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<tr>
<th>Code</th>
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<tbody>
<tr>
<td>phy509</td>
<td>Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>phy513</td>
<td>Basic Laboratory</td>
<td>5</td>
</tr>
<tr>
<td>phy520</td>
<td>Electrodynamics and Optics</td>
<td>7</td>
</tr>
<tr>
<td>phy540</td>
<td>Mathematical Methods for Physics and Engineering I</td>
<td>9</td>
</tr>
<tr>
<td>phy031</td>
<td>Atomic and Molecular Physics</td>
<td>10</td>
</tr>
<tr>
<td>phy041</td>
<td>Thermodynamics and Statistics</td>
<td>12</td>
</tr>
<tr>
<td>phy505</td>
<td>Lab Project I</td>
<td>13</td>
</tr>
<tr>
<td>phy541</td>
<td>Mathematical Methods for Physics and Engineering II</td>
<td>15</td>
</tr>
<tr>
<td>phy542</td>
<td>Mathematical Methods for Physics and Engineering III</td>
<td>16</td>
</tr>
<tr>
<td>phy551</td>
<td>Quantum Structure of Matter</td>
<td>17</td>
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<tr>
<td>phy555</td>
<td>Basic Engineering</td>
<td>19</td>
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<tr>
<td>phy563</td>
<td>Specialization</td>
<td>21</td>
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<tr>
<td>phy570</td>
<td>Electronics</td>
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<tr>
<td>phy581</td>
<td>Materials Sciences</td>
<td>24</td>
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<tr>
<td>phy590</td>
<td>Control Systems</td>
<td>25</td>
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<tr>
<td>phy501</td>
<td>Numerical Methods</td>
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<td>phy502</td>
<td>Solid State Physics</td>
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<td>phy533</td>
<td>Metrology</td>
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<td>bam</td>
<td>Bachelor´s Thesis Module</td>
<td>32</td>
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Modules for Engineering Physics

Basismodule

phy509 - Mechanics

<table>
<thead>
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<tbody>
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<td>Module abbreviation</td>
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<tr>
<td>Credit points</td>
<td>6.0 KP</td>
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<tr>
<td>Workload</td>
<td>180 h</td>
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<td>(Attendance: 84 hrs Self study: 96 hrs)</td>
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</table>

Applicability of the module

- Bachelor's Programme Engineering Physics (Bachelor) > Basismodule

Responsible persons

- Kittel, Achim (authorised to take exams)
- Kühn, Martin (authorised to take exams)
- Lienau, Christoph (authorised to take exams)
- Nilius, Niklas (authorised to take exams)
- Peinke, Joachim (authorised to take exams)
- Schäfer, Sascha (authorised to take exams)
- Uppenkamp, Stefan (authorised to take exams)
- Wollenhaupt, Matthias (authorised to take exams)
- Kühn, Martin (module responsibility)

Prerequisites

- Basic knowledge of mathematics acc. the pre-course of mathematics

Skills to be acquired in this module

- 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.

Module contents

- 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

Recommended reading

- P. A. Tipler, G. Mosca, D. Pelte, M. Basler: Physics/Physik. Spektrum Akademischer Verlag, 2004

Links

Language of instruction: English
Duration (semesters): 1 Semester
Module frequency: jährlich
Module capacity: unlimited

Teaching/Learning method

Previous knowledge

<table>
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<tr>
<th>Examination</th>
<th>Examination times</th>
<th>Type of examination</th>
</tr>
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<tbody>
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<td>weekly exercises, 2 hrs written exam or 45 min oral exam and assignment. Here you will find information about the consideration of bonus points</td>
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<td>Type of course</td>
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<td>SWS</td>
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<td>Lecture</td>
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<td>Exercises</td>
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<td><strong>Total module attendance time</strong></td>
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phy513 - Basic Laboratory

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<td>Credit points</td>
<td>9.0 KP</td>
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<tr>
<td>Workload</td>
<td>270 h (Präsenzzeit 140h, Selbststudium: 130h)</td>
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Applicability of the module
- Bachelor's Programme Engineering Physics (Bachelor) > Basismodule

Responsible persons
- Krüger, Michael (module responsibility)
- Koch, Sandra (module responsibility)
- Hück, Philipp (authorised to take exams)
- Hölling, Michael (authorised to take exams)
- Koch, Sandra (authorised to take exams)
- Krüger, Michael (authorised to take exams)
- Neu, Walter (authorised to take exams)
- Reck, Martin (authorised to take exams)
- Schellenberg, Markus (authorised to take exams)
- Schünig, Thomas (authorised to take exams)
- Silies, Martin (authorised to take exams)
- Teubner, Ulrich (authorised to take exams)

Prerequisites
- Simultaneous hearing of Mechanics & Electrodynamics and Optics lectures - Course I is a prerequisite for course II

Skills to be acquired in this module
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.

Module contents
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.

Recommended reading
See [http://www.physik.uni-oldenburg.de/Docs/praktika/45394.html](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.

Links
Language of instruction: English
Duration (semesters): 2 Semester
Module frequency: jährlich
Module capacity: unlimited
Reference text
The first part will take place in Oldenburg (Winter Semester)
The second part will take place in Emden (Summer Semester)

Module level
Type of module
Teaching/Learning method

Previous knowledge
<table>
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<tr>
<th>Examination</th>
<th>Examination times</th>
<th>Type of examination</th>
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<td>Final exam of module</td>
<td>Successful execution and record keeping of the experiments, presentation of the results in lectures.</td>
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Type of course
Practical training

SWS
8
Frequency
On-site workload
112 h
### PHY520 - Electrodynamics and Optics

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<td>Credit points</td>
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<tr>
<td>Workload</td>
<td>270 h</td>
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<td>Attendance 112 hrs Self study: 158 hrs</td>
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<td>Applicability of the module</td>
<td>Bachelor's Programme Engineering Physics (Bachelor) &gt; Basismodule</td>
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<tr>
<td>Responsible persons</td>
<td>Groß, Petra (authorised to take exams)</td>
</tr>
<tr>
<td></td>
<td>Kittel, Achim (authorised to take exams)</td>
</tr>
<tr>
<td></td>
<td>Lienau, Christoph (authorised to take exams)</td>
</tr>
<tr>
<td></td>
<td>Nilius, Niklas (authorised to take exams)</td>
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<td></td>
<td>Peinke, Joachim (authorised to take exams)</td>
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<td>Schäfer, Sascha (authorised to take exams)</td>
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<td>Schellenberg, Markus (authorised to take exams)</td>
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<td></td>
<td>Uppenkamp, Stefan (authorised to take exams)</td>
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<td>van de Par, Steven (authorised to take exams)</td>
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<td></td>
<td>Wollenhaupt, Matthias (authorised to take exams)</td>
</tr>
<tr>
<td></td>
<td>Silles, Martin (authorised to take exams)</td>
</tr>
<tr>
<td></td>
<td>van de Par, Steven (module responsibility)</td>
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<tr>
<td>Prerequisites</td>
<td>Mechanics</td>
</tr>
<tr>
<td>Skills to be acquired in this module</td>
<td>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.</td>
</tr>
<tr>
<td>Module contents</td>
<td>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 optics 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</td>
</tr>
<tr>
<td>Recommended reading</td>
<td>D. Meschede: Gerthsen, Physik. Springer, Berlin, 2005 (available in English)</td>
</tr>
<tr>
<td></td>
<td>P. A. Tipler, G. Mosca, D. Pelte, M. Basler: Physik. Spektrum Akademischer Verlag, 2004</td>
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<tr>
<td></td>
<td>W. Demtröder: Experimentalphysik, Band 2: Elektrizität und Optik. Springer, Berlin, 2004 (available in English)</td>
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<tr>
<td></td>
<td>W. Greiner: Klassische Elektrodynamik. Harri Deutsch, Frankfurt, 2002</td>
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<td></td>
<td>E. Hecht: Optik. Oldenbourg, München, 2005</td>
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<td></td>
<td>G. Schröder: Technische Optik, Vogel Verlag Würzburg, 2007</td>
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<td>Duration (semesters)</td>
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<td>Module frequency</td>
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<td>Type of course</td>
<td>Comment</td>
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<tr>
<td>Lecture</td>
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<td>Exercises</td>
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<td><strong>Total module attendance time</strong></td>
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Here, you will find information about the consideration of bonus points for module marks.

Module capacity unlimited

Module level

Type of module

Teaching/Learning method

Previous knowledge

<table>
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<tr>
<th>Examination</th>
<th>Examination times</th>
<th>Type of examination</th>
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<tbody>
<tr>
<td>Final exam of module</td>
<td>2 exams: 180 min written exam or 60 min oral exam</td>
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</table>
phy540 - Mathematical Methods for Physics and Engineering I

Module label | Mathematical Methods for Physics and Engineering I
---|---
Module abbreviation | phy540
Credit points | 9.0 KP
Workload | 270 h

- Präsenzzeit: 84 Stunden
- Selbststudium: 186 Stunden

Applicability of the module
- Bachelor's Programme Engineering Physics (Bachelor) > Basismodule
- Bachelor's Programme Physics, Engineering and Medicine (Bachelor) > Basismodule

Responsible persons
- Uppenkamp, Stefan (module responsibility)
- Doclo, Simon (authorised to take exams)
- Hohmann, Volker (authorised to take exams)
- Uppenkamp, Stefan (authorised to take exams)
- van de Par, Steven (authorised to take exams)

Prerequisites
- Abiturwissen Mathematik

Skills to be acquired in this module
To obtain basic knowledge in application of mathematical methods to solve problems in physics and engineering

Module contents
- Vector algebra (vectors in 2- and 3-space, vector products, planes, lines, cylindrical and spherical coordinates)
- Preliminary calculus (elementary functions, limits, series, differentiation, integration)
- Preliminary complex analysis
- Introduction to ordinary differential equations
- Partial differentiation
- Vector calculus (scalar and vector fields, vector operators, line, surface and volume integrals, divergence and Stokes' theorem)

Recommended reading

Links

Languages of instruction
- English, German

Duration (semesters)
- 1 Semester

Module frequency
- jährlich

Module capacity
- unlimited

Module level

Type of module

Teaching/Learning method

Previous knowledge

Examination | Examination times | Type of examination
---|---|---
Final exam of module | Max. 180 min written exam or 30 min oral exam. Here, you will find information about the consideration of bonus points for module marks.

Type of course | Comment | SWS | Frequency | Workload of compulsory attendance
---|---|---|---|---
Lecture | 4 | | 56 |
Exercises | 2 | | 28 |

Total module attendance time | 84 h
### Aufbaumodule

**phy031 - Atomic and Molecular Physics**

<table>
<thead>
<tr>
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<td>Workload</td>
<td>180 h</td>
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<td>Präsenzzzeit</td>
<td>84h, Selbststudium: 96h</td>
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#### Applicability of the module
- Bachelor's Programme Engineering Physics (Bachelor) > Aufbaumodule

#### Responsible persons
- Neu, Walter (module responsibility)
- Bayer, Tim-Daniel (authorised to take exams)
- Englert, Lars (authorised to take exams)
- Groß, Petra (authorised to take exams)
- Kittel, Achim (authorised to take exams)
- Lienau, Christoph (authorised to take exams)
- Neu, Walter (authorised to take exams)
- Nilius, Niklas (authorised to take exams)
- Pengel, Dominik (authorised to take exams)
- Schäfer, Sascha (authorised to take exams)
- Wollenhaupt, Matthias (authorised to take exams)
- Silles, Martin (authorised to take exams)

#### Prerequisites
Courses in Experimental Physics I and II and Mathematics I & II

#### Skills to be acquired in this module
The students are competent on the fundamental principles of atomic and molecular physics. They are familiar to classical description and have established a quantum mechanical understanding. The exercises and tutorials deepen the knowledge by assigning appropriate homework.

#### Module contents
- concepts of atomic models
- angular momentum, spin, and magnetic properties of the electrons
- interaction with electric and magnetic fields
- wave-particle dualism of electrons and photons
- introduction to quantum mechanics: wave packets, Schrödinger equation, Heisenberg uncertainty principle
- relativity and Dirac equation
- coupling schemes and atomic spectra
- Bosons and fermions
- periodic system of the elements
- introduction to molecular physics
- molecular spectra
- applications: the electron in the box, the harmonic oscillator, the hydrogen atom, fine and hyperfine structure, line shapes, spectroscopy and modern experimental methods

#### Recommended reading

#### Links

#### Language of instruction
English

#### Duration (semesters)
1 Semester

#### Module frequency
jährlich

#### Module capacity
unlimited

#### Reference text

#### Type of module
## Teaching/Learning method

### Previous knowledge

<table>
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<th>Examination</th>
<th>Examination times</th>
<th>Type of examination</th>
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<tr>
<td><strong>Final exam of module</strong></td>
<td>90 - 180 min. written examination (regular) or 30 - 45 min. oral exam (optional).</td>
<td><a href="http://www.uni-oldenburg.de/en/physics/studies/bonus-points">Here</a>, you will find information about the consideration of bonus points for module marks.</td>
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<table>
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<tr>
<td>Lecture</td>
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<td>Exercises</td>
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**Total module attendance time**

84 h
**phy041 - Thermodynamics and Statistics**

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<tr>
<td>Credit points</td>
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<tr>
<td>Workload</td>
<td>180 h (attendance: 84 hrs self study: 96 hrs)</td>
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**Applicability of the module**
- Bachelor's Programme Engineering Physics (Bachelor) > Aufbaumodule

**Responsible persons**
- Kittel, Achim (authorised to take exams)
- Lienau, Christoph (authorised to take exams)
- Nilius, Niklas (authorised to take exams)
- Peinke, Joachim (authorised to take exams)
- Schäfer, Sascha (authorised to take exams)
- Wollenhaupt, Matthias (authorised to take exams)

**Prerequisites**
- courses experimental physics 1, 2, 3

**Skills to be acquired in this module**
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.

**Recommended reading**

**Module contents**
- I. PHENOMENOLOGICAL THERMODYNAMICS
  - A) Fundamental Concepts
    - Temperature, thermal equilibrium, S. 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, Gibbs 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 (Plancks law)
  - Saha-Equation

**Recommended reading**

**Language of instruction**
- German

**Duration (semesters)**
- 1 Semester

**Module frequency**
- jährlich

**Module capacity**
- unlimited

**Module level**

**Type of module**

**Teaching/Learning method**

**Previous knowledge**

**Examination**

<table>
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<tr>
<th>Type of course</th>
<th>Comment</th>
<th>SWS</th>
<th>Frequency</th>
<th>Workload of compulsory attendance</th>
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<tbody>
<tr>
<td>Lecture</td>
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<td></td>
<td>56</td>
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<tr>
<td>Exercises</td>
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</table>

Total module attendance time 84 h

**Links**
phy505 - Lab Project I

<table>
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<tbody>
<tr>
<td>Module abbreviation</td>
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<tr>
<td>Credit points</td>
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<td>Workload</td>
<td>270 h</td>
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<td>Attendance: 70 hrs Self-study: 200 hrs</td>
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Applicability of the module
- Bachelor's Programme Engineering Physics (Bachelor) > Aufbaumodule

Responsible persons
- Teubner, Ulrich (module responsibility)
- Agert, Carsten (authorised to take exams)
- Anemüller, Jörn (authorised to take exams)
- Dietz, Mathias (authorised to take exams)
- Doclo, Simon (authorised to take exams)
- Groß, Petra (authorised to take exams)
- Ewert, Stephan (authorised to take exams)
- Gütay, Levent (authorised to take exams)
- Hartmann, Alexander (authorised to take exams)
- Hein, Andreas (authorised to take exams)
- Held, Esther (authorised to take exams)
- Helms, Olaf (authorised to take exams)
- Hohmann, Volker (authorised to take exams)
- Hölling, Michael (authorised to take exams)
- Huke, Philipp (authorised to take exams)
- Kittel, Achim (authorised to take exams)
- Kühn, Martin (authorised to take exams)
- Koch, Sandra (authorised to take exams)
- Krüger, Michael (authorised to take exams)
- Kollmeier, Birger (authorised to take exams)
- Lienau, Christoph (authorised to take exams)
- Meyer, Bernd (authorised to take exams)
- Neu, Walter (authorised to take exams)
- Nilius, Niklas (authorised to take exams)
- Schellenberg, Markus (authorised to take exams)
- Peinke, Joachim (authorised to take exams)
- Poppe, Björn (authorised to take exams)
- Reck, Martin (authorised to take exams)
- Schäfer, Sascha (authorised to take exams)
- Schmidt, Andreas Hermann (authorised to take exams)
- Schütting, Thomas (authorised to take exams)
- Silies, Martin (authorised to take exams)
- Teubner, Ulrich (authorised to take exams)
- van de Par, Steven (authorised to take exams)
- Uppenkamp, Stefan (authorised to take exams)
- Vogelgesang, Ralf (authorised to take exams)
- Willenb, Matthias (authorised to take exams)
- Lange, Sven Carsten (authorised to take exams)

Prerequisites
- Lecture "Electronics"

Skills to be acquired in this module
- Laboratory: Knowledge and experience about experimental work, managing experimental work and evaluating results.
- Design Fundamentals: 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.

Module contents
- Laboratory: Experiments in the field of electronics and measurement technique
- 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

Recommended reading
Laboratory:
Specific project descriptions
Design Fundamentals:
ISO- and EN- Standards,
Childs: Mechanical Design,
Ulrich/Eppinger: Product Design and Development,
Matousek: Engineering Design

Links
Language of instruction
English
Duration (semesters)
1 Semester
Module frequency
jährlich
Module capacity
unlimited

Type of module
Teaching/Learning method

Previous knowledge
Examination Examination times Type of examination
Final exam of module Report and project presentation; assignment (Design Fundamentals)

Type of course Comment SWS Frequency Workload of compulsory attendance
Lecture 2 28
Practical training 3 42

Total module attendance time 70 h
phy541 - Mathematical Methods for Physics and Engineering II

<table>
<thead>
<tr>
<th>Module label</th>
<th>Mathematical Methods for Physics and Engineering II</th>
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<tbody>
<tr>
<td>Module abbreviation</td>
<td>phy541</td>
</tr>
<tr>
<td>Credit points</td>
<td>6.0 KP</td>
</tr>
<tr>
<td>Workload</td>
<td>180 h (attendance: 56 hrs self study: 124 h)</td>
</tr>
</tbody>
</table>

**Applicability of the module**
- Bachelor's Programme Engineering Physics (Bachelor) > Aufbaumodule
- Bachelor's Programme Physics, Engineering and Medicine (Bachelor) > Basismodule

**Responsible persons**
- Doclo, Simon (module responsibility)
- Doclo, Simon (authorised to take exams)
- Hohmann, Volker (authorised to take exams)
- Uppenkamp, Stefan (authorised to take exams)

**Prerequisites**
Contents of the lecture “Mathematical Methods for Physics and Engineering I”

**Skills to be acquired in this module**
To obtain advanced knowledge in application of mathematical methods to solve problems in physics and engineering.

**Module contents**
- Matrices and vector spaces (linear vector spaces, basis, norm, matrices, matrix operations, determinant, inverse matrix, eigenvalue decomposition)
- Quadratic forms
- Linear equations (Gauss elimination, least-squares solution)
- Functions of multiple variables (stationary points, constrained optimisation using Lagrange multipliers)
- Fourier series

**Recommended reading**

**Language of instruction**
English

**Duration (semesters)**
1 Semester

**Module frequency**
jährlich

**Module capacity**
unlimited

**Module level**

**Type of module**

**Teaching/Learning method**

**Previous knowledge**

**Examination**

**Final exam of module**
Max. 180 min written exam or 30 min oral exam. Here, you will find information about the consideration of bonus points for module marks.

**Type of course**

<table>
<thead>
<tr>
<th>Type of course</th>
<th>Comment</th>
<th>SWS</th>
<th>Frequency</th>
<th>Workload of compulsory attendance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
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<tr>
<td>Exercises</td>
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<td>2</td>
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<td>28</td>
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</table>

**Total module attendance time**
56 h
phy542 - Mathematical Methods for Physics and Engineering III

Module label: Mathematical Methods for Physics and Engineering III
Module abbreviation: phy542
Credit points: 6.0 KP
Workload: 180 h
( 180h (attendance: 56h; self-study: 124h) )

Applicability of the module:
- Bachelor's Programme Engineering Physics (Bachelor) > Aufbaumodule
- Bachelor's Programme Physics, Engineering and Medicine (Bachelor) > Aufbaumodule

Responsible persons:
- Hohmann, Volker (module responsibility)
- Doclo, Simon (authorised to take exams)
- Hohmann, Volker (authorised to take exams)
- Uppenkamp, Stefan (authorised to take exams)
- van de Par, Steven (authorised to take exams)

Prerequisites:

Skills to be acquired in this module:
To obtain advanced knowledge in application of mathematical methods to solve problems in physics and engineering.

Module contents:
- 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

Recommended reading:

Links:
Language of instruction: English
Duration (semesters): 1 Semester
Module frequency: jährlich
Module capacity: unlimited
Module level:
Type of module:
Teaching/Learning method:

Previous knowledge:

Examination:

Final exam of module:
- 2 hrs written exam or 45 min oral exam. Here, you will find information about the consideration of bonus points for module marks.

Type of course:
- Lecture: 2
- Exercises: 2

Total module attendance time:
56 h
# phy551 - Quantum Structure of Matter

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<tr>
<th>Module label</th>
<th>Quantum Structure of Matter</th>
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<tbody>
<tr>
<td>Module abbreviation</td>
<td>phy551</td>
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<tr>
<td>Credit points</td>
<td>6.0 KP</td>
</tr>
</tbody>
</table>
| Workload | 180 h  
Attendance: 56 hrs  
Self study: 124 hrs |
| Applicability of the module |  
- Bachelor’s Programme Engineering Physics (Bachelor) > Aufbaumodule |
| Responsible persons |  
- Cocchi, Caterina (module responsibility)  
- Blehs, Svend-Age (authorised to take exams)  
- Cocchi, Caterina (authorised to take exams)  
- Lienau, Christoph (authorised to take exams)  
- Vogelgesang, Ralf (authorised to take exams) |
| Prerequisites | Mechanics, Electrodynamics and Optics, Atomic and Molecular Physics, Mathematical Methods for Physics and Engineering I-III. These courses are mandatory prerequisites. |
| Skills to be acquired in this module | The students will gain knowledge of the fundamental principles of quantum mechanics and their application to the modelling of the equilibrium structure of different atomic, molecular and solid state material systems. The course will enhance their competence to understand and apply basic theoretical concepts in quantum mechanics. The students will learn how to rationalize quantum effects and wave phenomena in a variety of material systems and will become acquainted with strategies how to explain the equilibrium steady-state structure of different types of matter. The students will also be introduced into the nonequilibrium dynamics of selected quantum systems. |
| Module contents | The course aims at providing a modern introduction into quantum mechanical foundations of the structure of atomic, molecular and solid state systems. It will bridge the gap between „Atomic and Molecular Physics“ and „Solid State Physics.“ The following content will be covered:  
1. Introduction into quantum mechanics  
2. Quantum theory: techniques and applications  
3. Atomic and molecular structure  
4. Light-matter interaction  
5. Molecular spectroscopy  
6. Introduction into quantum dynamics  
7. Molecular reaction dynamics  
8. Macromolecules and Aggregates  
9. Solid State Materials  
The course will be held at the level of an advanced course in physical chemistry and requires basic knowledge of quantum mechanics as introduced in “Atomic and Molecular Physics”. |
| Recommended reading |  
- W. Demtröder, Molecular Physics, Wiley-VCH (2005)  
<p>| Links |  |
| Language of instruction | English |
| Duration (semesters) | 1 Semester |
| Module frequency | jährlich |
| Module capacity | unlimited |</p>
<table>
<thead>
<tr>
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<td>Teaching/Learning method</td>
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<td>Previous knowledge</td>
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<tr>
<td>Examination</td>
<td>Examination times</td>
</tr>
<tr>
<td>Final exam of module</td>
<td>180 min written exam or 45 min oral exam</td>
</tr>
<tr>
<td>Type of course</td>
<td>Lecture</td>
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<tr>
<td>SWS</td>
<td>--</td>
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<tr>
<td>Frequency</td>
<td>0 h</td>
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<tr>
<td>On-site workload</td>
<td>0 h</td>
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**phy555 - Basic Engineering**

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<tr>
<td>Workload</td>
<td>180 h</td>
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<td>(Attendance: 64 hrs Self study: 116 hrs)</td>
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<td>Applicability of the module</td>
<td>Bachelor's Programme Engineering Physics (Bachelor) &gt; Aufbaumodule</td>
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<tr>
<td>Responsible persons</td>
<td>Lange, Sven Carsten (module responsibility)</td>
</tr>
<tr>
<td></td>
<td>Schmidt, Florian (authorised to take exams)</td>
</tr>
<tr>
<td></td>
<td>Lange, Sven Carsten (authorised to take exams)</td>
</tr>
<tr>
<td>Prerequisites</td>
<td>Basic Math (Algebra, Derivation, Integration) Basic knowledge in Physics (Mechanics, Thermodynamics, esp. Heat transfer)</td>
</tr>
<tr>
<td>Skills to be acquired in this module</td>
<td>Achieving basic knowledge in applied mechanics, especially in statics and elasticity theory. Achieving basic knowledge on how to produce objects with defined geometry and properties in an effective and economic way.</td>
</tr>
<tr>
<td>Module contents</td>
<td>Applied Mechanics:</td>
</tr>
<tr>
<td></td>
<td>• Static equilibrium (mainly 2D)</td>
</tr>
<tr>
<td></td>
<td>• frame works</td>
</tr>
<tr>
<td></td>
<td>• friction (Coulomb)</td>
</tr>
<tr>
<td></td>
<td>• Hooke's law (3D including lateral contraction and thermal expansion)</td>
</tr>
<tr>
<td></td>
<td>• bending and torsion with planar cross sections</td>
</tr>
<tr>
<td></td>
<td>• Mahr's theory</td>
</tr>
<tr>
<td>Production Engineering:</td>
<td>Overview on manufacturing technologies, like</td>
</tr>
<tr>
<td></td>
<td>Casting and other primary shaping processes</td>
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<tr>
<td></td>
<td>Plastic deformation processes</td>
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<tr>
<td></td>
<td>Cutting and separating processes</td>
</tr>
<tr>
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<td>Joining processes</td>
</tr>
<tr>
<td></td>
<td>Coating processes</td>
</tr>
<tr>
<td></td>
<td>Changing material properties</td>
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</table>

**Recommended reading**

- **Applied Mechanics:**
  - Assmann: Technische Mechanik (in 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)

**Links**

- **Language of instruction**: English
- **Duration (semesters)**: 2 Semester
- **Module frequency**: halbjährlich
- **Module capacity**: unlimited
- **Module level**:
- **Type of module**: Teaching/Learning method
- **Previous knowledge**
- **Examination**: Examination times
  - Type of examination: 2 exams: 180 min written exam or 60 min oral exam. Here, you will find information about the consideration of bonus points for module marks.
- **Type of course**: Comment
- **SWS**: Frequency
- **Workload of compulsory attendance**
<table>
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<th>Comment</th>
<th>SWS</th>
<th>Frequency</th>
<th>Workload of compulsory attendance</th>
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<tbody>
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<tr>
<td>Exercises</td>
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<td>SoSe oder WiSe</td>
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<td><strong>Total module attendance time</strong></td>
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<td><strong>84 h</strong></td>
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phy563 - Specialization

Module label
Specialization

Module abbreviation
phy563

Credit points
6.0 KP

Workload
180 h
(Attendance: 56 hrs Self study: 124 hrs)

Applicability of the module
- Bachelor's Programme Engineering Physics (Bachelor) > Aufbaumodule

Responsible persons
- Doclo, Simon (module responsibility)
- Kollmeier, Birger (module responsibility)
- Kühn, Martin (module responsibility)
- Neu, Walter (module responsibility)
- Poppe, Björn (module responsibility)
- Doclo, Simon (authorised to take exams)
- Huke, Philipp (authorised to take exams)
- Schüning, Thomas (authorised to take exams)
- Koch, Sandra (authorised to take exams)
- Kollmeier, Birger (authorised to take exams)
- Kühn, Martin (authorised to take exams)
- Steinfeld, Gerald (authorised to take exams)
- Neu, Walter (authorised to take exams)
- Poppe, Björn (authorised to take exams)
- Silles, Martin (authorised to take exams)
- Teubner, Ulrich (authorised to take exams)
- Looe, Hui Khee (authorised to take exams)

Prerequisites

Skills to be acquired in this module
The students are enabled to establish an overview on principles and applications of engineering physics. The introduction to a specific field of specialization yields a basic knowledge on theoretical and experimental concepts and deepens on selected applications.

Module contents
Specialization
- Laser and Optics:
  Introduction to relevant research fields in Laser and Optics. Knowledge of the characteristics of waves, optical radiation, design and function of optical elements and instruments, basic design of photonic systems and optical metrology.

- 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.

Recommended reading
Acc. selected lecture

Links

Language of instruction
English

Duration (semesters)
2 Semester

Module frequency
halbjährlich

Module capacity
unlimited

Module level

Type of module

Teaching/Learning method

Previous knowledge

Examination
Examination times
Type of examination

Final exam of module
Max. 2 hrs written exam or 30 min oral exam. Here you will find information about the consideration of bonus points for module marks.
<table>
<thead>
<tr>
<th>Examination</th>
<th>Examination times</th>
<th>Type of examination</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>1 Klausur (max. 180 Min.) oder 1 mündliche Prüfung (max. 45 Min.) oder 1 Hausarbeit (max. 30 Seiten)</td>
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<table>
<thead>
<tr>
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<th>Comment</th>
<th>SWS</th>
<th>Frequency</th>
<th>Workload of compulsory attendance</th>
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**Total module attendance time**: 56 h
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<tr>
<th>Module label</th>
<th>Electronics</th>
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<td>Credit points</td>
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<td>Workload</td>
<td>180 h</td>
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<tr>
<td>Attendance: 70 hrs Self study: 110 hrs</td>
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<td>Applicability of the module</td>
<td>Bachelor's Programme Engineering Physics (Bachelor) &gt; Aufbaumodule</td>
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<tr>
<td>Responsible persons</td>
<td>Haja, Andreas (authorised to take exams)</td>
</tr>
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<td>Haja, Andreas (module responsibility)</td>
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<tr>
<td>Prerequisites</td>
<td>Basic Lab. I, Math. Methods for Physics and Engineering I</td>
</tr>
<tr>
<td>Skills to be acquired in this module</td>
<td>The students acquire basic competences to set-up and analyze digital and analog electronic circuits; furthermore basic knowledge for measurement methods as well as for handling measurement systems are imparted</td>
</tr>
<tr>
<td>Module contents</td>
<td>logic functions and gates, digital circuit analysis and synthesis, flip-flops, digital counters and memories, A/D- and D/A converters, programmable logic devices, impedances, inductances and capacitances, complex alternating electric quantities, RCL-filter circuits, semiconductor circuits, rectifier circuits, operational amplifier circuits</td>
</tr>
<tr>
<td>Links</td>
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<td>Language of instruction</td>
<td>English</td>
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<tr>
<td>Duration (semesters)</td>
<td>1 Semester</td>
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<td>Module frequency</td>
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<td>Module capacity</td>
<td>unlimited</td>
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<td>Module level</td>
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<td>Teaching/Learning method</td>
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<tr>
<td>Examination</td>
<td>Examination times</td>
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<td>Final exam of module</td>
<td>2 hrs written examination</td>
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<td>Total module attendance time</td>
<td>70 h</td>
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</table>
**phy581 - Materials Sciences**

**Module label**
Materials Sciences

**Module abbreviation**
phy581

**Credit points**
6.0 KP

**Workload**
180 h
- Attendance: 56 hrs
- Self study: 124 hrs

**Applicability of the module**
- Bachelor's Programme Engineering Physics (Bachelor) > Aufbaumodule

**Responsible persons**
- Held, Esther (module responsibility)
- Held, Esther (authorised to take exams)
- Helms, Olaf (authorised to take exams)
- Lünemann, Martin (authorised to take exams)
- Schüning, Thomas (authorised to take exams)

**Prerequisites**

**Skills to be acquired in this module**
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.

**Module contents**
- 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)

**Recommended reading**
- 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

**Links**

**Language of instruction**
English

**Duration (semesters)**
1 Semester

**Module frequency**
halbjährlich

**Module capacity**
unlimited

**Module level**

**Type of module**

**Teaching/Learning method**

**Previous knowledge**

**Examination**

**Examination times**
1 hour written examination or 30 min oral exam

**Type of course**
Lecture

**SWS**
4

**Frequency**

**On-site workload**
56 h
phy590 - Control Systems

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<td>6.0 KP</td>
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<tr>
<td>Workload</td>
<td>180 h (120 h)</td>
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</table>

Applicability of the module
- Bachelor's Programme Engineering Physics (Bachelor) > Aufbaumodule

Responsible persons
- Huke, Philipp (authorised to take exams)
- Hein, Andreas (authorised to take exams)
- Huke, Philipp (module responsibility)
- Huke, Philipp (Module counselling)

Prerequisites
Understanding of basic open- and closed-loop control systems. Basic concepts for modelling of systems, design and development of controllers. Description of controller design using differential equations. Understanding the response function of a control-loop and testing the control structure with respect to instabilities.

The students will achieve the competence to work into technical realization of controlled systems and to develop approaches for optimization.

Skills to be acquired in this module
Understanding of basic open- and closed-loop control systems. Basic concepts for modelling of systems, design and development of controllers. Description of controller design using differential equations. Understanding the response function of a control-loop and testing the control structure with respect to instabilities.

Module contents
The module contains: Design procedures for controllers, Basic description of components, development, understanding and working with functional diagrams, simulation and modelling, root locus, stability, controller types, linear control systems with reference- and disturbance response function.

Recommended reading
- Hans-Werner Philippsen - Einstieg in die Regelungstechnik mit Python; München Carl Hanser Verlag GmbH & Co. KG, 20190805 (OPAC)

Language of instruction
English

Duration (semesters)
1 Semester

Module frequency
every year

Module capacity
unlimited

Module level

Type of module

Teaching/Learning method

Previous knowledge

<table>
<thead>
<tr>
<th>Examination</th>
<th>Examination times</th>
</tr>
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<tbody>
<tr>
<td>Final exam of module</td>
<td>30 - 45 minutes oral exam. <a href="http://www.uni-oldenburg.de/en/physics/studies/bonus-points">Here</a> you will find information about the consideration of bonus points for module marks.</td>
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</table>

<table>
<thead>
<tr>
<th>Type of course</th>
<th>Comment</th>
<th>SWS</th>
<th>Frequency</th>
<th>Workload of compulsory attendance</th>
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</thead>
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<td>Exercises</td>
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| Total module attendance time | 70 h |

Links

Language of instruction
English

Duration (semesters)
1 Semester

Module frequency
every year

Module capacity
unlimited

Module level

Type of module

Teaching/Learning method

Previous knowledge

<table>
<thead>
<tr>
<th>Examination</th>
<th>Examination times</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final exam of module</td>
<td>30 - 45 minutes oral exam. <a href="http://www.uni-oldenburg.de/en/physics/studies/bonus-points">Here</a> you will find information about the consideration of bonus points for module marks.</td>
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</table>

<table>
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<th>Comment</th>
<th>SWS</th>
<th>Frequency</th>
<th>Workload of compulsory attendance</th>
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<tr>
<td>Lecture</td>
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<td>56</td>
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<tr>
<td>Exercises</td>
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| Total module attendance time | 70 h |

Links
phy501 - Numerical Methods

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<td>Module abbreviation</td>
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<td>Credit points</td>
<td>6.0 KP</td>
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<td>Workload</td>
<td>180 h (attendance: 56h; self-study: 124h)</td>
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**Applicability of the module**
- Bachelor's Programme Engineering Physics (Bachelor) > Aufbaumodule

**Responsible persons**
- Anemüller, Jörn (authorised to take exams)
- Brand, Thomas (authorised to take exams)
- Dietz, Mathias (authorised to take exams)
- Hartmann, Alexander (authorised to take exams)
- Hohmann, Volker (authorised to take exams)
- Lücke, Jörg (authorised to take exams)
- Meyer, Bernd (authorised to take exams)
- Petrovic, Cornelia (authorised to take exams)
- Hohmann, Volker (module responsibility)

**Prerequisites**
Course Mathematical Methods II passed with a grade of at least 4.0.

**Skills to be acquired in this module**
Students acquire theoretical knowledge of basic numerical methods and practical skills to apply these methods to physical problems within all areas of experimental, theoretical and applied physics.

**Module contents**
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 C or, preferably, in Matlab, which is a powerful package for numerical computing. Matlab 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. The tutorials provide basic programming support.

**Recommended reading**
1. V. Hohmann: Numerical Methods for Physicists, Universität Oldenburg (lecture script; will be provided with the course material)

**Links**
- Language of instruction: English
- Duration (semesters): 1 Semester
- Module frequency: Annual, summer semester
- Module capacity: unlimited
- Module level
<table>
<thead>
<tr>
<th>Type of module</th>
<th>Teaching/Learning method</th>
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<tr>
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<tr>
<td>Examination</td>
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<td>Exercises</td>
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<td>Workload of compulsory</td>
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| Lecture | 2 | SoSe und WiSe | 28 |
| Exercises | 2 | SoSe und WiSe | 28 |

**Total module attendance time**: 56 h
phy502 - Solid State Physics

Module label: Solid State Physics
Module abbreviation: phy502
Credit points: 6.0 KP

Workload: 180 h
(180 h (Präsenzzeit 84h, Selbststudium: 96h))

Applicability of the module
- Bachelor's Programme Engineering Physics (Bachelor) > Aufbaumodule

Responsible persons
- Nilius, Niklas (module responsibility)
- Kittel, Achim (authorised to take exams)
- Lienau, Christoph (authorised to take exams)
- Schäfer, Sascha (authorised to take exams)
- Wollenhaupt, Matthias (authorised to take exams)

Prerequisites
- Experimental Physics I-IV, Quantum structure of Matter

Skills to be acquired in this module
The students gain comprehensive insights into solid state physics and associated phenomena. They learn how symmetry operations are interconnected with structural parameters of solids. From the chemical interaction between atoms, the binding properties and thermodynamic stability of solids are derived. The oscillatory motion of atoms in simple 1D chain models is extended towards the dynamic response of crystals, while a statistical analysis leads to the concept of heat capacity and heat conductance of solids. The quantum mechanical description of particles in a box is exploited to develop the model of free and quasi-free electrons as well as the band structure of solids. The students are made familiar with the economically relevant fields of semiconductor and low temperature physics as well as magnetism.

Module contents
- Crystal structures and symmetries, Bravais lattices, Reciprocal lattice and translational symmetry, Brillouin zone
- Binding principles in solids (covalent, ionic, metallic, van-der Waals and hydrogen bonding)
- Dynamic properties of solids, Phonons, Atomic chain models, Dispersion relation
- Specific heat, Heat conductance
- Electrons in solids, Model of free and quasi-free electrons, State density, Fermi energy, Electrons in periodic potentials, Bloch theorem, Band model of electrons, Effective mass, Band gap, Occupation numbers
- Semiconductors, Doping, Dielectric properties, Magnetic properties, Dia-, para- and ferro magnetism, Superconductivity

Recommended reading

Links

Language of instruction: English
Duration (semesters): 1 Semester
Module frequency: jährlich
Module capacity: unlimited
Module level:
Type of module:
Teaching/Learning method:
Previous knowledge:

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phy533 - Metrology

Module label: Metrology
Module abbreviation: phy533
Credit points: 6.0 KP
Workload: 180 h
  (Präsenzzeit 56h, Selbststudium: 124h)

Applicability of the module:
- Bachelor's Programme Engineering Physics (Bachelor) > Aufbaumodule

Responsible persons:
- Meyer, Bernd (module responsibility)
- Meyer, Bernd (Module counselling)
- Doclo, Simon (authorised to take exams)
- Hohmann, Volker (authorised to take exams)
- Huke, Philipp (authorised to take exams)
- Kittel, Achim (authorised to take exams)
- Kollmeier, Birger (authorised to take exams)
- Meyer, Bernd (authorised to take exams)

Prerequisites:
The students will learn basic principles of measurement technology and signal processing as well as the application of complex measurement methods to extract the measurement information. They will acquire skills to carry out advanced internships and experimental work in research laboratories. Further, they will develop the competence for analytical thinking in the evaluation of measurement situations, which will enable them to solve measurement problems such as those encountered in different branches of industry (e.g. automotive and semiconductor industries; analytical, pharmaceutical and medical industries).

Module contents:
Lecture Measurement Technology:
- Sensors for measuring different physical quantities (e.g. force, temperature, charge, electric and magnetic fields, energies of particles and radiation), high-resolution measurements of small signals, influence of interfering signals, linearization and reduction of interfering variables through compensation methods, noise reduction, phase-sensitive detector, complex measurement systems such as nuclear magnetic resonance, electron resonance, laser measurement technology (including pump / probe systems), spatially resolved measurement methods such as magnetic resonance tomography, electron and scanning probe microscopy.

Lecture Signal Processing:
- Characterization and processing of measurement signals (linear signal analysis, filtering), characterization and elimination of interferences (empirical statistics, noise in physical systems, correlation analysis, phase-sensitive amplifiers, methods of averaging), signal digitization, digital signal processing

Recommended reading:
SE Physikalische Messtechnik:
Elmar Schrüfer, Elektrische Messtechnik: Messung elektrischer und nichtelektrischer Größen. Hanser Fachbuchverlag
J. F. Keithley [Ed.]: Low /Level Measurements Handbook. Keithley Instruments Inc; VL Signalverarbeitung;
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# Abschlussmodul

**bam - Bachelor’s Thesis Module**

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## Applicability of the module
- Bachelor’s Programme Engineering Physics (Bachelor) > Abschlussmodul

## Responsible persons
- Agert, Carsten (authorised to take exams)
- Bröcker, Hans Josef (authorised to take exams)
- Hein, Andreas (authorised to take exams)
- Biehs, Svend-Age (authorised to take exams)
- Struve, Bert (authorised to take exams)
- Brand, Thomas (authorised to take exams)
- Doclo, Simon (authorised to take exams)
- Heinemann, Detlev (authorised to take exams)
- Ewert, Stephan (authorised to take exams)
- Gütay, Levent (authorised to take exams)
- Hartmann, Alexander (authorised to take exams)
- Schädler, Marc René (authorised to take exams)
- Neu, Walter (authorised to take exams)
- Kittel, Achim (authorised to take exams)
- Hohmann, Volker (authorised to take exams)
- Kollmeier, Birger (authorised to take exams)
- Kühn, Martin (authorised to take exams)
- Schöning, Thomas (authorised to take exams)
- Lienau, Christoph (authorised to take exams)
- Meyer, Bernd (authorised to take exams)
- Poppe, Björn (authorised to take exams)
- van de Par, Steven (authorised to take exams)
- Nilius, Niklas (authorised to take exams)
- Peinke, Joachim (authorised to take exams)
- Petrovic, Cornelia (authorised to take exams)
- Schäfer, Sascha (authorised to take exams)
- Teubner, Ulrich (authorised to take exams)
- Uppenkamp, Stefan (authorised to take exams)
- Vogelgesang, Ralf (authorised to take exams)
- Wollenhaupt, Matthias (authorised to take exams)

## Prerequisites

## Skills to be acquired in this module
- Students will apply their diversified scientific and professional skills to plan, prepare, organize and produce single-handed a research study.

## Module contents
- The thesis comprises empirical, theoretical or experimental research and development according to the field of specialization.

## Recommended reading
- as required

## Languages of instruction
- German, English

## Duration (semesters)
- 1 Semester

## Module capacity
- unlimited

## Module level

## Type of module

## Teaching/Learning method

## Previous knowledge

## Examination

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## Type of course
- Seminar

## SWS
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