics and Engineering I – phy540, BM 1**
Field:	Mathematics
Course:	Mathematical Methods for Physics and Engineering I, lecture Mathematical Methods for Physics and Engineering I, exercise
Term:	Winter
Subject:	Compulsory
Person in charge:	Dr. Uppenkamp
Lecturer:	Dr. L. Uppenkamp, Prof. Doclo
Language:	English
Curriculum correlation:	Bachelor Engineering Physics, 1st semester
form/time:	Lecture: 4 hrs/week Exercise: 2 hrs/week
Workload:	attendance: 84 hrs self study: 186 hrs
CP:	9
Prerequisites acc. Syllabus	
Recommended prerequisites:	
Aim:	To obtain basic knowledge in application of mathematical methods to solve problems in physics and engineering
Content:	Preliminary algebra (polynomial equations, binomial expansion, proof by induction and contradiction, vectors in 2- and 3-space, products, planes, lines) Preliminary calculus (elementary function, operations, limits, differentiation, integration) Preliminary complex analysis Preliminary vector algebra, matrices, linear equations Determinants, transformations Introduction to differential equations
Assessment:	Max. 3 hrs written exam or 30 min oral exam. Here, you will find information about the consideration of bonus points for module marks.
Media:	Script, transparencies, blackboard, computer presentation
Literature:	K. F. Riley, M. P. Hobson, S. J. Bence: Mathematical methods for physics and engineering. Third edition, 2006

Module description:	**Mechanics – phy510, BM 2**
Module	Physics
Course:	Mechanics, lecture Mechanics, exercise Design Fundamentals
Term:	Winter (Mechanics); Summer (Design Fundamentals)
Subject:	Compulsory
Person in charge:	Prof. Kühn
Lecturer:	Prof. Kühn, Hübner, Dr. Schüning
Language:	English
Curriculum correlation:	Bachelor Engineering Physics, 1st semester & 2nd semester
form/time:	Lecture: 6 hrs/week Exercise: 2 hrs/week
Workload:	Attendance: 112 hrs Self study: 158 hrs
CP:	9
Prerequisites acc. Syllabus	
Recommended prerequisites:	Basic knowledge of mathematics acc. the pre-course of mathematics
Aim:	Introduction into scientific reasoning; understanding the basic physical principles that govern physical behaviour in the real world, application of these principles to solve practical problems. General introduction to the fundamentals of experimental mechanics. Achieving basic knowledge in reading, understanding and production of technical drawings, getting and overview about the features of CAD-Software, knowing about the basic principles of designing and dimensioning of machine elements.
Content:	*Mechanics:* Scientific reasoning Space and Time Kinematics Dynamics Motion in accelerated frames Work and Energy Laws of Conservation Physics of rigid bodies Deformable bodies and fluid media Oscillations Waves *Design Fundamentals:* Rules and Standards for Technical Drawings, Design Phases: • Functional requirements, performance specifications • Design methodology • Decision processes • Detailing • Manufacturing Drawings • Grouping of parts Basic Machine Elements: • Frames • Joints • Bearings

	• Sealing
Assessment:	weekly exercises, 2 hrs written exam or 45 min oral exam and assignment (Design Fundamentals). Here, you will find information about the consideration of bonus points for module marks.
Media:	Script, transparencies, blackboard, Beamer presentation, experiments.
Literature:	*Mechanics:* D. Halliday, R. Resnick, J. Walker, S. W. Koch: Fundamentals of physics / Physik. Wiley-VCH, Weinheim, 2003 P. A. Tipler, G. Mosca, D. Pelte, M. Basler: Physics/Physik. Spektrum Akademischer Verlag, 2004 W. Demtröder: Experimentalphysik, Band 1: Mechanik und Wärme. Springer, Berlin, 2004 L. Bergmann, C. Schäfer, H. Gobrecht: Lehrbuch der Experimentalphysik, Band 1: Mechanik, Relativität, Wärme. De Gruyter, Berlin, 1998 *Design Fundamentals:* ISO- and EN- Standards, Childs: Mechanical Design, Ulrich/Eppinger: Product Design and Development, Matousek: Engineering Design

Module description:	**Natural Science & Introduction to Specialisation – phy560, AM 2**
Field:	Engineering & Specialisation
Course:	Introduction to "Engineering Physics", lecture, winter semester Introduction to field of specialisation, lecture, summer semester Chemistry, lecture, winter semester Chemistry, laboratory, winter semester
Term:	Summer & Winter
Subject:	Compulsory
Person in charge:	Prof. Doclo, Prof. Neu, Prof. Kühn, Prof. Kollmeier, Prof. Poppe, Dr. Koch
Lecturer:	Prof. Doclo, Prof. Neu, Prof. Kühn, Prof. Poppe, Dr. Heinemann, Dr. Koch
Language:	English
Curriculum correlation:	Bachelor Engineering Physics, 1st semester & 2nd semester
form/time:	Lecture: 6 hrs/week, Laboratory: 8 hrs
Workload:	Attendance: 84 + 8 hrs Self study: 118 hrs
CP:	7
Prerequisites acc. syllabus	
Recommended prerequisites:	
Aim:	Students acquire knowledge of principles in chemistry and fluorescent substances
Content:	*Specialisation:* *Laser and Optics:* Knowledge of the characteristics of waves, optical radiation, design und function of optical elements and instruments, basics of design of new measurement techniques, knowledge of physical and technical properties of optoelectronic components, ability to design and analyze simple optoelectronic systems *Biomedical Physics & Acoustics:* Overview of the research fields in Oldenburg related to biomedical physics and acoustics (acoustical signal processing, audiology, biomedical signal processing, neuro-sensory science and systems, medical radiation physics, medical imaging, noise control and vibration) *Renewable Energies:* Introduction into the areas of renewable energies, with special emphasis on energy conversion and utilization, based on complex physical models. The student will be able to understand the fundamental principles of the field renewable energies. *Chemistry:* Atomic model Periodic system of the elements Chemical bond Quantitative relations, stoichiometry Chemical equilibria Acid / base equilibria

	Redox processes Fluorescent substances Basic lab work
Assessment:	1 hr written exam or 0.5 hr oral exam (lectures), laboratory work (Chemistry)
Media:	Lecture script, transparencies, blackboard, data projector presentation
Literature:	G. Jander, E. Blasius, J.Strähle, E. Schweda: Lehrbuch der analytischen und präparativen anorganischen Chemie. Hirzel, Stuttgart, 2006 E. Riedel, C Janiak: Anorganische Chemie. Gruyter, 2007 R. Chang, J. Overby: General Chemistry, McGraw-Hill, 2011 N. Wiberg, A. F. Holleman, E. Wiberg: Holleman-Wiberg's Inorganic Chemistry. Academic Press, 2001

Module description:	**Basic Laboratory – phy513, BM 3**
Field:	Laboratory and Communication & Management
Course:	Basic Laboratory Course I & II Communication & Presentation
Term:	Winter (course I, Oldenburg), summer (course II, Emden)
Subject	Compulsory
Person in charge:	Dr. Helmers
Lecturer:	Dr. Helmers and others
Language:	English
Curriculum correlation:	1Bachelor Engineering Physics, 1st semester & 2nd semester 2
form/time:	Laboratory: 2*3 hrs/week Communication and presentation: 2*1 hr/week
Workload:	attendance: 112 hrs self study: 158 hrs
CP:	9
Prerequisites acc. syllabus	
Recommended prerequisites:	Simultaneous hearing of Mechanics & Electrodynamics and Optics lectures
Aim:	Students will learn the basics of physical experimentation, the use of modern instrumentation, data collection, and analysis using appropriate hardware and software. They deepen lecture material through their own experiments. They acquire the skills for planning, implementation, evaluation, analysis, and reporting of physical experiments and presenting of results using multimedia tools. By working in groups, they gain competencies in the areas of teamwork and communication.
Content:	Introduction to software for scientific data analysis, analysis and assessment of measurement uncertainties, analysis and verification of measured data, fitting of functions to measured data, dealing with modern measurement techniques, carrying out experiments in the fields of mechanics, electricity, optics, nuclear radiation, electronics, signal acquisition, signal processing.
Assessment:	Successful execution and record keeping of the experiments, presentation of the results in lectures.
Media:	English and German Script (see http://www.physik.uni-oldenburg.de/Docs/praktika/45392.html for first semester experiments and will be provided via Stud-IP for second semester experiments, blackboard, Beamer presentation
Literature:	see http://www.physik.uni-oldenburg.de/Docs/praktika/45394.html for the first semester and will be provided via Stud-IP for the second semester

Module description:	**Language – pb162**
Field:	Communication & Management
Course:	Language Course I and II (German, other language courses are possible)
Term:	Winter and Summer
Subject	Compulsory
Person in charge:	Dr. Engelhardt
Lecturer:	Sprachenzentrum
Language:	German (or as desired)
Curriculum correlation:	1st and 2nd semester B.Eng. Engineering Physics
form/time:	4 SWS per Semester (other languages may differ)
Workload:	attendance: 56 hrs per Semester self study: 42 hrs per Semester 2 intensive course (each 72 hrs)
CP:	6
Prerequisites acc. syllabus	
Recommended prerequisites:	
Aim:	The student can understand sentences and frequently used expressions related to areas of most immediate relevance (e.g. very basic personal and family information, shopping, local geography, employment). He/She can communicate in simple and routine tasks requiring a simple and direct exchange of information on familiar and routine matters. She/he can describe in simple terms aspects of his/her background, immediate environment and matters in areas of immediate need. Other language courses are in accordance with the guidelines given by the “Sprachenzentrum”
Content:	• Reading • Writing • Listening • Speaking • Lecturing • Grammar in scientific papers
Assessment:	Written and oral examination acc. requirements (“Sprachprüfung” in accordance with: *Common European Framework of Reference for Languages* **CEFR** : level A2)
Media:	Black board, PC, language laboratory
Literature:	Dallapiazza, von Jan, Schönherr, Tangram. Deutsch als Fremdsprache, Lehrerbuch 1A u. 1B, 1999

2nd Semester, compulsory subjects:

Module description:	**Mathematical Methods for Physics and Engineering II – phy541, AM 3**
Field:	Mathematics
Course:	Mathematical Methods for Physics and Engineering II, lecture Mathematical Methods for Physics and Engineering II, exercise
Subject:	Compulsory
Term:	Summer
Person in charge:	Prof. Doclo
Lecturer:	Prof. Doclo
Language:	English
Curriculum correlation:	Bachelor Engineering Physics, 2nd semester
form/time:	Lecture: 2 hrs/week Exercise: 2 hrs/week
Workload:	attendance: 56 hrs self study: 124 hrs
CP:	6
Prerequisites acc. syllabus	
Recommended prerequisites:	Contents of the lecture “Mathematical Methods for Physics and Engineering I”
Aim:	To obtain advanced knowledge in application of mathematical methods to solve problems in physics and engineering
Content:	Vector calculus Vector algebra Partial differentiation Line, surface, volume, multiple integrals Fourier series and transform Ordinary differential equations
Assessment:	Max 3 hrs written exam or 30 min oral exam. Here, you will find information about the consideration of bonus points for module marks.
Media:	Script, transparencies, blackboard, computer presentation
Literature:	K. F. Riley, M. P. Hobson, S. J. Bence: Mathematical methods for physics and engineering. Third edition, 2006

Module description:	**Electrodynamics and optics – phy520, BM 4**
Field:	Physics
Course:	Electrodynamics and optics, lecture Electrodynamics and optics, exercise Optical systems, lecture
Term:	Summer
Subject:	Compulsory
Person in charge:	Prof. van der Par
Lecturer:	Lienau, van de Par, Schellenberg
Language:	English
Curriculum correlation:	Bachelor Engineering Physics, 2nd semester
form/time:	Lecture: 6 hrs/week Exercise: 2 hrs/week
Workload:	Attendance 112 hrs Self study: 158 hrs
CP:	9
Prerequisites acc. syllabus	
Recommended prerequisites:	Mechanics
Aim:	*Electrodynamics and optics:* Students will be able to understand the electric and magnetic phenomena and their treatment by an electromagnetic field including electromagnetic waves - with special emphasis on light. *Optical systems:* The students should be able with the help of optics basics to apply the optics to solve questions of informatics and measurement technology illumination technology materials processing with laser beams and the development of optical mechanical instruments and systems to implement the field of optics and to solve engineering questions.
Content:	*Electrodynamics and optics:* Basics of Electrostatics Matter in an electric field The magnetic field Motion of charges in electric and magnetic fields Magnetism in matter Induction Electromagnetic waves Light as electromagnetic wave *Optical systems:* Summary of optical basics: Technical optics as basics Optical rays Behaviour and properties of electromagnetic waves Application of wave optic properties Area of validity and low of geometric optics Application of ray optic laws Optical image Imaging construction elements Ray bundle, bundle limitation Physics of rays and light Colours Optical systems Set-up and function of selected optical systems of the

	illumination technology Measurement technology Material processing with laser beams Communication technology
Assessment:	weekly exercises, 2 1/2 hrs written exam or 60 min oral exam. Here, you will find information about the consideration of bonus points for module marks.
Media:	Script, transparencies, blackboard, Beamer presentation, experiments.
Literature:	*Electrodynamics and optics:* D. Meschede: Gerthsen, Physik. Springer, Berlin, 2005 (available in English) P. A. Tipler, G. Mosca, D. Pelte, M. Basler: Physik. Spektrum Akademischer Verlag, 2004 W. Demtröder: Experimentalphysik, Band 2: Elektrizität und Optik. Springer, Berlin, 2004 (available in English) H. Hänsel, W. Neumann: Physik. Elektrizität, Optik, Raum und Zeit. Spektrum Akademischer Verlag, Heidelberg, 2003 S. Brandt, H. D. Dahmen: Elektrodynamik. Eine Einführung in Experiment und Theorie. Springer, Berlin, 2005 W. Greiner: Klassische Elektrodynamik. Harri Deutsch, Frankfurt, 2002 E. Hecht: Optik. Oldenbourg, München, 2005 *Optical systems:* Waren J. Smith: Modern Optical Engineering, Mc Graw Hill, 4th edition, 2008 G. Schröder: Technische Optik, Vogel Verlag Würzburg, 2007 Skriptum

Module description:	**Electronics – phy570, AM 4**
Field:	Engineering
Course:	Electronics (analog), lecture, summer Electronics (digital), lecture, winter
Term:	Summer & winter
Subject:	Compulsory
Person in charge:	Prof. Dr. Brückner
Lecturer:	Prof. Dr. Brückner
Language:	English
Curriculum correlation:	Bachelor Engineering Physics, 2nd & 3rd semester
form/time:	Lecture 4 hrs/week
Workload:	Attendance: 64 hrs Self study: 116 hrs including preparation for examination
CP:	6
Prerequisites acc. syllabus	
Recommended prerequisites:	Fundamentals of static electrical circuits
Aim:	The students acquire knowledge to understand electronic circuits.
Content:	*Analogue:* analogue electronics: time dependence of capacitors and inductances, complex numbers, calculation of alternating current circuits, RCL-circuits, electronic filters, complex transfer functions, pulse response, semiconductor diodes, rectification circuits, operational amplifiers and amplifier circuits *Digital:* Digital electronics: logical elements and functions, analysis and synthesis of logical circuits, time dependent circuits, Flip-Flops, digital counters and memories, DA-/AD-converters
Assessment:	2 hrs written examination
Media:	Blackboard, transparencies and beamer projections, electronic hand-outs
Literature:	Böhmer: Elemente der angewandten Elektronik, Vieweg Verlag Beuth: Digitalelektronik, Vogel Fachbuch Verlag, 2007 Kories, Schmidt-Walter: Taschenbuch der Elektronik, Verlag Harri Deutsch, 2006 Beuth, Schmusch: Grundschaltungen (Serie Elektronik, 3), Vogel Fachbuch Verlag, 2003 Hering, Bressler, Gutekunst: Elektronik für Ingenieure und Naturwissenschaftler, Springer Verlag, 2005 Excerpts from lecture script Hill: The Art of Electronics, Cambridge University Press, 1989, ISBN 0521370957, 9780521370950

3rd Semester, compulsory subjects:

Module description:	**Mathematical Methods for Physics and Engineering III – phy542, AM 5**
Field:	Mathematics
Course:	Mathematical Methods for Physics and Engineering III, lecture Mathematical Methods for Physics and Engineering III, exercise
Term:	Winter
Subject:	Compulsory
Person in charge:	Prof. Hohmann
Lecturer:	Dr. Hohmann, Prof. Doclo
Language:	English
Curriculum correlation:	Bachelor Engineering Physics, 3rd semester
form/time:	Lecture: 2 hrs/week Exercise: 2 hrs/week
Workload:	attendance: 56 hrs self study: 124 hrs
CP:	6
Prerequisites acc. syllabus	
Recommended prerequisites:	Contents of the lecture “Mathematical Methods for Physics and Engineering I and II”
Aim:	To obtain advanced knowledge in application of mathematical methods to solve problems in physics and engineering
Content:	Complex analysis Partial differential equations Special functions in physics and engineering Special integral transform in physics and engineering Special linear and nonlinear differential equations in physics and engineering Statistics
Assessment:	2 hrs written exam or 30 min oral exam. Here, you will find information about the consideration of bonus points for module marks.
Media:	Script, transparencies, blackboard, computer presentation
Literature:	K. F. Riley, M. P. Hobson, S. J. Bence: Mathematical methods for physics and engineering. Third edition, 2006

Module description:	**Atom- und Molekülphysik - phy031, AM 6**
Field:	Physics
Course:	Atomic physics, lecture Atomic physics, exercise
Term:	Winter
Subject:	Compulsory
Person in charge:	Prof. Dr. Wollenhaupt
Lecturer:	Prof. Dr. Lienau, Prof. Dr. Wollenhaupt
Language:	German
Curriculum correlation:	Bachelor Engineering Physics, 3rd semester Fach-Bachelor in Physik, Pflicht, 3rd Semester Zwei-Fächer-Bachelor in Physik, 3rd Semester
form/time:	Lecture: 4 hrs/week Exercise: 2 hrs/week
Workload:	Attendance: 84 hrs Self study: 96 hrs
CP:	6
Prerequisites acc. syllabus	
Recommended prerequisites:	courses experimental physics I and II
Aim:	Students learn the fundamental principles of the atomic and molecular physics in differentiation to the classical physics.
Content:	development of the concept of atoms angular momentum and spin, and magnetic properties of the electrons, periodic system of the elements wave-particle dualism of electrons and photons modern experimental methods introduction to quantum mechanics: wave packets, Schrodinger equation, Heisenberg uncertainty principle applications: the electron in the box, the harmonic oscillator, the hydrogen atom
Assessment:	Successful attendance of the weekly exercises, 45 min oral exam. Here, you will find information about the consideration of bonus points for module marks.
Media:	Script, transparencies, blackboard, Beamer presentation, experiments.
Literature:	W. Demtröder: Experimentalphysik, Band 3: Atome, Moleküle, Festkörper. Springer, Berlin, 2000 (available in English) H. Haken, H. C.Wolf: Atom- und Quantenphysik. Springer, Berlin 2004 H. Haken, H. C. Wolf: Molekülphysik und Quantenchemie. Springer, Berlin, 2004 (available in English) H.-J. Leisi: Quantenphysik. Springer, Berlin, 2004 G. Otter, R. Honecker: Atome, Moleküle, Kerne. Teubner, Stuttgart, 1998 B. Thaller: Visual Quantum Mechanics – Selected topics with computer generated movies of quantum mechanical phenomena. Springer, Berlin, 2002.

Module description:	**Computing – phy550, AM 1**
Field:	Mathematics
Course:	Computing, lecture Computing, tutorial
Term:	Winter
Subject:	Compulsory
Person in charge:	NN
Lecturer:	Dipl.-Physiker Brosig
Language:	English
Curriculum correlation:	Bachelor Engineering Physics, 1st semester
form/time:	Lecture: 3 hrs/week Tutorial: 2 hrs/week
Workload:	Attendance: 70 hrs Self study: 110 hrs
CP:	6
Prerequisites acc. Syllabus	
Recommended prerequisites:	Basic computer knowledge; knowledge in undergraduate physics
Aim:	Students acquire knowledge of the most important ideas and methods of computer science including one programming language.
Content:	General Foundation Computer system (principal computer parts, peripheral devices, software. Operating system with short exercises) Numbers, characters Algorithms (sequence, selection, iteration) Programming language (C++) Structures of algorithms Input/output, pre-processor Arrays, strings Functions (procedural programming) Programme files (modular programming) Short introduction into classes (object orientated programming)
Assessment:	1 hr written exam or homework.
Media:	Lecture script, transparencies, blackboard, data projector presentation, reference programs
Literature:	General books about C++, z. B. Ulrich Breymann, C++, Eine Einführung, Hanser Bjarne Stroustrup, The C++ Programming Language, Special 3rd Edition, Addison-Wesley 2000.

Module description:	**Laboratory Project I – pb163**
Field:	Laboratory and Communication & Management
Course:	Laboratory Project I Communication & Presentation
Term:	Winter
Subject:	compulsory optional
Person in charge:	Prof. Dr. Brückner
Lecturer:	Prof. Dr. Brückner et al.
Language:	English/German
Curriculum correlation:	Bachelor Engineering Physics, 3rd semester
form/time:	Laboratory: 3 hrs/week (Campus Emden) Communication & Presentation: 2 hrs/week (Campus Emden)
Workload:	Attendance: 70 hrs Self study: 110 hrs
CP:	6
Prerequisites acc. syllabus	Lecture "Electronics"
Recommended prerequisites:	Basic laboratory course I & II
Aim:	Knowledge and experience about experimental work, managing experimental work and evaluating results
Content:	Experiments in the field of electronics and measurement technique
Assessment:	Report and project presentation
Media:	
Literature:	Specific project descriptions

4th Semester**, compulsory subjects*:***

Module description:	**Numerische Methoden der Physik – phy150, AM 9**
Field:	Mathematics
Course:	Numerical methods, lecture Numerical methods, tutorial
Term:	Summer
Subject:	Compulsory
Person in charge:	Prof. Hartmann, Prof. Dr. Hohmann
Lecturer:	Prof. Hartmann, Prof. Dr.Hohmann, Dr. Brand, PD Polley
Language:	German (tutorials and materials also in English)
Curriculum correlation:	Bachelor Engineering Physics, 4th semester Fach-Bachelor in Physik, Pflicht, 4th Semester
form/time:	Lecture: 2 hrs/week Tutorial: 2 hrs/week
Workload:	Attendance: 56 hrs Self study: 124hrs
CP:	6
Prerequisites acc. syllabus	
Recommended prerequisites:	Basic computer knowledge; knowledge in undergraduate physics
Aim:	Students acquire theoretical knowledge of basic numerical methods and practical skills to apply these methods on physical problems within all areas of experimental, theoretical and applied physics.
Content:	Basic concepts of numerical mathematics are introduced and applied to physics problems. Topics include: finite number representation and numerical errors linear and nonlinear systems of equations numerical differentiation and integration function minimization and model fitting discrete Fourier analysis ordinary and partial differential equations. The learned numerical methods will be partly implemented (programmed) and applied to basic problems from mechanics, electrodynamics, etc. in the exercises. The problems are chosen so that analytical solutions are available in most cases. In this way, the quality of the numerical methods can be assessed by comparing numerical and analytical solutions. Programming will be done in Matlab, which is a powerful package for numerical computing. It offers easy, portable programming, comfortable visualization tools and already implements most of the numerical methods introduced in this course. These built-in functions can be compared to own implementations or used in the exercises in some cases when own implementations are too costly. An introduction to Matlab will be given at the beginning of the tutorial.
Assessment:	Weekly graded programming exercises
Media:	Lecture script, transparencies, blackboard, data projector presentation, reference programs
Literature:	V. Hohmann: Computerphysik: Numerische Methoden (lecture script). Universität Oldenburg, http://medi.uni-oldenburg.de/16750.html W. H. Press et al.: Numerical Recipes in C - The Art of Scientific Computing. Cambridge University Press, Cambridge, 1992 A. L. Garcia: Numerical Methods for Physics. Prentice Hall, Englewood Cliffs (NJ), 1994 J. H. Mathews: Numerical Methods for Mathematics, Science

	and Engineering. Prentice Hall, Englewood Cliffs (NJ), 1992 B.W. Kernigham und D. Ritchie: The C Programming Language, Prentice Hall International, Englewood Cliffs (NJ), 1988

Module description:	**Thermodynamik und Statistik - phy041, AM 10**
Field:	Physics
Course:	Thermodynamics and Statistics, lecture Thermodynamics and Statistics, exercise
Term:	Summer
Subject:	Compulsory
Person in charge:	Prof. Peinke
Lecturer:	Prof. Peinke, (Neuberufung W2 Experimentalphysik)
Language:	German
Curriculum correlation:	Bachelor Engineering Physics, 4th semester Fach-Bachelor in Physik, Pflicht, 4th Semester Zwei-Fächer-Bachelor in Physik, LA Gymnasium, Pflicht, 4th Semester Zwei-Fächer-Bachelor in Physik, LA GHR, Pflicht, 4th Semester
form/time:	Lecture: 4 hrs/week Exercise: 2 hrs/week
Workload:	attendance: 84 hrs self study: 96 hrs
CP:	6
Prerequisites acc. syllabus	
Recommended prerequisites:	courses experimental physics 1, 2, 3
Aim:	Procurement of fundamental principles of thermodynamics and statistical physics to enable students to understand and analyze formulation of relations for particle ensembles with appropriate magnitudes.
Content:	I PHENOMENOLOGICAL THERMODYNAMICS A Fundamental Concepts Temperature, thermal equilibrium, 0. law, heat, internal energy, work from a system, first law , thermodynamic states and processes, thermodynamic cycles, B Application of Fundamental Concepts Carnot and Stirling cycle, second law, entropy, Legendre Transform and potential functions (Free Energy, Enthalpy, Gibb's Potential), irreversible processes and change in entropy, C Open Systems, Real Gases, Phase Transitions II STATISTICS • Isotropic particle distribution in space • Diffusion (1-dim) via particle hopping • entropy changes with volume alteration • energy distribution for distinguishable particles (Boltzmann- and Maxwell-distribution) • energy distribution for non-distinguishable Particles (Fermi-Dirac-, and Bose-Einstein-distribution) • Black Body Radiator (Planck's law) • Saha-Equation
Assessment:	weekly exercises, 2 hrs written exam or 45 min oral exam. Here, you will find information about the consideration of bonus points for module marks.
Media:	Script, transparencies, blackboard, beamer presentation,

	experiments.
Literature:	M. W. Zemansky, R. H. Dittman: Heat and Thermodynamics. McGraw-Hill, New York, 1997; Van P. Carey: Statistical thermodynamics and microscale thermophysics, Cambridge University Press, Cambridge (UK) 1999; H. B. Callen: Thermodynamics. John Wiley, New York, 1978; C. Kittel, H. Krömer: Physik der Wärme. Oldenbourg, München, 1993; D. K. Kondepudi, I. Prigogine: Modern thermodynamics. John Wiley, New York, 1998;

Module description:	**Basic Engineering – pb067**
Field:	Engineering
Course:	Applied Mechanics, lecture, winter semester Production Engineering, lecture, summer semester
Term:	Summer
Subject:	Compulsory optional
Person in charge:	Prof. Dr. Lange
Lecturer:	Prof. Dr. Schmidt, Prof. Dr. Lange
Language:	English
Curriculum correlation:	Bachelor Engineering Physics, 3rd & 4th semester Bachelor Photonik
form/time:	Lecture with integrated sample problems and exercises / 4 hrs/week
Workload:	Attendance: 64 hrs Self study: 116 hrs
CP:	6
Prerequisites acc. syllabus	
Recommended prerequisites:	Basic Math (Algebra, Derivation, Integration) Basic knowledge in Physics (Mechanics, Thermodynamics, esp. Heat transfer)
Aim:	*Applied Mechanics:* Achieving basic knowledge in applied mechanics, especially in statics and elasticity theory *Production Engineering:* Achieving basic knowledge on how to produce objects with defined geometry and properties in an effective and economic way
Content:	*Applied Mechanics:* Static equilibrium (mainly 2D), frame works, friction (Coulomb), Hooke's law (3D including lateral contraction and thermal expansion), bending and torsion with planar cross sections, Mohr's theory *Production Engineering:* Overview on manufacturing technologies, like • Casting and other primary shaping processes • Plastic deformation processes • Cutting and separating processes • Joining processes • Coating processes Changing material properties
Assessment:	Written exam, 1hr.
Media:	Beamer, black board, electronic scripts
Literature:	*Applied Mechanics:* Assmann: Technische Mechanik (German); Meriam, Kraige: Engineering Mechanics, Beer, Russell, Johnston: Vector Mechanics for Engineers *Production Engineering:* Groover: Fundamentals of Modern Manufacturing DeGarmo: Materials and Processes in Manufacturing König: Fertigungsverfahren (in German)

Module description:	**Physikalische Messtechnik – phy530, AM 11**
Field:	Engineering
Course:	Signalverarbeitung,lecture Physikalische Messtechnik, lecture Signalverarbeitung / Physikalische Messtechnik, excercise
Term:	Summer
Subject:	Compulsory
Person in charge:	Kollmeier
Lecturer:	Kollmeier, Doclo , Kittel, Helmers, van de Par
Language:	German
Curriculum correlation:	Bachelor Engineering Physics, 4th semester Fach-Bachelor in Physik, Pflicht, 4th Semester
form/time:	Lecture: hrs/week Exercise: 1 hrs/week
Workload:	Attendance: 70 hrs Self study: 110 hrs
CP:	6
Prerequisites acc. syllabus	
Recommended prerequisites:	
Aim:	Procurement of fundamental principles of metrology to enable the student to analyze, understand and solve the principle problems of measurement techniques.
Content:	Sensors for measurements of the different physical quantities Data logging and processing Measuring systems
Assessment:	1 1/2 hrs written exam or 45 min oral exam (Signalverarbeitung) and assignment (Phys. Messtechnik). Here, you will find information about the consideration of bonus points for module marks.
Media:	Script, transparencies, blackboard, Beamer presentation, experiments.
Literature:	H.-R. Tränkler, E. Obermeier: Sensortechnik. Springer, Berlin, 1998 J. Niebuhr, G. Lindner: Physikalische Messtechnik mit Sensoren. Oldenbourg, München, 2001 J. F. Keithley [Ed.]: Low /Level Measurements Handbook. Keithley Instruments Inc., 1998 J.-R. Ohm, H. D. Lüke: Signalübertragung. Springer, Berlin, 2005 K.-D. Kammeyer, K. Kroschel: Digitale Signalverarbeitung: Filterung und Spektralanalyse mit MATLAB-Übungen. Teubner, Stuttgart, 2002 Fourieranalyse

Module description:	**Specialisation I – pb159**
Field:	Specialisation
Course:	Lecture
Term:	Summer
Subject	Compulsory optional
Person in charge:	Prof. Doclo, Prof. Neu, Prof. Kühn
Lecturer:	Prof. Doclo, Prof. Neu, Prof. Kühn
Language:	German or English
Curriculum correlation:	Bachelor Engineering Physics, 4th semester
form/time:	Lecture 6 hrs/week
Workload:	Attendance: 84 hrs Self study: 186 hrs
CP:	9
Prerequisites acc. syllabus	
Recommended prerequisites:	
Aim:	Knowledge of the current state of research in the field of specialisation and acquisition of specialist knowledge
Content:	Familiarization of the specific area of specialisation in which the thesis will be written. Introduction into special problems of selected areas of physics and current publications Please see lectures under Subjects of Specialisation, page 36ff.
Assessment:	Acc. selected lectures
Media:	Acc. selected lectures
Literature:	Acc. selected lectures

5th Semester, compulsory subjects:

Module description:	**Theoretische Physik (Elektrodynamik) – phy431, AM 7**
Field:	Physics
Course:	Theoretical Physics II (Electrodynamics), lecture Theoretical Physics II (Electrodynamics), exercise
Term:	Winter
Subject:	Compulsory
Person in charge:	Dr. Pade, PD Dr. Polley
Lecturer:	Dr. Pade, PD Dr. Polley
Language:	German
Curriculum correlation:	Bachelor Engineering Physics, 3rd semester
form/time:	Lecture: 2 hrs/week Exercise: 2 hrs/week
Workload:	Attendance: 56 hrs Self study: 124 hrs
CP:	6
Prerequisites acc. syllabus	
Recommended prerequisites:	
Aim:	Obtain expertise to analyze and understand theoretically the basic concept of electrodynamics
Content:	Basic concept and structure of classical electrodynamics and theory of relativity Field, wave, potential of moving charges boundary value problem differentiation between relativistic and non-relativistic problems electrodynamics in matter Lorenz transformation
Assessment:	Successful attendance of the weekly exercises, 2 hrs written exam or 30 min oral exam. Here, you will find information about the consideration of bonus points for module marks.
Media:	Script, transparencies, blackboard, Beamer presentation, experiments.
Literature:	T. Fließbach; Lehrbuch zur theoretischen Physik, Spektrum Verlag, 2003 W. Nolting: Grundkurs Theoretische Physik 3 (Elektrodynamik) und 4 (Spezielle Relativitätstheorie, Thermodynamik), Springer Verlag, 2001 J.D. Jackson: Klassische Elektrodynamik, de Gruyter, 2006 (available in English) R.P. Feynman et al.: Vorlesungen über Physik, Band 2, Oldenbourg, 2001 (available in English) A.P. French: Die spezielle Relativitätstheorie, Vieweg, 1982

Module description:	**Control Systems – phy590, AM 13**
Field:	Engineering
Course:	Regelungstechnik, lecture
Term:	Winter
Subject:	Compulsory
Person in charge:	Prof. Dr. Andreas Hein
Lecturer:	Prof. Dr. Andreas Hein
Language:	Deutsch
Curriculum correlation:	BA Engineering Physics, 5th semester
form/time:	lecture: 4 hrs/week exercises: 1 hrs/week
Workload:	Attendance: 70 hrs Self study: 110 hrs
CP:	6
Prerequisites acc. syllabus	
Recommended prerequisites:	Complex numbers, ordinary differential equations, Laplace transformation
Aim:	The course provides an introduction to the principles of control engineering. Students should understand the basic elements, operations and characteristics of control systems. They should know how to analyse, model and design basic control systems. On completion of the course a student should be able to: Explain basic concepts of control systems Model simple electrical and mechanical systems Understand in depth first and second order systems Understand modelling using the state-space approach Determine transfer functions of simple control systems from differential equations Determine stability of feedback systems and evaluate error signals Design feedback control systems using PI, PID controllers Design feedback control systems in frequency domain and using the root locus method Die Studierenden • verfügen über Grundverständnis der Ansätze zur Steuerung und Regelung von technischen Systemen, • verstehen die Grundkonzepte der Modellierung von Systemen und deren Kopplung mit Reglern, • kennen die Methoden zur Bestimmung von Qualitätsmerkmalen von geregelten Systemen. Sie sind in der Lage • die Modellierung von technischen Systemen mit Hilfe von Differenzialgleichungen und deren Umsetzung in Übertragungsfunktionen durchzuführen, • Reglerstrukturen zu entwerfen, deren Stabilität zu prüfen und optimale Parameter der Regler zu bestimmen. Absolventen des Moduls haben die Kompetenz

	• sich in spezifische Fragen der Entwicklung von geregelten Systemen schnell einzuarbeiten, • Lösungsansätze zu präsentieren, • die technischen Herausforderung zu erkennen und durch Kommunikation mit anderen Disziplinen darauf zu reagieren.

Content:	Modelling of dynamical system, linear time-invariant systems, transfer functions, block diagrams, state space description, transfer functions and state-space description, relationship of pole/zero locations and dynamic response, stability of control systems, design of control systems, PID controller, design methods in the frequency domain, root-locus design method, state-space design
	
	Das Modul vermittelt die folgenden Inhalte:
	
	• Grundbegriffe
	• Analoge Übertragungsglieder:
	    ○ Lineare zeitinvariante (LZI-) Glieder
	    ○ Wirkungspläne
	    ○ Simulation und Modellbildung
	    ○ Testsignalantworten
	    ○ Frequenzgang
	    ○ Differentialgleichungen und Übertragungsfunktion
	    ○ Stabilität
	• Regelstreckenarten
	• Reglerarten
	• Lineare Regelkreise: Führungs- und Störverhalten
	• Stabilitätskriterien
	• Klassische Methoden der Analyse und Synthese:
	    ○ Realisierung
	    ○ Computergestützte Regelung MATLAB/Simulink

Assessment:	1 h written exam or 30 min oral exam. Here, you will find information about the consideration of bonus points for module marks.
Media:	Blackboard, transparents and beamer projections, electronic hand-outs
Literature:	Lutz, H. und Wendt, W.: Taschenbuch der Regelungstechnik Unbehauen, H.: Regelungstechnik I, Klassische Verfahren zur Analyse und Synthese linearer kontinuierlicher Regelsysteme

Module description:	**Werkstoffkunde – phy580, AM 12**
Field:	Engineering
Course:	Introduction to solid state physics, Einführung in die Festkörperphyik, lecture Werkstoffkunde, Materials Science, lecture
Term:	Winter
Subject:	Compulsory
Person in charge:	Prof. Dr. Brückner
Lecturer:	Prof. Dr. Brückner, Prof. Dr. Mundt
Language:	English/German, bilingual
Curriculum correlation:	Bachelor Engineering Physics, 5th semester
form/time:	Lecture 6 hrs/week with integrated exercises
Workload:	Attendance: 96 hrs Self study: 144 hrs
CP:	8
Prerequisites acc. syllabus	
Recommended prerequisites:	Knowledge of the fundamental physical laws; poised use of the mathematical methods of physics Lecture "Atomic Physics"
Aim:	*Einführung in die Festkörperphyik:* Acquisition of basic knowledges and methods concerning the physical properties of solids *Werkstoffkunde:* The students are able - outgoing from the microscopic structure of engineering materials - to understand its macroscopic properties, so that they are able to involve the behaviour of engineering materials into engineering requirements independently
Content:	*Einführung in die Festkörperphyik:* Crystal lattices and structures Reciprocal lattice 2-level systems, crystal bonds Phonons Specific heat and heat conductivity Free electron gas in crystals Electronic band structure Semiconductor crystals *Werkstoffkunde:* Introduction Classification of engineering materials in groups Constitution of engineering materials (microscopic structure, macroscopic properties) Physical basics of constitution: Constitution of single phase solids (crystals, amorphous materials, real materials) Constitution of multi-phase materials Basic diagrams of constitution of binary alloys Crystallisation Diffusion Properties of materials Physical properties Mechanical properties (plastic deformation, crack growth, friction, wear) Groups of materials (metals, ceramics, polymers)

	Selected materials (iron, aluminium, copper) Testing of materials (an overview of methods)
Assessment:	1 hr written examination or 30 min oral exam
Media:	Blackboard, transparents and beamer projections, electronic hand-outs
Literature:	*Einführung in die Festkörperphyik:* Kittel: Festkörperphysik, Oldenbourg Verlag, 2006 Ashcroft, Mermin: Solid State Physics, Saunders College Publ., 1995 Ibach, Lüth: Festkörperphysik, Springer Verlag, 2002 *Werkstoffkunde:* E. Hornbogen: Werkstoffe, Springer Verlag Berlin u. a. W. Bergmann: Werkstofftechnik Teil 1, Grundlagen; Carl Hanser Verlag München Wien Bargel, Schulze: Werkstoffkunde, VDI-Springer W. D. Callister, Jr.: Materials Science and Engineering, An Introduction; John Wiley-VCH Verlag Gmbh Weinheim

Module description:	**Specialisation II – pb077**
Field:	Specialisation
Course:	Compulsory lecture Engineering Physics, lecture
Term:	Summer
Subject:	Compulsory optional
Person in charge:	Prof. Doclo, Prof. Neu, Prof. Kühn
Lecturer:	Prof. Doclo, Prof. Neu, Prof. Kühn
Language:	German or English
Curriculum correlation:	Bachelor Engineering Physics, 5th semester
form/time:	Lecture 4 hrs/week
Workload:	Attendance: 56 hrs Self study: 126 hrs
CP:	6
Prerequisites acc. syllabus	
Recommended prerequisites:	
Aim:	Knowledge of the current state of research in the field of specialisation and acquisition of specialist knowledge
Content:	Familiarization of the specific area of specialisation in which the thesis will be written. Introduction into special problems of selected areas of physics and current publications Please see lectures under Subjects of Specialisation, page 36ff.
Assessment:	Acc. selected lectures
Media:	Acc. selected lectures
Literature:	Acc. selected lectures

(c) = compulsory subject / Pflichtfach, (cos) = compulsory optional subject / Wahlpflichtfach

Module description:	**Laboratory Project II – phy516, AM 8**
Field:	Laboratory & Management
Course:	Laboratory Project II Management
Term:	Winter
Subject:	Compulsory optional
Person in charge:	Prof. Dr. Neu
Lecturer:	Profs. Photonik, Prof. Doclo, Prof. Kühn, Prof. Poppe
Language:	English/German
Curriculum correlation:	Bachelor Engineering Physics, 5th semester
form/time:	Laboratory: 5 hrs/week Communication & Presentation: 2 hrs/week
Workload:	Attendance: 98 hrs Self study: 172 hrs
CP:	9
Prerequisites acc. syllabus	
Recommended prerequisites:	Basic laboratory course I & II; Lab project I
Aim:	*Laboratory Project II:* The students are enabled to systematically explore and structure a given project task. These projects are settled in the field of current research and are worked on in a team. This requires as well project scheduling, definition of milestones, specification and design, literature research, and presentation discussion of results. The students do not only gain technical and experimental experience but do also train soft-skills like team work, communication, presentation and management tasks *Management:* The student will be able to understand and apply the basic management concept and basic leadership qualities.
Content:	*Laboratory Project II:* Projects close to current research projects *Management:* Basics of general economics Organisation Concept of a company Company philosophy and policies Decision-making-theory Company planning Strategic management
Assessment:	Report and Presentation, Management: proof of participation
Media:	Script, manuals, experiments.
Literature:	recent publications, as required

6th Semester, compulsory subjects:

Module description:	**Bachelor Thesis – bam**
Field:	Thesis
Course:	Bachelor Thesis
Term:	Summer
Subject:	Compulsory optional
Person in charge:	Teaching Staff Engineering Physics
Lecturer:	N.A.
Language:	German or English
Curriculum correlation:	Bachelor Engineering Physics, 6th semester
form/time:	Seminar and self-learning
Workload:	Attendance: 28 hrs Self study: 422 hrs
CP:	15
Prerequisites acc. syllabus	Bachelor curriculum Engineering Physics
Recommended prerequisites:	
Aim:	Students will apply their diversified scientific and professional skills to plan, prepare, organize and produce single-handed a research study.
Content:	The thesis comprises empirical, theoretical or experimental research and development according to the field of specialisation
Assessment:	Bachelor thesis and colloquium
Media:	as required
Literature:	as required

Module description:	**Praxismodul Engineering Physics – prx110**
Field:	Communication & Management
Course:	Internship & Seminar
Term:	Winter
Subject:	Compulsory optional
Person in charge:	Dr. Koch
Lecturer:	Teaching staff of Engineering Physics
Language:	English / German
Curriculum correlation:	Bachelor Engineering Physics, 6th semester
form/time:	Seminar and self-learning
Workload:	Attendance: 300 hrs Self study: 60 hrs
CP:	12
Prerequisites acc. syllabus	
Recommended prerequisites:	Physics I – IV; metrology
Aim:	The student will be able to conduct, conceive, analyze, and journalize ambitious physical experiments. He/she will gather operating experience with modern measuring processes.
Content:	Practical assessment in research institute, industrial company, clinic, or university except University Oldenburg or University of Applied Sciences Emden/Leer. The students learn to apply their theoretical knowledge in an industrial environment. The phase will be accompanied by a seminar to ensure and depict the progress during the practical phase.
Assessment:	Report (10 CP), poster presentation (2 KP)
Media:	as required
Literature:	as required

Subjects of Specialisation:

Module description:	**Acoustical measurement technology**
Field:	Specialisation Biomedical Physics and Acoustics
Course:	Akustische Messtechnik I
Term:	Winter
Subject:	Compulsory optional
Person in charge:	Prof. Dr. Blau
Lecturer:	Prof. Dr. Blau
Language:	German or English
Curriculum correlation:	BA in Engineering Physics
form/time:	Lecture: 4 hrs/week
Workload:	Attendance: 56 hrs Self study: 124 hrs
CP:	6
Prerequisites acc. syllabus	Basic knowledge of acoustics and signal processing
Recommended prerequisites:	
Aim:	Students are expected to gain an overview of measurement methods frequently used in acoustics. They shall understand the underlying principles, and be able to spot possible measurement errors. In addition, students will be qualified in setting up actual measurements, using generic software for control, signal processing, and result analysis.
Content:	Messung von Wechselspannungen und elektrischen Impedanzen,Instrumentierung, Messung und Beurteilung des Schalldruckpegels, Messung von Spektren über Bandpassfilter, Messung von Spektren über Leistungsdichten, Messung von Übertragungsfunktionen, praktische Übungen
Assessment:	Written examination or project report
Media:	Blackboard, computer presentations
Literature:	B&K Microphone Handbook, Metra Manual zu Beschleunigungsaufnehmern, TA Lärm, Randall: Frequency Analysis, Bendat/Piersol: Engineering Applications of Correlation and Spectral Analysis, Bendat/Piersol: Random Data – Analysis and Measurement Procedures

Module description:	**Angewandte und medizinische Akustik**
Field:	Specialisation Biomedical Physics
Course:	Angewandte und medizinische Akustik, VL Angewandte und medizinische Akustik, Übung
Term:	Summer
Subject:	Compulsory optional
Person in charge:	Prof. Dr. Van de Par
Lecturer:	Prof. Dr. Van de Par, Prof. Dr. Dr. Kollmeier Dr. Weber, Prof. Blau
Language:	German
Curriculum correlation:	Bachelor in Physik, 3.-6. Semester; Bachelor Engineering Physics, 4^{th} or 5^{th} semester
form/time:	Lecture: 2 hrs/week Exercises: 2 hrs/week
Workload:	Attendance: 56 hrs Self study: 124 hrs
CP:	6
Prerequisites acc. syllabus	
Recommended prerequisites:	Physics (Bachelor level); additionally recommended: Practical course attempts from the progressing and/or block practical course from the areas acoustics and/or medical physics and/or signal processing
Aim:	Students are expected to gain an overview of bio-medical physics. They shall understand the activities of physicists in medicine and be able to analyse current research topics of medical physics.
Content:	*Angewandte Akustik (3 KP):* Physikalische Grundlagen der Akustik, Schwingungen und Wellen, Erzeugung, Abstrahlung und Ausbreitung von Schall, akustische Messtechnik, Schalldämmung und -dämpfung, Raum- und Bauakustik, Elektroakustik/ Wandler *Medizinische Akustik (3 KP):* Signalanalyse, Bewertung von Schall, Akustik von Stimme und Sprache, Sprachpathologie, Stoßwellen, Photoakustischer Effekt; ausgesuchte Kapitel der medizinische Akustik, Vibrationen und des Ultraschalls
Assessment:	Max. 45 min. oral exam or presentation, weekly exercises. Here, you will find information about the consideration of bonus points for module marks.
Media:	Script, transparencies, blackboard, Beamer presentation, experiments.
Literature:	B. Kollmeier: Skriptum Physikalische, technische und medizinische Akustik. Universität Oldenburg, http://medi.uni-oldenburg.de/16750.html. G. Müller, M. Möser (Eds.): Taschenbuch der technischen Akustik. Springer, Berlin, 2004 H. Kuttruff: Akustik: eine Einführung. Hirzel, Stuttgart, 2004. D. R. Raichel: The science and applications of acoustics. Springer, Berlin, 2000 A. D. Pierce: Acoustics: an introduction to its physical principles and applications. Acoustical Society of America, Melville (NY),1994

Module description:	**Biomedizinische Physik und Neurophysik**
Field:	Specialisation Biomedical Physics and Acoustics
Course:	Biomedizinische Physik und Neurophysik, VL Biomedizinische Physik und Neurophysik, Übung
Term:	Winter
Subject:	Compulsory optional
Person in charge:	Prof. Kollmeier
Lecturer:	Prof. Kollmeier, Prof. Poppe, Prof. Verhey, Dr. Uppenkamp
Language:	German
Curriculum correlation:	Bachelor in Physik, 6. Semester; Bachelor Engineering Physics, 4th or 5th semester
form/time:	Lecture: 2 hrs/week Exercises: 2 hrs/week
Workload:	Attendance: 56 hrs Self study: 124 hrs
CP:	6
Prerequisites acc. syllabus	
Recommended prerequisites:	Inorganic and organic chemistry, biology (in each case Abitur level), physics (Bachelor level); additionally recommended: Practical course attempts from the progressing and/or block practical course from the areas acoustics and/or medical physics and/or signal processing
Aim:	Students are expected to gain an overview of bio-medical physics. They shall understand the activities of physicists in medicine and be able to analyse current research topics of medical physics.
Content:	Medical bases: Anatomy and physiology of humans, sense and neuro physiology, Psychophysics, pathophysiology of select organ systems, pathology of select diseases, physics in the biomedicine: Methods of biophysics and neuro physics, Roentgen diagnostics, radiotherapy, nuclear medicine, tomography, the medical acoustics/ultrasonic, medical optics and laser applications, Audiology
Assessment:	Successful attendance of the weekly exercises, 30 min. oral exam and presentation. Here, you will find information about the consideration of bonus points for module marks.
Media:	Script, transparencies, blackboard, Beamer presentation, experiments.
Literature:	Silbernagl, S., Lang, F.: Taschenatlas der Pathophysiologie, Thieme, 2007 Silbernagel, Despopulos: Taschenatlas der Physiologie, Thieme 2007 Klinke/Silbernagl: Lehrbuch der Physiologie, Thieme, 2005 J.Richter: Strahlenphysik für die Radioonkologie, Thieme. 1998

Module description:	**Energy Systems**
Field:	SpecialisationRenewable Energy
Course:	Energy Systems I
Term:	Winter
Subject:	Compulsory optional
Person in charge:	Dr. Heinemann
Lecturer:	Dr. Heinemann
Language:	
Curriculum correlation:	Bachelor in Engineering Physics, 5th & Semester
form/time:	Lecture: 2 hrs/week each
Workload:	Attendance: 28 hrs each Self study: 62 hrs each
CP:	3
Prerequisites acc. syllabus	
Recommended prerequisites:	Naturwissenschaftliches Grundlagenwissen
Aim:	Discussion of the following questions: How to supply energy to all people? How will energy production/consumption look like in the future? What are the available resources? Which technologies will be available? What are the conditions? How can energy be used in human-friendly manner?
Content:	Energy basics, energy resources, global energy overview, energy scenarios, techno-economic aspects of energy use (external costs, life cycle analysis, ..), environmental effects of energy use (greenhouse gas emissions, ozone, ..), conventional and advanced power plant technologies, power distribution, advanced storage technologies, solar thermal power plants, geothermal and ocean energies
Assessment:	Klausur/en von max. 3 Stunden Dauer und /oder mündliche Prüfungen von max. 45 Minuten Dauer nach Maßgabe der Dozentin / des Dozenten sowie regelmäßige aktive und dokumentierte Teilnahme
Media:	
Literature:	Goldemberg, J. et al.: Energy for a Sustainable World, Wiley Eastern, 1988 Johansson, T.B. et al. (Eds.): Renewable Energy Sources for Fuels and Electricity, Island Press, Washington D.C., 1995 Khartchenko, N.V.: Advanced Energy Systems, Taylor & Francis, 1998 Nakicenovic, N., A. Grübler and A. McDonald (Eds.): Global Energy Perspectives, Cambridge University Press, 1998 Ramage, J.: Energy: A Guide Book, Oxford University Press, 1997 United Nations Development Programme (Ed.): World Energy Assessment: Energy and the Challenge of Sustainability, 2000

Module description:	**Introduction to Speech processing**
Field:	Specialisation Biomedical Physics and Acoustics
Course:	Speech processing / lecture with exercise
Term:	Winter
Subject:	Compulsory optional
Person in charge:	Prof. Dr. Doclo
Lecturer:	Prof. Dr. Doclo, Prof. Dr. Kollmeier, Dr. Anemüller, Dr. Brand
Language:	English / German
Curriculum correlation:	- Bachelor Engineering Physics, 4th or 5th semester - Fach-Bachelor in Physik, 6th semester - MSc Hörtechnik und Audiologie, 1st or 2nd semester (module „Akustik und Signalverarbeitung“)
form/time:	Lecture: 3 hrs/week Exercise: 1 hrs/week
Workload:	Attendance: 56 hrs Self study: 124 hrs
CP:	6
Prerequisites acc. syllabus	
Recommended prerequisites:	Contents of the lecture Physikalische Messtechnik
Aim:	Students will be able to (a) explain the foundations of speech production, perception and analysis, (b) understand the mathematical and information-theoretical principles of speech signal processing, and (c) apply the studied methods to explain the working principle of practical speech processing systems.
Content:	Speech production and perception, speech analysis, speech signal processing (STFT, LPC, cepstrum, speech enhancement), speech coding, speech synthesis, automatic speech recognition, speech intelligibility, selected topics on speech processing research and information theory
Assessment:	2 hr written examination or 30 min. oral examination. Here, you will find information about the consideration of bonus points for module marks.
Media:	Script, transparencies, blackboard, data projection, experiments.
Literature:	- M. R. Schroeder: Computer Speech, Springer, Berlin, 1999. - J. R. Deller, J. H. L. Hansen, J. G. Proakis: Discrete-Time Processing of Speech Signals, Wiley-IEEE Press, 1999. - P. Vary, R. Martin: Digital Speech Transmission, Enhancement, Coding and Error Concealment, Wiley, 2006. - J. Benesty, M. M. Sondhi, Y. Huang (Eds.): Handbook of Speech Processing, Springer, 2008.

Module description:	**Introduction to Renewable Energies**
Field:	Specialisation Renewable Energy
Course:	
Term:	Summer
Subject:	Compulsory optional
Person in charge:	Dr. Heinemann; Prof. Dr. Kühn
Lecturer:	Dr. Heinemann; Prof. Dr. Kühn
Language:	English
Curriculum correlation:	Bachelor in Engineering Physics, 2nd semester
form/time:	Lecture: 2 hrs/week
Workload:	Attendance: 26 hrs Self study: 64 hrs
CP:	3
Prerequisites acc. syllabus	
Recommended prerequisites:	
Aim:	This lecture gives an overview over the utilisation of renewable energy sources. The lecture handles this subject mainly from a natural scientific and technical point of view, nevertheless also social, historical and political aspects are regarded. The different renewable energy sources are introduced, their most important physical laws and effects are explained and the magnitudes of their physical and technical potentials are named. Students, who attended this lecture should: • name the main sources of renewable energy • understand reasons for the utilization of renewable energies • name the main advantages and disadvantages of the different renewable energy sources • understand and use the basic physical laws that describe the energy sources and their technical utilization • understand the most important conversion technologies of the different renewable energy sources • have a rough overview over the theoretical and technical potentials of these energy sources
Content:	• overview over global energy; • current energy situation and importance of renewable energies; • personal energy balance; • solar radiation & resources; • solar energy systems (optional with exercise); • energy storage systems; • biomass; • geothermal & ocean technologies; • wind turbines; • wind farms; • future power supply: scenarios; • hydropower; • transition of our energy supply: social and political aspects.
Assessment:	90 min written exam
Media:	data projector presentation, blackboard presentation
Literature:	t.b.a.

Module description:	**Femtosecond Laser Technology**
Field:	Specialisation Laser & Optics
Course:	Femtosecond Laser Technology
Term:	Summer
Subject:	Compulsory optional
Person in charge:	Prof. Dr. Teubner
Lecturer:	Prof. Dr. Teubner
Language:	English (German)
Curriculum correlation:	Photonik (BA) Bachelor Engineering Physics, 4th or 5th semester
form/time:	Lecture: 2 hrs/week
Workload:	Attendance: 28 hrs Self study: 62 hrs
CP:	3
Prerequisites acc. syllabus	
Recommended prerequisites:	Basics of optics, (basics of laser physics)
Aim:	Starting from their basic knowledge of optics, the students do learn the special aspects of optics on ultrashort time scales which do not play a role in standard optics. The module yields a basic knowledge of the physics of femtosecond light pulses and their interaction with matter, as well as the technology of femtosecond lasers.
Content:	Linear and non-linear optics of ultrashort pulses such as: amplitude, phase and spectral phase of the electric field, chirp, phase and group velocity, dispersion, pulse compression, self focusing, self phase modulation, frequency conversion, multi photon effects; femtosecond laser pulse generation with various schemes, measurement of ultrashort pulses
Assessment:	1 hr written final examination
Media:	black board, power point, practical work in the laboratory
Literature:	Rullière: Femtosecond Laser Pulses (Springer); Diels, & Rudolph: Ultrashort Laser Pulse Phenomena (Academic Press)

Module description:	**Laser Design**
Field:	Specialisation Laser & Optics
Course:	Laser Design, Lecture
Term:	Winter
Subject:	Compulsory optional
Person in charge:	Prof. Dr. Struve
Lecturer:	Prof. Dr. Struve
Language:	German
Curriculum correlation:	Bachelor Engineering Physics, 4^{th} or 5^{th} semester
form/time:	Lecture: 2 hrs/week
Workload:	Attendance: 28 hrs Self study: 62 hrs
CP:	3
Prerequisites acc. syllabus	Specialisation/Laser Physics
Recommended prerequisites:	Basic knowledge in atomic physics, optics and laser physics
Aim:	Students acquire basic knowledge on optical components used in lasers and on design of the most important laser types
Content:	• Optical components, e.g. mirrors, polarizers • Electrooptical and acoustooptical modulators • Gas, liquid and solid-state lasers • Frequency Doubling
Assessment:	1 hr. written final examination or homework
Media:	Blackboard, transparencies, data projector presentation
Literature:	B. Struve, Laser (Verlag Technik, 2001) A. E. Siegman, Lasers (University Science Books, 1998)

Module description:	**Laser Physik**
Field:	Specialisation Laser & Optics, Regenerative Enrgies, Materials Sciences, Biomedical Physics
Course:	Laser Physics, Lecture
Term:	Summer
Subject:	Compulsory optional
Person in charge:	Prof. Dr. Struve
Lecturer:	Prof. Dr. Struve
Language:	German
Curriculum correlation:	Bachelor Engineering Physics, 4^{th} or 5^{th} semester
form/time:	Lecture: 2 hrs/week
Workload:	Attendance: 28 hrs Self study: 62 hrs
CP:	3
Prerequisites acc. syllabus	
Recommended prerequisites:	Basic knowledge in atomic physics and optics
Aim:	Students acquire basic knowledge on generation of laser radiation and on technical realization of the most important operation modes
Content:	• Interaction processes between optical radiation and atoms • Optical amplification, laser principle • Optical resonators, beam propagation • Q-switching, cavity dumping, mode locking • Wavelength tuning
Assessment:	1 hr written final examination
Media:	Blackboard, transparencies, data projector presentation
Literature:	B. Struve, Laser (Verlag Technik, 2001) A. E. Siegman, Lasers (University Science Books, 1998)

Module description:	**Lasers in Medicine I**
Field:	Specialisation Laser & Optics / Biomedical Physics
Course:	Lasers in Medicine
Term:	Winter
Subject	Compulsory optional
Person in charge:	Prof. Dr. Neu
Lecturer:	Prof. Dr. Neu
Language:	Englisch
Curriculum correlation:	Pflicht: Photonik (BA) , Bachelor Engineering Physics, 4th or 5th semester
form/time:	Lecture: 2 hrs/week
Workload:	Attendance: 28 hrs Self study: 62 hrs
CP:	3
Prerequisites acc. syllabus	
Recommended prerequisites:	Laser physics, Technical Optics
Aim:	The students are enabled to understand basic laser biotissue interaction processes based on the knowledge of optical and thermal properties of biotissue. The students are able to describe the principle function of a laser, distinguish between the different laser types and designs regarding medical laser systems. The students have a basic knowledge on beam guiding techniques, medical applicators, and safety requirements. The students gain an overview on lasers in medicine and a first insight into clinical laser applications via an excursion to a clinic.
Content:	Optical and thermal properties of biotissue Basic interaction processes of light and biotissue Medical laser systems Beam guiding and applicators Introduction to lasers in medicine Laser safety and regulatory affairs in medicine Insight into clinical laser therapy (Excursion)
Assessment:	1 hr written final examination
Media:	Blackboard, transparencies, data projector presentation
Literature:	Berlien, Hans-Peter; Müller, Gerhard J., Breuer, H.; Krasner, N.; Okunata, T.; Sliney, D. (Eds.): Applied Laser Medicine. Springer-Verlag, 2003. ISBN: 978-3-540-67005-6 Niemz, Markolf H.: Laser-Tissue Interactions. Fundamentals and Applications.Series: Biological and Medical Physics, Biomedical Engineering. Springer-Verlag, 3rd enlarged ed. 2003. 2nd printing, 2007. ISBN: 978-3-540-72191 Sliney, D. Trokel, S.L.: Medical Lasers and Their Safe Use. Springer-Verlag 1993. ISBN: 978-3540978565.

Module description:	**Lasers in Medicine II**
Field:	Specialisation Laser & Optics, Biomedical Physics
Course:	Advanced Lasers in Medicine
Term:	Winter
Subject	Compulsory optional
Person in charge:	Specialisation Laser & Optics
Lecturer:	Prof. Dr. Neu
Language:	English
Curriculum correlation:	Photonik (BA) , Bachelor Engineering Physics, 4^{th} or 5^{th} semester
form/time:	Lecture: 2 hrs/week
Workload:	Attendance: 28 hrs Self study: 62 hrs
CP:	3
Prerequisites acc. syllabus	
Recommended prerequisites:	Laser physics, Technical Optics, Lasers in medicine I
Aim:	The students are able to analyze and model in depth optical properties of biotissue. They can explain laser-tissue interaction in depth. The students are able to design and evaluate medical laser systems and assign specific therapeutical areas. Special emphasis is put into dosimetry and minimal invasive techniques. An excursion to a university clinic enables the students to transfer the acquired course knowledge to practical experience.
Content:	Light propagation in biotissue Optical diagnostics and imaging, simulation, computer modelling Photochemical, photothermal, photomechanical interaction mechanisms Minimal invasive surgical therapies Medical laser applications Lasers in clinical diagnostics Dosimetry Excursion to a clinic; clinical laser applications
Assessment:	1 hr written final examination
Media:	Blackboard, transparencies, data projector presentation
Literature:	Berlien, Hans-Peter; Müller, Gerhard J., Breuer, H.; Krasner, N.; Okunata, T.; Sliney, D. (Eds.): Applied Laser Medicine. Springer-Verlag, 2003. ISBN: 978-3-540-67005-6 Niemz, Markolf H.: Laser-Tissue Interactions. Fundamentals and Applications.Series: Biological and Medical Physics, Biomedical Engineering. Springer-Verlag, 3rd enlarged ed. 2003. 2nd printing, 2007. ISBN: 978-3-540-72191 Sliney, D. Trokel, S.L.: Medical Lasers and Their Safe Use. Springer-Verlag 1993. ISBN: 978-3540978565. Puliafito, Carmen A: Laser Surgery and Medicine. Principles and Practice. J. Wiley&Sons, 1996. ISBN 0-471-12070-7 Recent publications (www.medline.de)

Module description:	**Laser Spectroscopy**
Field:	Specialisation Laser & Optics, Materials Sciences, Regenerative Energies
Course:	Laser spectroscopy
Term:	Winter
Subject	Compulsory optional
Person in charge:	Prof. Dr. Neu
Lecturer:	Prof. Dr. Neu
Language:	English
Curriculum correlation:	Bachelor Engineering Physics, 5th semester 1Fach-Bachelor in Physik, 5th Semester 2Zwei-Fächer-Bachelor in Physik, 3rd Semester
form/time:	Lecture: 2 hrs/week
Labor intensity:	Attendance: 28 hrs Self study: 62 hrs
CP:	3
Prerequisites acc. syllabus	
Recommended prerequisites:	Optics, Atomic and molecular physics, basics in quantum mechanics
Aim:	Students learn the fundamental principles of laser spectroscopy on atoms and molecules; applications of laser spectroscopy
Content:	Optical spectroscopy and line shapes Atomic and molecular spectra Doppler limited spectroscopy High resolution single photon spectroscopy Time resolved laser spectroscopy Multi photon spectroscopy Doppler free spectroscopy Applications of laser spectroscopy
Assessment:	Successful attendance of the weekly exercises, 2 hrs written exam or 30 min oral exam
Media:	Script, transparencies, blackboard, Beamer presentation, experiments.
Literature:	W. Demtröder, Laserspektroskopie, Springer, 5.Aufl. 2007; engl. Laser Spectroscopy, Springer, 3nd ed. 2003 W. Demtröder: Atoms, Molecules, and Photons. Springer, Berlin, 2005 H. Haken, H. C.Wolf: Atom- und Quantenphysik. Springer, Berlin 2004 S. Svanberg: Atomic and molecular spectroscopy basic aspects and practical applications. Springer, 2001. A. Corney: Atomic and laser spectroscopy. Clarendon Press, 1988. P. Hannaford: Femtosecond laser spectroscopy. Springer, New York , 2005.

Module description:	**Materialbearbeitung mit Laserstrahlen I**
Field:	Specialisation Laser & Optics, Materials Sciences
Course:	Material Processing with Lasers I
Term:	Summer
Subject	Compulsory optional
Person in charge:	Dr.-Ing. Thomas Schüning)
Lecturer:	Dr.-Ing. Thomas Schüning
Language:	German
Curriculum correlation:	Photonik (BA) Bachelor Engineering Physics, 4th semester
form/time:	Lecture: 2 hrs/week
Workload:	Attendance: 28 hrs Self study: 62 hrs
CP:	3
Prerequisites acc. syllabus	
Recommended prerequisites:	Knowledge in physics, optics, production engineering
Aim:	Fundamental knowledge of the characteristics of the laser beam, knowledge of procedures of the material processing with laser beams
Content:	Overview of the procedures of the material processing with laser beams: Procedure, allocation of the procedures in relation to production engineering the laser beam as tool: Jet characteristics, Gauss jets, other jets, jet transformation the material: Materials, characteristics reciprocal effect between laser beam and material: Penetration behavior, the treatment laser plant: Laser apparatuses in the material processing, guidance machine, remark examples of laser plants the individual manufacturing processes: Surface processing, joining process, separation procedure, material property changing examples from the industrial manufacturing
Assessment:	1 hr written final examination
Media:	Blackboard, transparencies, data projector presentation
Literature:	Script

Module description:	**Materialbearbeitung mit Laserstrahlen II**
Field:	Specialisation Laser & Optics
Course:	Material Processing with Lasers II
Term:	Summer
Subject	Compulsory optional
Person in charge:	Dr.-Ing. Schüning)
Lecturer:	Dr. Schüning
Language:	German
Curriculum correlation:	Photonik (BA) Bachelor Engineering Physics, 4^{th} semester
form/time:	Lecture: 2 hrs/week
Workload:	Attendance: 28 hrs Self study: 62 hrs
CP:	3
Prerequisites acc. syllabus	
Recommended prerequisites:	Knowledge of material processing with lasers
Aim:	Knowledge of the physical-technical procedures of the individual manufacturing processes with laser beams; Ability for the estimation of favorable working parameters; The participants should be able to understand the procedures of the material processing with laser beams and evaluate the tasks of manufacturing
Content:	Deepening treatment of the manufacturing processes in the areas: Treatment of outer zones adding separation under view of the physical-technical operational sequence
Assessment:	1 hr written final examination
Media:	Blackboard, transparencies, data projector presentation
Literature:	Script

Module description:	**Micro Technology**
Field:	Specialisation Laser & Optics
Course:	Micro Technology
Term:	Winter
Subject	Compulsory optional
Person in charge:	Prof. Dr. Teubner
Lecturer:	Prof. Dr. Teubner
Language:	English (German)
Curriculum correlation:	Photonik (BA) Bachelor Engineering Physics, 5th semester
form/time:	Lecture: 2 hrs/week
Workload:	Attendance: 28 hrs Self study: 62 hrs
CP:	3
Prerequisites acc. syllabus	
Recommended prerequisites:	
Aim:	The students get introduced to the field of micro technology (MEMS and MOEMS) They should be able to work in that field in industry.
Content:	Materials for micro technology, thin layers, clean rooms, methods and processes for the generation and modification of thin films such as evaporation, sputtering, CVD, diffusion, doping etc., etching; special emphasis is put on lithographic methods and laser micro machining
Assessment:	1 hr written final examination
Media:	black board, power point, practical work in the laboratory
Literature:	Mescheder: Mikrosystemtechnik (Teubner Verlag); Hilleringmann: Mikrosystemtechnik (Teubner Verlag); Völklein& Zetterer: Praxiswissen Mikrosystemtechnik (Vieweg) W. Menz, J. Mohr, O. Paul: Microsystem Technology Print ISBN: 9783527296347 Online ISBN: 9783527613007 DOI: 10.1002/9783527613007

Module description:	**Optik der Atmosphäre und des Ozeans**
Field:	Specialisation Renewable Energy
Course:	Optik der Atmosphäre und des Ozeans Optics of the atmosphere and the ocean, lecture, exercise and sailing time (if available)
Term:	Sommer
Subject	Compulsory optional
Person in charge:	Dr. Reuter
Lecturer:	Dr. Reuter; NN PostDoc
Language:	German
Curriculum correlation:	Bachelor Engineering Physics, 4th or 5th semester Fach-Bachelor in Physik, 6th Semester
form/time:	Lecture: 2 hrs/week Exercise: 1hrs/week Excursion: 3 days (if available)
Workload:	Attendance: 42 hrs Self study: 48 hrs Excursion: 72 hrs (if available)
CP:	3
Prerequisites acc. syllabus	Experimental physics I – IV, metrology
Recommended prerequisites:	
Aim:	Students will be able to understand the principles of optics in relation to the physics of the atmosphere and the ocean. This includes the fundamentals of optical interaction between light diffusion and experimental analysis of irradiance including the use of models to describe the radiative transfer.
Content:	Methods of radiometry, Theory of radiative transport, absorption and scattering, spectra of the sun, atmosphere, aerosol, light in the ocean, remote sensing
Assessment:	Successful attendance of the weekly exercises, 1 hr written exam or 30 min oral exam. Here, you will find information about the consideration of bonus points for module marks.
Media:	Script, transparencies, blackboard, Beamer presentation, experiments.
Literature:	D. C. Mobley: Light and Water. Academic Press, San Diego (CA), 1994 I. S. Robinson: Measuring the Oceans from Space. Springer, Berlin, 2004 J. T. O. Kirk: Light and Photosynthesis in Aquatic Ecosystems. Cambridge University Press, Cambridge, 1994

Module description:	**Optische Kommunikationstechnik**
Field:	Specialisation Laser & Optics
Course:	Optical communication technology
Term:	Summer
Subject:	Compulsory optional
Person in charge:	Prof. Dr. Brückner
Lecturer:	Prof. Dr. Brückner
Language:	German
Curriculum correlation:	Photonik (BA) Engineering Physics 4th semester
form/time:	Lecture: 2 hrs/week
Workload:	Attendance: 28 hrs Self study: 62 hrs
CP:	3
Prerequisites acc. syllabus	
Recommended prerequisites:	Optics, electronics, solid state physics
Aim:	Basic knowledge of fiber optical fiber systems, Competence to design and evaluate simple fiber systems
Content:	Optical fibers Signal attenuation and dispersion in optical fibers Fundamentals of optical data transmission Optical fiber amplifiers, fiber lasers Optical fiber connections
Assessment:	1 hr written examination
Media:	Blackboard, transparencies, data projector presentation
Literature:	H.-G. Unger: Optische Nachrichtentechnik 1, Hüthig Verlag, 1993 H.-G. Unger: Optische Nachrichtentechnik 2, Hüthig Verlag, 1994 E. Voges, K. Petermann: Optische Kommunikationstechnik. Handbuch für Wissenschaft und Indutrie, Springer Verlag, 2002 J. M. Senior: Optical Fiber Communications. Principles and Practice, Prentice Hall, 1992

Module description:	**Optoelektronik**
Field:	Specialisation Laser & Optics
Course:	Optoelectronics
Term:	4
Subject:	Compulsory optional
Person in charge:	Prof. Dr.Brückner
Lecturer:	Prof. Dr. Brückner
Language:	German
Curriculum correlation:	Photonik (BA) Bachelor Engineering Physics, 4^{th} or 5^{th} semester
form/time:	Lecture: 2 hrs/week
Workload:	Attendance: 28 hrs Self study: 32 hrs
CP:	3
Prerequisites acc. syllabus	
Recommended prerequisites:	Atoms and Molecules, Optics, Electronics, Solid state physics
Aim:	Acisition of physical and technical properties of optoelectronic components; ability to design and analyse simple optoelectronics systems
Content:	Electronics in solids Semiconductor junctions Optical radiation sources Optical radiation detectors Non linear optics
Assessment:	1 hr written final examination
Media:	Blackboard, transparencies, data projector presentation
Literature:	Bludau: Halbleiter-Optoelektronik, Hanser Verlag Paul: Optoelektronische Halbleiterbauelemente, Teubner Studienskripte Saleh, Teich: Fundamentals of Photonics, Wiley & Sons, 2007

Module description:	**Photovoltaics**
Field:	Specialisation Renewable Energy
Course:	
Term:	Summer
Subject:	Compulsory optional
Person in charge:	Dr. Riedel
Lecturer:	Dr. Riedel, Dr. Hammer
Language:	German
Curriculum correlation:	Bachelor in Engineering Physics, 4^{th} or 5^{th} semester
form/time:	Lecture: 2 hrs/week
Workload:	Attendance: 28 hrs Self study: 62 hrs
CP:	3
Prerequisites acc. syllabus	
Recommended prerequisites:	Vorausgesetzt werden Grundkenntnisse der Festkörper-/ Halbleiterphysik und persönliches Interesse in den Bereichen der Solaren Strahlungswandlung und regenerative Energiequellen.
Aim:	Die Studierenden entwickeln ein grundlegenden Verständnisses der Photovoltaik
Content:	Photonen-Solarstrahlung und maximaler Wirkungsgrad von Solarzellen; Prinzip des detaillierten Gleichgewichts; Struktur und Funktionkonventioneller Silizium-Solarzellen I+II; Strategien zur Erhöhung des Energiewandlungswirkungsgrades von Silizium-Solarzellen; Konzentrator- und Tandemsysteme; Dünnschichtsolarzellen; Thermophotovoltaik; Photovoltaik der dritten Generation;
Assessment:	Vortrag ; Hausarbeit
Media:	Blackboard, transparencies, data projector presentation
Literature:	

Module description:	**Power System and Grid**
Field:	Specialisation Renewable Energy
Course:	
Term:	Summer
Subject:	Compulsory optional
Person in charge:	Ziethe
Lecturer:	Ziethe
Language:	English
Curriculum correlation:	Bachelor in Engineering Physics, 4th or 5th semester
form/time:	Lecture: 2 hrs/week
Workload:	Attendance: 28 hrs Self study: 62 hrs
CP:	3
Prerequisites acc. syllabus	
Recommended prerequisites:	High-school knowledge of DC and AC current basics
Aim:	• Understanding of electrical basic relations (voltage-current-power, reactive impedance, power factor, power factor compensation) • functional principles of electric machines (transformers, rotating e-machines)
Content:	• DC current • AC current basics • Basics of Magnetic circuits • Transformers • DC machines • Induction machines • Synchronous machines
Assessment:	Written exam
Media:	Blackboard, transparencies, data projector presentation
Literature:	

Module description:	**Solar Energy Systems – Electric and Thermal**
Field:	Specialisation Renewable Energy
Course:	
Term:	Winter
Subject:	Compulsory optional
Person in charge:	Prof. Dr. Parisi, Holtorf
Lecturer:	Prof. Dr. Parisi, Holtorf
Language:	English
Curriculum correlation:	Bachelor in Engineering Physics, 4^{th} or 5^{th} semester
form/time:	Lecture: 2 hrs/week
Workload:	Attendance: 28 hrs Self study: 62 hrs
CP:	3
Prerequisites acc. syllabus	
Recommended prerequisites:	
Aim:	
Content:	
Assessment:	
Media:	Blackboard, transparencies, data projector presentation
Literature:	

Module description:	**Wind Energy Utilization**
Field:	Specialisation Renewable Energy
Course:	
Term:	
Subject:	Compulsory optional
Person in charge:	Prof. Dr. Kühn
Lecturer:	Prof. Dr. Kühn
Language:	English
Curriculum correlation:	• Bachelor in Engineering Physics, 4th or 5th semester • Master Sustainability Economics and Management • Bachelor Umweltwissenschaften • Zwei-Fächer-Bachelor Physik • etc.
form/time:	Lecture: 2 hrs/week Tutorial: 2 hrs/week
Workload:	Attendance: 52 hrs Self-study: 128 hrs
CP:	6
Prerequisites acc. syllabus	
Recommended prerequisites:	Basic computer knowledge; mechanics; mathematical methods for physics and engineering
Aim:	This lecture with exercises is intended as introduction into physics and engineering of wind energy utilisation. Nevertheless also social, historical and political aspects are regarded. The lecture gives a deeper understanding of physical effects, methods, calculations and parameters into the field of wind energy utilisation, wind physics and wind energy science. Experiments and exhibits are used to deliver deeper insights into the subjects of the lectures. The tutorial part consists of calculation exercises and an introduction into the common and professional software WindPro ® (subject to modifications). Students who have attended »Wind Energy Utilisation« in the Bachelor phase should be able to directly enrol for advanced wind energy lectures in the Master phase (without attending 5.04.4061 – Wind Energy).
Content:	• The wind: generation, occurence, measurement, profiles etc.; • Energy and power in the wind; • Drag driven converters; • Principle of lift driven converters; • Dimensionless parameters and characteristic diagrams of wind turbines; • Optimum twist and horizontal plan of the rotor blade; • Rotor power losses; • Power control; • Generator concepts and grid interaction; • Loads; • Mechanical design and components of a wind turbine; • Calculation of energy yield; • Economics; • Wind farms, wakes and wind farm efficiency;

	• Environmental effects; • Unconventional converters; • Prepared discussion about social and political aspects; • Use of wind farm calculation software WindPro.
Assessment:	90 min written exam. Here, you will find information about the consideration of bonus points for module marks.
Media:	data projector presentations, blackboard presentations and calculations, experiments, professional software for wind farm calculation for each 2-person-team
Literature:	• *English Language:* Robert Gasch, Wind Power Plants – Fundamentals, Design, Construction and Operation, 2nd Ed., 2012, Springer-Verlag; ISBN: 978-3-642-22937-4 • *German Language:* Robert Gasch, Windkraftanlagen - Grundlagen und Entwurf, 8. Aufl., 2013, Springer + Vieweg