Faculty of Applied Sciences

Bachelor program „Technische Physik“
„Engineering Physics“

Module guide
(with exchange year at USST/Shanghai; in cooperation with Ostbayerische Technische Hochschule Regensburg)

15.03.19 – subject to change
Engineering Physics

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<th>Shanghai Optoelectronics</th>
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Abbreviations:
ECTS = Credit Points nach dem European Credit Transfer and Accumulation System
SS = summer semester
WS = winter semester
Min = minutes
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Semester 1 & 2 are taught in German and are equal to the German bachelor program “Technische Physik”. The module descriptions can be found here.
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| **COURSE OBJECTIVES** | Provide a foundation for analyzing and designing analog electronic circuits. The majority of electronic circuit design involves using integrated circuits (ICs). The IC can contain millions of semiconductor devices and can perform complex functions. The ultimate goal of this course is to understand the operation, characteristics of each basic amplifying circuits. |

| **PREREQUISITES** | Circuit Principles, High Mathematics, Physics |

| **COURSE CONTENTS** | 1. Semiconductor Diodes (4 hours) 2. Diode Applications (8 hours) 3. Bipolar Junction Transistors (4 hours) 4. DC Biasing – BJTs (8 hours) 5. BJT AC Analysis (8 hours) 6. Field-Effect Transistors (2 hours) 7. FET Biasing (1 hours) 8. FET Amplifiers (1 hours) 9. Operational Amplifiers (8 hours) 10. Op- Amp Applications (8 hours) 11. Feedback Circuits (4 hours) |

<p>| <strong>DIDACTIC METHODS</strong> | Blackboard and chalk, PPT Lecture notes display by computer and projector |
| <strong>GRADING</strong> | Homework: 10%; Quiz: 10%; Attendance: 10%; Final Exam: 70% |</p>
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| **COURSE NAME** | Complex Variable and Integral Transformation (Eng)  
复变函数与积分变换(英) |
| **COURSE CODE** | 22000141 |
| **LOCATION** | University of Shanghai for Science and Technology |
| **SEMESTER** | 3 |
| **RESPONSIBLE FOR THIS COURSE** | LIU Xiping  
刘锡平 |
| **CREDITS POINTS** | 4 ECTS |
| **HOURS OR WEEKS** | 48 hours |
| **COURSE OBJECTIVES** | Learn basic knowledge of complex integral function;  
Lay foundation of learning differential equations, mathematical methods and other following courses;  
Lay necessary foundations of mathematics for other major courses;  
Help students to understand the basic concept, theory and counting ability of complex integral function, Fourier and Laplace transformation. |
| **PREREQUISITES** | Calculus |
| **COURSE CONTENTS** | 1. Plural and complex function (4 hours)  
2. Analytic functions (5 hours)  
3. Integration of Complex function (6 hours)  
4. Series (5 hours)  
5. Residue (6 hours)  
6. Fourier Transformation (9 hours)  
7. Laplace Transformation (9 hours) |
| **DIDACTIC METHODS** | Instruction, Quiz, Modeling, Questions |
| **GRADING** | 30% for homework and attendance, 70% for final written examination |
| **BIBLIOGRAPHIES** | 1. "Complex function" (fourth edition), Xi'an Jiaotong University,  
2. "Integral transformation" (fourth edition), Southeast University,  
Department of Mathematics, Zhang Yuanlin series, Higher Education Press, December 2003 |
### SYLLABUS “OPTOELECTRONIC ENGINEERING”

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| COURSE NAME | Packaging (Eng)  
封装技术 (英) |
| COURSE CODE | 12002860 |
| LOCATION   | University of Shanghai for Science and Technology |
| SEMESTER   | 3 |
| RESPONSIBLE FOR THIS COURSE | DAI Bo  
戴博 |
| CREDITS POINTS | 3 ECTS |
| HOURS OR WEEKS | 32 hours |

#### COURSE OBJECTIVES
Students are familiar with some updated electrical, mechanical and optical components including integrated circuit (IC), micro-electro-mechanical system MEMS, optical MEMS and microfluidic devices. In addition, students get to know materials for packaging and fabrication and packaging technology such as bulk micromachining and surface micromachining.

#### PREREQUISITES
A fundamental knowledge of physics, chemistry and microtechnology

#### COURSE CONTENTS
- **1 Integrated circuit**
  - 1.1 Electronic Packaging Hierarchy
  - 1.2 IC Package Families
  - 1.3 Evolution of Package Type
- **2 MEMS**
  - 2.1 Applications of MEMS
  - 2.2 Microelectronics, micro mechanics, and micro optics
- **3 Optical MEMS**
  - 3.1 Advantages of optical MEMS
  - 3.2 Applications of optical MEMS
- **4 Packaging of MEMS**
  - 4.1 Tradeoff of packaging complexity and performance
  - 4.2 Bulk micromachining
  - 4.3 Surface micromachining
- **5 Microfluidic device**
  - 5.1 Applications of microfluidic device
  - 5.2 Fabrication and packaging of microfluidic device
  - 5.3 Lab tour for microfluidic device
- **6 Materials for packaging**
  - 6.1 Semiconductor materials.
  - 6.2 Properties of materials used for packaging

#### DIDACTIC METHODS
Lecture supported by blackboard or visualizer and beamer, lab tour

#### GRADING
Attendance (40%) + Report (30%) + Presentation (30%);

#### BIBLIOGRAPHIES
- Daniel Lu, C.P. Wong, Materials for Advanced Packaging, Springer
- Dan E. Angelescu, Highly Integrated Microfluidics Design, Artech House Publishers
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<td>COURSE NAME</td>
<td>Digital Circuits (Eng) 数字电路 (Eng)</td>
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<td>XIN Shangzhi 忻尚芝</td>
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<td>CREDIT POINTS</td>
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**COURSE OBJECTIVES**

After successfully studying the digital circuits course, students will be able to:
1. Understand the basic digital electronic engineering concepts and principles.
2. Use these engineering abstractions to analyze and design digital electronic circuits.

After successfully studying the lab, students will be able to:
1. Use the lab instruments to finish every experiment on schedule.
2. Record measurements, observe and graph of data taken during the lab exercises.
3. Use the theory of digital electronic Technology to analyze and process the phenomenon of experiment.

**PREREQUISITES**

Circuit Principles, Mathematics, Physics

**COURSE CONTENTS**

1. Member systems; (6 hours)
2. Logic gates; (8 hours)
3. Wave forms and Boolean algebra; (6 hours)
4. Exclusive-or gates; (6 hours)
5. Adders; (6 hours)
6. Specifications and open-collector gates; (6 hours)
7. Flip-flops; (6 hours)
8. Master-slave D and JK flip-flops; (6 hours)
9. Shift registers; (6 hours)
10. Counters. (8 hours)

**DIDACTIC METHODS**

Blackboard and chalk, PPT Lecture notes display by computer and projector

**GRADING**

Homework: 20%; Quiz: 10%; Attendance: 20%; Final Exam: 50%

**BIBLIOGRAPHIES**

2. Lab book printed by USST
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| **COURSE CONTENTS** | 1. Introduction to Signals and Systems (7 hours)  
2. Linear Time-Invariant Systems (11 hours)  
3. Continuous-Time Fourier Series (6 hours)  
4. Continuous-Time Fourier Transform (9 hours)  
5. Sampling (4 hours)  
6. Laplace Transform (8 hours)  
7. Review (3 hours) |
<p>| <strong>DIDACTIC METHODS</strong> | Instruction with auxiliary Forum/Homework/Experiment/Simulation |
| <strong>GRADING</strong> | Quiz (20 %) + Homework/Forum (30 %) + Final Exam (50 %) |</p>
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**COURSE OBJECTIVES**

Knowledge and Understanding:
This course will introduce the basic theory of thermodynamics including the first law of thermodynamics, the ideal gas, gas and steam heat process, the second law of thermodynamics, the flow of gas and steam, thermal process of the compressor, and refrigeration cycle, etc.

Intellectual Skills:
The students will have the ability of analyzing specific engineering applications. Develop the thinking capability in the aspect of thermal elements, thermal power and thermal system.

Practical Skills:
Students are no longer limited simply to understand and master the basic theory of thermodynamics. Stress on linking theory with practice and train the ability to solve practical issues.

**PREREQUISITES**
General Chemistry, Advanced Mathematics, Physics

**COURSE CONTENTS**
1. Introduction of thermodynamics (Lecture 2 Hours)
2. Generic Concepts and Definitions (Lecture 2 Hours)
3. The first law of thermodynamics (Lecture 4 hours)
4. The nature of the gas and steam (Lecture 4 hours)
5. Basic thermodynamic process of gas and steam (Lecture 5 hours)
6. The second law of thermodynamics (Lecture 4 hours)
7. The flow of gas and steam (Lecture 4 hours)
8. The thermal process of compressor (Lecture 4 hours)
9. Gas power cycle (Lecture 3 hours)
10. Circulation of steam power device (Lecture 4 hours)
11. Refrigeration cycle (Lecture 5 hours)
12. The ideal gas mixture and wet air (Lecture 4 hours)
13. Fundamentals of chemical thermodynamics (Lecture 3 hours)

**DIDACTIC METHODS**
Lectures & experiments

**GRADING**
70 % exam + 30 % attendance

**BIBLIOGRAPHIES**
<p>| <strong>SYLLABUS “OPTOELECTRONIC ENGINEERING”</strong> |
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| <strong>DATE</strong>                     | June 2019                |
| <strong>COURSE NAME</strong>              | Solid State Physics I (Eng) |
|                              | 固体物理 I (英)            |
| <strong>COURSE CODE</strong>              | 12004000                 |
| <strong>LOCATION</strong>                 | University of Shanghai for Science and Technology |
| <strong>SEMESTER</strong>                 | 4                        |
| <strong>RESPONSIBLE FOR THIS COURSE</strong> | ZHANG Ling |
|                              | 张玲                      |
| <strong>CREDIT POINTS</strong>            | 4 ECTS                   |
| <strong>HOURS OR WEEKS</strong>           | 64 hours                 |
| <strong>COURSE OBJECTIVES</strong>        | The students are required to penetrate with basic conception, make clear physical image, and master basic physical method skillfully and fall to work on analyzing and solving problem by using the learned knowledge synthetically. |
| <strong>PREREQUISITES</strong>            | Physics, Quantum Mechanics, Thermodynamics and Statistical Physics, Atomic Physics |
| <strong>COURSE CONTENTS</strong>          | Chapter 1: Crystal structure (8 hours) |
|                              | Chapter 2: Crystal binding (6 hours) |
|                              | Chapter 3: Crystal vibrations and thermal properties (10 hours) |
|                              | Chapter 4: Defects in crystal (6 hours) |
|                              | Chapter 5: Energy bands (10 hours) |
|                              | Chapter 6: Free electron fermi gas (8 hours) |
| <strong>DIDACTIC METHODS</strong>         | lecture with exercises    |
| <strong>GRADING</strong>                  | 50 % exam + 50 % usual results |
| <strong>BIBLIOGRAPHIES</strong>           | 1. Jinfeng Wang, Solid State Physics, Shadong University, 2013 |
|                              | 2. Charles Kittel, Introduction to Solid State Physics, 2005 |</p>
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| **COURSE NAME** | Physical Optics (Eng)  
物理光学(英) |
| **COURSE CODE** | 12002700 |
| **LOCATION** | University of Shanghai for Science and Technology |
| **SEMESTER** | 4 |
| **RESPONSIBLE FOR THIS COURSE** | YUAN Shuai |
| **CREDIT POINTS** | 2 ECTS |
| **HOURS OR WEEKS** | 32 hours |
| **COURSE OBJECTIVES** | The course aims to make students understand the basic concept of physical optics and get an overview of the optical world. |
| **PREREQUISITES** | Mathematics, Physics |
| **COURSE CONTENTS** | 1. General Introduction to physical optics;  
2. Basic theory of electromagnetic waves;  
3. The light reflection and refraction on the boundary of two different media;  
4. The interference of light waves;  
5. Typical installation of interference and their applications;  
6. The diffraction of light waves;  
7. Typical installation of diffraction and their applications;  
8. The polarization of light waves;  
9. The optical instruments;  
10. Modern optics and the concept of Laser system;  
11. The generation of polarized light waves and their applications;  
12. Conclusion. |
<p>| <strong>DIDACTIC METHODS</strong> | Lecture &amp; experiment |
| <strong>GRADING</strong> | Written Examination + Oral Test |</p>
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| COURSE NAME | Project of Single-Chip Microcomputer (Eng)  
                  单片机课程设计(英) |
| COURSE CODE | 12101340  |
| LOCATION   | University of Shanghai for Science and Technology |
| SEMESTER   | 3         |
| RESPONSIBLE FOR THIS COURSE | XIA Chunlei  
                  夏春蕾 |
| CREDIT POINTS | 2 ECTS  |
| HOURS OR WEEKS | 2 weeks  |

## COURSE OBJECTIVES
Be familiar with the design of an entire application system including system design, hardware design and software design based on single-chip microcomputer.

## PREREQUISITES
Principles of Microprocessor on single chip

## COURSE CONTENTS
Some design topics are provided here as following. Each team (3~4 students) needs to select one as target and each student needs to finish at least one of the tasks in project.

Some Typical Design Topics:
1. **The digital voltmeter design** including multiple input signals, 0 to 10V voltage testing, and optional display according to the test result.
2. **The clock system** design including records of hour, minute, second and millisecond choose of 12 hours or 24 hours, hourly chime and on time alarm and the setting option.
3. **The smart temperature measurement system** based on DS18B20 with the functions such as -55 to 125℃ testing scope, setting top and bottom limitation alarm, real time display and so on.
4. **The traffic light control system** experiments for two crossroads with the functions such as manual and auto control switch, setting passing time, adjusting the passing mode according to the special vehicle request. Other possible options:

## DIDACTIC METHODS
Laboratory teaching

## GRADING
Design work 70 % + report 15 % + daily work 15 %

## BIBLIOGRAPHIES
3. Song Xuesong, Li Dongming etal. MCS51 Course: Step by step (C Programming Language), Tsinghua Press, 2014.5
5. Han Jianguo, Shu Xiongying, Foundation and Application of Microcontroller, China measurement Publishing House, 2010.2
<table>
<thead>
<tr>
<th>SYLLABUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>DATE</td>
</tr>
<tr>
<td>COURSE NAME</td>
</tr>
<tr>
<td>LOCATION</td>
</tr>
<tr>
<td>SEMESTER</td>
</tr>
<tr>
<td>RESPONSIBLE FOR THIS COURSE</td>
</tr>
<tr>
<td>CREDIT POINTS</td>
</tr>
<tr>
<td>HOURS OR WEEKS</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>COURSE OBJECTIVES</th>
</tr>
</thead>
<tbody>
<tr>
<td>By the end of Chinese I, students should be able to</td>
</tr>
<tr>
<td>• identify, upon hearing, any of the tones of a word in Mandarin.</td>
</tr>
<tr>
<td>• spell any word of Chinese according to the conventions of Pinyin.</td>
</tr>
<tr>
<td>• write, for any Chinese character listed in the schedule, the English equivalent and its Pinyin spelling.</td>
</tr>
<tr>
<td>• write, for any English word covered in class, the Chinese equivalent in Pinyin.</td>
</tr>
<tr>
<td>• write, for any “Active” character listed in the Chinese Characters Schedule, the English equivalent and its Pinyin spelling.</td>
</tr>
<tr>
<td>• pronounce, with correct tones, vocabulary items taught in class—both those from <em>Survival Chinese</em> and those from the Chinese Characters Schedule.</td>
</tr>
<tr>
<td>• say, according to the conventions of Chinese, numerals in a variety of formats: dates, addresses, ages, prices, etc.</td>
</tr>
<tr>
<td>• converse, with reasonable fluency and the correct conventions of Chinese grammar, on any of the topics covered for this course in <em>Survival Chinese</em>.</td>
</tr>
<tr>
<td>• write, using the correct conventions of Pinyin and Chinese grammar, on any of the sentences covered for this course in <em>Survival Chinese</em>.</td>
</tr>
<tr>
<td>• recite in Mandarin, from memory, a Tang dynasty poem.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PREREQUISITES</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>COURSE CONTENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chinese I is designed to help students with little or no background in the subject to acquire survival fluency in spoken and written Mandarin Chinese, the national language of China. Lessons cover basic language interactions such as shopping, eating, getting help, etc.</td>
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<table>
<thead>
<tr>
<th>DIDACTIC METHODS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classroom teaching</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>GRADING</th>
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<tbody>
<tr>
<td>Chinese I</td>
</tr>
<tr>
<td>Quizzes 50%</td>
</tr>
<tr>
<td>Tang dynasty poem 10%</td>
</tr>
<tr>
<td>Written Exam 30%</td>
</tr>
<tr>
<td>Oral Exam 10%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BIBLIOGRAPHIES</th>
</tr>
</thead>
</table>

NOTE: Copies of the above book is already available at the CSP for you to keep.
<table>
<thead>
<tr>
<th><strong>SYLLABUS</strong></th>
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<tbody>
<tr>
<td><strong>COURSE NAME</strong></td>
<td>Chinese 2</td>
</tr>
<tr>
<td><strong>LOCATION</strong></td>
<td>University of Shanghai for Science and Technology</td>
</tr>
<tr>
<td><strong>SEMESTER</strong></td>
<td>Semester 4</td>
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<td><strong>RESPONSIBLE FOR THIS COURSE</strong></td>
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<tr>
<td><strong>CREDIT POINTS</strong></td>
<td>4 ECTS</td>
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<tr>
<td><strong>HOURS OR WEEKS</strong></td>
<td>4 hours/week</td>
</tr>
<tr>
<td><strong>COURSE OBJECTIVES</strong></td>
<td>By the end of Chinese II, students should be able to do all of the above for the additional topics that have been covered, as well as be able to • explain linguistic aspects of Chinese, oral and written. • appreciate the factors involved in translating from Chinese to English. • learn how to input Chinese characters as text via a computer</td>
</tr>
<tr>
<td><strong>PREREQUISITES</strong></td>
<td>none</td>
</tr>
<tr>
<td><strong>COURSE CONTENTS</strong></td>
<td>Chinese II focuses on acquiring low-intermediate fluency in spoken and written Mandarin Chinese so that a student can handle situations such as travel planning, illness, making appointments, etc. All students will also learn other aspects of the language, such as the categories and make-up of Chinese characters, issues relating to traditional and simplified characters, and Chinese dialects.</td>
</tr>
<tr>
<td><strong>DIDACTIC METHODS</strong></td>
<td>Classroom teaching</td>
</tr>
<tr>
<td><strong>GRADING</strong></td>
<td>Quizzes 50% Chinese pop song assg. 10% Written Exam 30% Oral Exam 10%</td>
</tr>
<tr>
<td><strong>BIBLIOGRAPHIES</strong></td>
<td>Snow, Don (2002). <em>Survival Chinese</em>. Beijing: Commercial Press NOTE: Copies of the above book is already available at the CSP for you to keep</td>
</tr>
<tr>
<td>Programme:</td>
<td>Technical Physics</td>
</tr>
<tr>
<td>-------------------------</td>
<td>--------------------------------------------------------</td>
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<tr>
<td>Module designation:</td>
<td>Mathematical Methods for Physicists</td>
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<tr>
<td>Abbreviation, if any:</td>
<td>MMP</td>
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<tr>
<td>Subtitle, if any:</td>
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<td>Instruction events, if any:</td>
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</tr>
<tr>
<td>Semesters:</td>
<td>5</td>
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<tr>
<td>Person responsible for the module:</td>
<td>Prof. Dr. Maria Kufner</td>
</tr>
<tr>
<td>Lecturer:</td>
<td>Prof. Dr. Maria Kufner</td>
</tr>
<tr>
<td>Language:</td>
<td>English</td>
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<tr>
<td>Form of instruction/lecture hours per week:</td>
<td>Lecture, exercises, laboratory experiments / 6 hours per week</td>
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<tr>
<td>Level of work:</td>
<td>Tuition time: 90 hours</td>
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<td></td>
<td>Self-study: 150 hours</td>
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<tr>
<td>Credit points:</td>
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<tr>
<td>Prerequisites:</td>
<td>Mathematik 1, 2, 3</td>
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<tr>
<td>Course objectives/skills:</td>
<td>Understanding of the requirement of mathematical procedures for the solution of problems from physics.</td>
</tr>
<tr>
<td></td>
<td>Ability to apply mathematical standard operations on typical problems from physics, in particular integral transforms, differential equations, systems of ordinary differential equations, partial differential equations.</td>
</tr>
<tr>
<td></td>
<td>Recognition of limitations of standard operations and understanding with respect to the development of advanced mathematical methods beyond standard operations.</td>
</tr>
<tr>
<td>Content:</td>
<td>Integral transformas (Fourier transform, Laplace transform)</td>
</tr>
<tr>
<td></td>
<td>Higher order differential equations, boundary value problems, , Linear systems of ordinary differential equations, in particular with constant coefficients, Partial differential equations: diffusion equation, wave equation, partial differential equations with cylindrical and with spherical symmetry</td>
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<tr>
<td>Programme examination requirements:</td>
<td>Written exam 120 min</td>
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<tr>
<td>Media forms:</td>
<td>multi-media equipment, black board, script</td>
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<td>Technical Physics</td>
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<tr>
<td>Module designation:</td>
<td>Computer Based Measurement Technology</td>
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<td>Subtitle, if any:</td>
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<td>Semesters:</td>
<td>5</td>
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<tr>
<td>Person responsible for the module:</td>
<td>Prof. Dr. Conrad Wolf</td>
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<td>Language:</td>
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<td>Form of instruction/lecture hours per week:</td>
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<td>Level of work:</td>
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<td>Self-study: 90 hours</td>
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<td>Credit points:</td>
<td>5 ECTS</td>
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<tr>
<td>Prerequisites:</td>
<td>Applied electrical engineering and electronics, computer science</td>
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<tr>
<td>Course objectives/skills:</td>
<td>Knowledge and basic understanding of measurement principles, hardware (e.g. amplifier circuits, ADC types, interfaces) and measurement procedures (e.g. sampling, windowing). Ability to produces measurement software with the graphical programming language LabVIEW. Ability to solve measurement problems autonomously (selection of hardware, programming, data analysis)</td>
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<tr>
<td>Content:</td>
<td>Lecture: Introduction (measurement basics, electronic measurement, computer-based measurement, measurement chain) Sensors (mechanical, thermodynamic, electromagnetic, optical measurement variables) Signal processing (conversion, amplification, adaption of measurement range, filter) Data sampling (computer numbers, sample and hold, DAC, ADC, measurement equipment, sampling theory, windowing) Interfaces &amp; protocols (communication models, network topologies, RS-232, USB, GPIB, VXI, PXI, VISA, SCPI) Measurement data processing (DFT, Digital filters) LabVIEW class: Introduction (LabVIEW development environment) Control flow (CASE, FOR, WHILE, Sequence, Scripting and formula nodes, Global and local variables) Data types and structures (Arrays, Cluster, Waveform data, Graphs and charts, Strings) Structuring (Sub-Vis) File and Hardware I/O (Basic file handling, Measurement instrumentation access) Design Patterns (State machine, Functional global variable, Producer and consumer Loops, Error handling, Timing) Data Sockets Practical Exercises: Resistivity measurement (shunt, Wheatstone bridge, Pt100, DMS) Amplifier circuits (inverting amplifier, differential amplifier, instrumentation amplifier, thermocouple, current-voltage-converter, photodiode) Control of a DSO with LabVIEW (SCPI-commands, virtual instrument) Measurement of time signal and spectrum with a DAQ-board (NI DAQmx, sampling theorem, aliasing, windowing)</td>
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<tr>
<td>Programme examination requirements:</td>
<td>Written exam</td>
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</tr>
<tr>
<td>Media forms:</td>
<td>multi-media equipment, PC, black board</td>
</tr>
</tbody>
</table>
| Literature:                         | B. Buckman:  
Computer-based Electronic Measurement  
Prentice Hall (2001) |
|                                     | G. D’Antona, A. Ferrero  
Digital Signal Processing for Measurement Systems  
Springer (2005) |
|                                     | R. Bishop:  
LabVIEW 2009 Student Edition  
Prentice Hall (2009) |
|                                     | S. Sumathi, P. Surekha  
LabVIEW Based Advanced Instrumentation Systems  
Springer (2007) |
<table>
<thead>
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<th>Programme:</th>
<th>Technical Physics</th>
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<tr>
<td>Module designation:</td>
<td>Physics 5</td>
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<td>Subtitle, if any:</td>
<td>Advanced Solid State Physics</td>
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<td>Instruction events, if any:</td>
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<tr>
<td>Semesters:</td>
<td>5</td>
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<tr>
<td>Person responsible for the module:</td>
<td>Prof. Dr. Klaus Drese</td>
</tr>
<tr>
<td>Lecturer:</td>
<td>Prof. Dr. Klaus Drese</td>
</tr>
<tr>
<td>Language:</td>
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<tr>
<td>Form of instruction/lecture hours per week:</td>
<td>Lecture, exercises, laboratory experiments / 4 hours per week</td>
</tr>
</tbody>
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| Level of work: | Tuition time: 60 hours  
Self-study: 90 hours |
| Credit points: | 5 ECTS |
| Prerequisites: | Physics 1-4, Mathematics 1-3, Mathemtics Methods of Physics |
| Course objectives/skills: | • Knowledge of physical properties of solids.  
Understanding of their technological applications.  
• Understanding of methods for the measurement fundamental physical properties of solids  
• Basic knowledge of quantum physical description of solids |
| Content: | Solid state physics: Electronic band structure, electrical conductivity, thermal, optical and magnetic properties. |
| Programme examination requirements: | Written exam 90 min |
| Media forms: | multi-media equipment, PC, black board, script |
| Literature: | C. Kittel: Introduction to Solid State Physics, Wiley, Hoboken, 2005  
<table>
<thead>
<tr>
<th>Programme:</th>
<th>Technische Physik</th>
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<tbody>
<tr>
<td>Module designation:</td>
<td>Materials Science</td>
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<td>5</td>
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<tr>
<td>Person responsible for the module:</td>
<td>Prof. Dr. Peter Weidinger</td>
</tr>
<tr>
<td>Lecturer:</td>
<td>Prof. Dr. Peter Weidinger</td>
</tr>
<tr>
<td>Language:</td>
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<tr>
<td>Form of instruction/lecture hours per week:</td>
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<td>Level of work:</td>
<td>Tuition time: 60 hours</td>
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<td>Credit points:</td>
<td>5 ECTS</td>
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<tr>
<td>Prerequisites:</td>
<td>none</td>
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<tr>
<td>Course objectives/skills:</td>
<td>Students are enabled to understand the basic facts of material science. Furthermore, they get explained topical keywords, whose knowledge allows them to realize and to describe fundamental relationships.</td>
</tr>
<tr>
<td>Content:</td>
<td>Introduction to the science of metallic materials with particular consideration of the dependence of material properties from processing treatments. Compilation and interpretation of phase diagrams. Introduction into the technology of plastics, ceramics, special and compound materials. Introduction to material testing methods and standards.</td>
</tr>
<tr>
<td>Programme examination requirements:</td>
<td>written exam 90 min</td>
</tr>
<tr>
<td>Media forms:</td>
<td>multi-media equipment, PC, black board</td>
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<tr>
<td>Programme:</td>
<td>Technical Physics</td>
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<td>Module designation:</td>
<td>Physics 6</td>
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<tr>
<td>Abbreviation, if any:</td>
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<tr>
<td>Subtitle, if any:</td>
<td>Quantum physics concepts, atomic and nuclear physics</td>
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<td>Instruction events, if any:</td>
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<td>Semesters:</td>
<td>5</td>
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<tr>
<td>Person responsible for the module:</td>
<td>Prof. Dr. Michael Wick</td>
</tr>
<tr>
<td>Lecturer:</td>
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<td>Language:</td>
<td>English</td>
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<tr>
<td>Form of instruction/lecture hours per week:</td>
<td>Lecture, exercises, laboratory experiments / 4 hours per week</td>
</tr>
</tbody>
</table>
| Level of work: | Tuition time: 60 hours  
Self-study: 80 hours |
| Credit points: | 5 ECTS |
| Prerequisites: | Physics 1 to 4, Mathematical 1 to 3, Mathematical Methods |
| Course objectives/skills: | • Knowledge of quantum physical concepts and their application to simple systems  
• Ability to perform fundamental experiments from atomic and nuclear physics  
• Knowledge of the atomic structure and the fundamental understanding of atomic and molecular spectra  
• Understanding of the structure of nuclei, the radioactive decay and simple nuclear reactions, including their technical applications.  
• Introduction in molecular physics |
| Content: | Fundamentals of quantum mechanics, hydrogen atom, atoms with several electrons, atoms in external fields, molecule structures, nucleons, nuclear models, nuclear radiation, radiation detectors. |
| Programme examination requirements: | Written exam 90 min |
| Media forms: | multi-media equipment, PC, black board, script |
**Programme:** Technical Physics

**Module designation:** Practice related module

**Abbreviation, if any:** --

**Subtitle, if any:** Internship Preparation Seminar

**Instruction events, if any:** --

**Semesters:** 5

**Person responsible for the module:** Katja Zimmer

**Lecturer:** Katja Zimmer

**Language:** English and German

**Form of instruction/lecture hours per week:** Lecture, exercises / 2 hours per week

**Level of work:** Tuition time: 30 hours  
Self-study: 60 hours

**Credit points:** 3 ECTS

**Prerequisites:** --

**Course objectives/skills:** To raise intercultural awareness in preparation for business life (internship) in Germany  
To be successful in the internship and integrate into a German team  
Students will gain an understanding of how to apply in Germany and obtain working knowledge.

**Content:** Intercultural training  
- Cultural differences in China and Germany  
- Culture models, learning traditions, communication styles  
- Working culture: intercultural communication in business

Internship training  
- Finding an internship – careers and interests  
- How to write a motivation letter  
- How to prepare and hold a job interview  
- Communication in business life; formal e-mail communication  
- How to write an internship report

**Programme examination requirements:** written report/letter of motivation, essay

**Media forms:** multi-media equipment, PC, black board, online material

**Literature:**
### Programme:
Technical Physics

### Module designation:
Practice related module

### Abbreviation, if any:
--

### Subtitle, if any:
Internship seminar

### Instruction events, if any:
--

### Semesters:
6

### Person responsible for the module:
Katja Zimmer

### Lecturer:
All Professors participating in the program

### Language:
English

### Form of instruction/lecture hours per week:
Project work and report

### Level of work:
Tuition time: 15 hours
Self-study: 45 hours

### Credit points:
2 ECTS

### Prerequisites:
Detailed knowledge of all relevant topics of the program;
Ability to work in a self-dependent way;
Language skills sufficient for a written report and communication in a company

### Course objectives/skills:
Ability to carry out practical studies on a specific project in a self-reliant way;
Ability to write a well-structured and consistent report about the results;
Ability to solve a practical problem in a well-structured procedure under industrial conditions;
Ability for productive work in a team;
Ability to communicate with colleagues about the project work and to give an oral presentation of the results

### Content:
Join a company or a research institute and work on a practical project in cooperation with the employees there, leading to a significant contribution to the project result and a written report

### Programme examination requirements:
Report, oral presentation

### Media forms:
multi-media equipment, PC, black board

### Literature:
Project-specific documents and publications, patents, instructions of the company or the research institute
<table>
<thead>
<tr>
<th>Programme:</th>
<th>Technische Physik</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module designation:</td>
<td>Language</td>
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<tr>
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<td>Subtitle, if any:</td>
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<tr>
<td>Instruction events, if any:</td>
<td>Several courses from Studium Generale</td>
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<td>Semesters:</td>
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<td>several</td>
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<td>Tuition time: 30 hours Self-study: 30 hours</td>
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<td>Prerequisites:</td>
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<tr>
<td>Course objectives/skills:</td>
<td>Training of practical skills in a foreign language (e.g. German, Mandarin)</td>
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<tr>
<td>Content:</td>
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<tr>
<td>Media forms:</td>
<td>multi-media equipment, PC, black board, scripts, language laboratory</td>
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<tr>
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<td>Literature will be announced in the course.</td>
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<td>Elective: Scientific Reporting and Documentation</td>
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<td>SDR</td>
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<tr>
<td>Semesters:</td>
<td>7</td>
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<td>Katja Zimmer</td>
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<td>Katja Zimmer</td>
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<td>Form of instruction/lecture hours per week:</td>
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<td>Self-study: 60 hours</td>
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<td>Basic knowledge of scientific writing</td>
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<tr>
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<td>Become acquainted with scientific writing on a researchers level</td>
</tr>
<tr>
<td></td>
<td>Knowing of different sorts of scientific writing</td>
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<tr>
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<td>Ability in using correct citation of different styles for different publications</td>
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<tr>
<td>Content:</td>
<td>How to plan and write a report for an experiment or a project</td>
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<tr>
<td></td>
<td>How to write a thesis, expectations for a thesis at University of Coburg,</td>
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<tr>
<td></td>
<td>Differences for different reports</td>
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<td>How to concept and prepare a scientific poster for a conference</td>
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<td>How to write a paper for a journal</td>
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<td>Written examination (closed book)</td>
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<td>Multi-media equipment, PC, visualizer, blackboard practical exercises, homework</td>
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<td>Semesters:</td>
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<tr>
<td>Person responsible for the module:</td>
<td>Prof. Dr. Michael Wick</td>
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<td>Prof. Dr. Michael Wick</td>
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<tr>
<td>Language:</td>
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<td>Form of instruction/lecture hours per week:</td>
<td>Lecture, exercises, laboratory experiments / 2 hours per week or block course</td>
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<td>Numerical solution processes</td>
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<tr>
<td>Course objectives/skills:</td>
<td>Understand the Finite Element Method. Use the Finite Element Software “COMSOL Multiphysics”</td>
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<tr>
<td>Content:</td>
<td>Based on the Finite Element Software “COMSOL Multiphysics”, know how to solve a project, in respects of, e.g. Heat Transfer, Electromagnetic, Acoustic, Structural Mechanics, Fluidics, and Wave Optics.</td>
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<td>Programme examination requirements:</td>
<td>Written examination</td>
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<tr>
<td>Media forms:</td>
<td>Beamer and board/whiteboard, Electronic scripts and working documents, PCs with programming environment</td>
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<td>Instruction events, if any:</td>
<td>Independent working on a topic related to engineering physics in terms of a research project including all research facilities of the faculty.</td>
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<td>Lecturer:</td>
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<td>Working on the project based in the conceptual project design which is agreed on in cooperation with the supervisor</td>
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<td>Detailed knowledge of all relevant topics of the programme; Ability to work in a self dependent way; Language skills sufficient for a written report and communication in the faculty</td>
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<td>Course objectives/skills:</td>
<td>The project work motivates the student to work independent and motivated on a topic of his/her own choice. Ability to carry out practical studies on a specific project in a self-reliant way; Ability to write a well structured and consistent report about the results; Ability to solve a practical problem in an independent way Ability to give an oral presentation of the results</td>
</tr>
<tr>
<td>Content:</td>
<td>Independent working on a topic related to engineering physics in terms of a research project, in a fixed period. Including all research facilities of the faculty in cooperation with academic and scientific employees of the faculty</td>
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<td>Programme examination requirements:</td>
<td>Written student project, presentation</td>
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<td>Media forms:</td>
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<td>Course objectives/skills:</td>
<td>Ability to use own knowledge and methodological skills to approach and solve practical issues in the field of Engineering Physics. The students work on their presentation skills.</td>
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<tr>
<td>Content:</td>
<td>Students will present and discuss their scientific work and methods through: Exchange of experience Short presentations during the thesis writing Final presentation with discussion</td>
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<td>Programme examination requirements:</td>
<td>oral presentation, written abstract of the topic or poster presentation</td>
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<tr>
<td>Media forms:</td>
<td>multi-media equipment, PC, black board</td>
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<td>Literature:</td>
<td>Bachelor thesis of participants, scientific articles, reviews</td>
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<td>Prerequisites:</td>
<td>Detailed knowledge of all relevant topics of the programme; Ability to work in a self-dependent way; Language skills sufficient for a written thesis and an oral presentation</td>
</tr>
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<td>Course objectives/skills:</td>
<td>Ability to carry out scientific studies on a specific subject in a self-reliant way; Ability to write a well-structured and consistent report about the results compliant to the standards of scientific publishing; Thorough knowledge of methods of scientific information retrieval; Ability to give an oral presentation of the results</td>
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<tr>
<td>Content:</td>
<td>Studies on a topic specified by a lecturer of the programme, leading to a written thesis and an oral presentation to the faculty</td>
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<tr>
<td>Programme examination requirements:</td>
<td>Thesis, oral presentation 30-45 min</td>
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<td>Media forms:</td>
<td>multi-media equipment, PC, black board</td>
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### SYLLABUS “OPTOELECTRONIC ENGINEERING”

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<tr>
<td>COURSE NAME</td>
<td>Optoelectronics (Eng)</td>
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<tr>
<td>COURSE CODE</td>
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<tr>
<td>LOCATION</td>
<td>Ostbayerische Technische Hochschule Regensburg</td>
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<td>SEMESTER</td>
<td>7</td>
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<tr>
<td>RESPONSIBLE FOR THIS COURSE</td>
<td>Prof. Dr. Rupert Schreiner</td>
</tr>
<tr>
<td>CREDITS</td>
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<tr>
<td>HOURS OR WEEKS</td>
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| COURSE OBJECTIVES | The students shall learn to know the fundamentals, the design, the technology and the operation of optoelectronic materials and modern optoelectronic devices (e.g. LED, OLED, Semiconductor Lasers, integrated optoelectronic circuits and photo-detectors). Based on this knowledge they should be able to read scientific publications in this field. |

| COURSE CONTENTS | Part I: Fundamentals  
|                 | 1. Light waves (Propagation of Light)  
|                 | 1.1 Ray Tracing  
|                 | 1.2 Light waves  
|                 | 1.3 Maxwell-Theory of EM-waves  
|                 | 1.4 Dielectric waveguides  
|                 | 2. Photons (Emission and Detection of Light)  
|                 | 2.1 Discrepancies between Maxwell’s Theory and Experiments  
|                 | 2.2 Light as a particle (Photon), Light-Particle dualism  
|                 | 2.3 Emission and absorption of light  
|                 | 2.4 Illumination and color perception  
|                 | 2.5 Optical gain and laser radiation  
|                 | 3. Opto-Semiconductors  
|                 | 3.1 Energy band model; direct and indirect semiconductors  
|                 | 3.2 Undoped and doped opto-Semiconductors  
|                 | 3.3 Semiconductor diode theory  
|                 | 3.4 Heterostructures / Technology of III-V-semiconductors  
|                 | Part II: Applications  
|                 | 4. LED’s  
|                 | 4.1 Excess recombination  
|                 | 4.2 Electro-optical characteristics  
|                 | 4.3 Radiative and non-radiative recombination  
|                 | 4.4 Measures for increasing efficiency  
|                 | 4.5 Emission spectrum  
|                 | 4.6 OLED  
|                 | 4.7 Modulation behavior  
|                 | 5. Optical Amplification and Semiconductor Lasers  
|                 | 5.1 First Laser condition (inversion condition)  
|                 | 5.2 Second laser condition (optical gain)  
|                 | 5.3 Technical realization of inversion  
|                 | 5.4 Electro-optical characteristic in cw-mode  
|                 | 5.5 Emission spectrum  
|                 | 5.6 wavelength tunable lasers  
|                 | 5.7 Modulation behavior  
|                 | 6. Photodetectors, solarcells and semiconductor optical modulators  
|                 | 6.1 Internal photoeffect |
| 6.2 Electrical characteristics of illuminated pn-junctions ("photo elements") |
| 6.3 Solar cells |
| 6.4 pin-photo diodes |
| 6.5 electro-optic modulators |
| 7. Optoelectronic Sensor-Systems |
| 7.1 Opto-electrical bridge circuit |
| 7.2 PS-Detectors / CCD-arrays |
| 7.3 Fiber-optic sensors |

**DIDACTIC METHODS**
Lecture supported by blackboard or visualizer and beamer, exercises

**GRADING**
Final exam (70%) + performance (30%);

**BIBLIOGRAPHIES**
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</table>
| **COURSE OBJECTIVES** | Help the students to understand the concept of Determinant, matrix, linear equations, vector spaces, eigenvalues eigenvectors, quadratic:
Help the students to grasp the basic theory and methods of Linear algebra;
Develop the students’ to solve practical problems. |
| **PREREQUISITES** | Mathematics |
| **COURSE CONTENTS** | 1. Introduction
2. Foundations of Optics
   Physics of Light (Maxwell equation, wave propagation, electromagnetic waves, polarization, plane waves, Gaussian Beam (paraxial wave equation), energy (pointing vector), free-space and waveguide propagation)
   Scattering: Rayleigh and Mie Theory
   Interaction of radiation with matter:
   Laser basics, Fresnel equations, power transmission and reflection
   The dielectrical function and optical properties of matter:
   Refractive index and absorption, metal optics, Plasmafrequency
   Photometry
2.1 Properties of natural and technical light sources
   Blackbody radiation: Plank’s laws of radiation
   Coherence (temporal, spatial)
2.2 Geometrical Optics (reflection and refraction, internal reflection)
   Lenses, microscopy, telescopes, special lenses e.g. telecentric lens
   Controlling light: Pockels cell, optical diodes, Prisms, Birefringence
2.3 Interference and diffraction
   Michelson, Mach-Zehnder, Speckles
3. Detection of Light
   Overview: Common detectors and their properties
   Noise in optical detection; S/N , NEP, Detectivity
4. Optical measurement techniques
   4.1 Distance measurement
      4.1.1 Time of flight
      4.1.2 Triangulation
      4.1.3 Confocal techniques
   4.2 Velocity measurement, LDA Laser doppler anemometry
   4.3 Meas. surface properties: Profile measurement, roughness measurement
   4.4 Ellipsometry, Meas. Layer thickness
   4.5 Interferometry (incl. Speckle interferometry)
   4.6 Methods of spectroscopy
      4.6.1 IR spectroscopy
      4.6.2 Raman, CARS, BOXCARS
   4.7 LIF and LIDAR |
5. Image processing methods – basics of Fourier optics
   5.1 Dark field and Schlieren photography
6. Optical fiber
   6.1 Geometrical-Optics Description (ray optics, step-index fiber, graded-index fibers)
   6.2 Fiber Modes (fiber modes of step-index fibers, fiber modes of gradient index fibers, single mode fiber)
   6.3 Material Characteristics of fibers (losses, dispersion, mechanical properties of fibers)
   6.4 Fiber Manufacturing (design issues, fabrication methods, cables)
7. Signal Degradation in Optical Fibers
   7.1 Attenuation (Absorption, scattering losses, bending losses)
   7.2 Signal Distortion in Optical Waveguides (Information capacity determination, bandwidth-distance product, group delay, material dispersion, waveguide dispersion, intermodal dispersion)
8. Power Launching and Coupling
   8.1 Coupling Loss (phase space, coupling loss of multimode systems, coupling loss of single mode systems)
   8.2 Source to Fiber Power Launching (power-coupling calculations, lensing schemes for coupling improvements)
   8.3 Fiber optic connectors (ferrule, split-sleeve, assembly of fiber optic connectors, multichannel connectors, insertion loss, return loss, measurement techniques)
9. Alignment Metrology and Techniques
   9.1 Alignment Techniques (active automated alignment, hybrid active/passive automated alignment, passive automated alignment)
   9.2 Examples of Micro-Optic Based Components (Coupling radiation from a Laser Diode into a fiber, coupling radiation form a fiber into a photodetector, packaging of optical subassemblies, attenuator, mechanical optical switch, beam splitter.)

DIDACTIC METHODS
Lecture supported by blackboard or visualizer and beamer, exercises

GRADING
Final exam(70%) + Performance report (30%);

BIBLIOGRAPHIES
7. Bergmann, Schäfer “Lehrbuch der Experimentalphysik” Band III, Optik, Walter de Gruyter Verlag
# SYLLABUS “OPTOELECTRONIC ENGINEERING”

<table>
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<td>COURSE CODE</td>
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<td>LOCATION</td>
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<td>RESPONSIBLE FOR THIS COURSE</td>
<td>Prof. Dr. Rupert Schreiner</td>
</tr>
<tr>
<td>CREDITS</td>
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<tr>
<td>HOURS OR WEEKS</td>
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## COURSE OBJECTIVES
The students shall learn to know the principles of lasers. All standard laser materials (solid state, gas, dye, etc.) will be covered. Based on this knowledge they shall be able to read scientific publications in this field.

## PREREQUISITES

## COURSE CONTENTS

1. Characterization of light
   - Temporal and spatial coherence
   - Photon statistic and blackbody radiator
   - Sources of radiation

2. Interaction of electromagnetic waves with atomic systems
   - Radiation field
   - Emission and absorption of electromagnetic radiation
   - Spontaneous and induced emission
   - Two level system, thermal equilibrium
   - Population density balance

3. Spectral lines and line shape
   - Spectral line broadening

4. Physical elements of lasers
   - Storage of light: Resonator types and their geometry
   - Losses of resonators
   - Modes in optical resonators
   - Wavelength selection
   - Q-switch
   - Nonlinear optics, frequency doubling etc.

5. The laser principle
   - Creation of a population inversion
   - Three and four level system
   - Amplification of light and feedback
   - Theoretical efficiency of lasers
   - Threshold condition
   - Bandwidth and mode spectrum
   - Dynamic of laser systems

6. Beam propagation
   - The Gauss beam
   - Focusing of laser beams
   - Atmospheric transmission and turbulence

7. Example of real laser systems
   - Gas laser: CO2 laser, Excimer laser, HeNe laser, Ar-ion laser
   - Diode lasers
   - Solid state laser: NdYag laser, ErYag laser
   - Diode pumped solid state lasers
   - Dye lasers

8. Technical aspects of optical elements used in lasers
| Metal mirrors versus dielectric mirrors |
| Brewster - plates |
| Electro-optical active elements, Pockels and Kerr cell (Q-switch details) |
| Polarizers |
| Beam steering elements – Laser optics |
| **9. Theory of Laser beam material interaction** |
| Metals, Plasma frequency |
| Dielectrics, isolators, |
| Semiconductors |
| **10. Applications** |
| Cutting, welding, annealing, hole drilling |
| Micro machining with lasers |
| Lasers for measurement and analytics |
| Distance measurement, rangefinders |
| Other applications: CD player … |
| **11. Eye Safety – Laser hazards** |

**DIDACTIC METHODS**  
Lecture supported by blackboard or vizualizer and beamer, exercises, laboratory experiments

**GRADING**  
Final exam (70%) + Performance report (30%);

**BIBLIOGRAPHIES**  
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