## Master Thesis

<table>
<thead>
<tr>
<th>CP</th>
<th>SHW</th>
<th>Workload</th>
<th>Contact Time</th>
<th>Self-Study</th>
<th>Begin</th>
<th>Sem</th>
<th>Duration</th>
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<tbody>
<tr>
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<td></td>
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<td>3</td>
<td>1 Semester</td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
<td>Summer Semester</td>
<td></td>
<td>2 Semesters</td>
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### Degree Objective
- Master of Science
- PM - Compulsory Module

### Study Form
- Lecture
- Tutorial
- Lab
- Self-Study
- Seminar
- Assignment
- Projekt Work
- Other: Paper, Report

### Prerequisites
- 50 credit points reduced by 5 credits for every extra-occupational semester;
- Module 33001 (project) passed

### Supporting Modules / Courses

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Title of the Module / Course</th>
<th>Lecturer</th>
<th>Type</th>
<th>SHW</th>
<th>CP</th>
<th>Sem</th>
<th>Module Exam Type / Length / Graded</th>
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<tbody>
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**Module Type (PM/WPM/WM)**

- PM - Compulsory

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**Module Type (PM/WPM/WM)**

- PM

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1 SHW = Semester Hours per Week
Allowed Exam Materials/Restrictions

- slides of presentation in English
- all parts of the thesis has to be performed individually; participation of more than one student is not permitted; each student works on its one topic.

Learning Goals / Competences

The students can apply the contents of the curriculum independently in a scientific paper. They can analyse demanding specialist literature. They can analyse and evaluate the results and carry out experimental measurements in research areas. They are able to defend the results of the Master's thesis in an oral presentation and document them in a written report.

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<thead>
<tr>
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<th>Medium</th>
<th>Light</th>
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<tbody>
<tr>
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<tr>
<td>Social Competence</td>
<td></td>
<td>☒</td>
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</tr>
</tbody>
</table>

Course Contents

Actual work in different fields of photonics

Language of oral part of examination

- ☒ English
- ☐ Spanish
- ☐ French
- ☐ Chinese
- ☐ Portuguese
- ☐ Russian
- ☐ Other:

Literature

Subject-specific books and publications

Composition of Final Grade

Oral part: 20%; Written report: 80%

Comments / Other

- Oral part of examination consists of an oral presentation in English (mandatory) of 15 minutes duration and 15 minutes oral questioning in English shared by first and second examiner. Student has to answer in English.
- Written report may be in English or German language according the requirement of first adviser/examiner.
- Maximum prolongation in case of delay that student doesn’t take responsibility for is 8 weeks; prior approval of dean of students required.
- Submission of Master thesis includes (delivery signed in student’s separation form)
  - Abstract of thesis in English
  - Information sheet for database
  - PDF-file of thesis

Last Update

29.10.2019 Krapp / Wa

1 SHW = Semester Hours per Week
## Module Name

### Projects / Soft Skills

<table>
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<th>SHW</th>
<th>Workload</th>
<th>Contact Time</th>
<th>Self-Study</th>
<th>Begin</th>
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<td>1 Semester</td>
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### Degree Objective

- Master of Science
- PM - Compulsory Module
- HS - Hauptstudium
- Photonics

### Study Form

- Lecture
- Tutorial
- Lab
- Self-Study
- Seminar
- Assignment
- Projekt Work
- Other: Paper, Report

### Prerequisites

- no

## Supporting Modules / Courses

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Title of the Module / Course</th>
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<th>Sem</th>
<th>Module Exam Type/ Length/ Graded</th>
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<td>Prof. Dr. Krapp</td>
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<td></td>
<td></td>
<td>Prof. Dr. Heinrich</td>
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</table>

## Allowed Exam Materials/ Restrictions

- all kinds of literature
- all parts of the project has to be performed individually; participation of more than one student is not permitted; each student works on its one topic.

1 SHW = Semester Hours per Week
## Learning Goals / Competences

Professional competence (professional knowledge and skills, professional expertise):

In photonics, the student can organize and structure solutions to a particular problem. The students are able to determine fundamental data concerning signal power and noise by evaluation. They can use and perform basic measurements.

Over professional competence (social skills und ability to work independently):

The laboratory work enables students to gain practical experience, as they are able to carry out experiments and create measurement set-ups etc. on their own responsibility or in small teams.

Special (methods) skills, if applicable:

Students can analyse literature and can separate from non-relevant and relevant information. Students are able to present the results of their comolitions.

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<thead>
<tr>
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<th>Heavy</th>
<th>Medium</th>
<th>Light</th>
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<td>Methods Competence</td>
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## Course Contents

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<th>Language</th>
<th>☐ German ☒ English ☐ Spanish ☐ French ☐ Chinese ☐ Portuguese ☐ Russian Other:</th>
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<tr>
<td>Literature</td>
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</table>
| Composition of Final Grade | Written report (PLL) 80 %  
Oral presentation (PLM 20) 20 % |
| Comments / Other | Final oral presentation will be on the beginning of summer semester according to the announcement on notice-board |
| Last Updated | 22.02.2017; J. Krapp /Wa |

1 SHW = Semester Hours per Week
**Module Name**: Interferometry  
**Modul No**: 33002

<table>
<thead>
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<th>Contact Time</th>
<th>Self-Study</th>
<th>Offering Begin</th>
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<th>Duration</th>
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<td>90 h</td>
<td>Winter Semester</td>
<td>1</td>
<td>1 Semester</td>
</tr>
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</table>

**Target Degree**

Master of Science  
PM - Compulsory Module

**Form of Studies**

- Lecture
- Lab
- Self-Study
- Seminar

- Assignment
- Projekt Work
- Other: Paper, Report

**Admission Requirement**

- 33035 Fundamental Optics

**Supporting Mini-Modules / Courses**

<table>
<thead>
<tr>
<th>Subjekt No.</th>
<th>Title of the Mini-Module / Course</th>
<th>Lecturer</th>
<th>Type</th>
<th>SHW¹</th>
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<th>Sem</th>
<th>Modul Exam Type/ Length/ Marked</th>
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<td>33102</td>
<td>Interferometry</td>
<td>Prof. Dr. Rainer Börret</td>
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<td>4</td>
<td>5</td>
<td>1</td>
<td>PLM 20</td>
</tr>
</tbody>
</table>

**Allowed Aid**

- Script, Pocket Calculator

¹ SHW = Semester Hours per Week
### Learning Goals / Competences

#### Professional competence (professional knowledge and skills, professional expertise):

Students will be able to apply and perform the basic concepts and applications of interferometry and optical measurement techniques. They will be able to interpret and discuss the results as well as alternative methods and solutions.

The Students are able to choose and specify suitable interferometric setups for different applications, choose and specify suitable light sources, sensors and components for interferometric setups and applications and design an interferometric setup for different applications by means of the learned methods and information.

They can specify and select the principles of fringe analysis and the appropriate assessment techniques.

They are able to select a suitable calibration technique to qualify an interferometer and are able to specify the range, resolution and accuracy of an interferometric setup.

#### Over professional competence (social skills und ability to work independently):

Students can discuss and debate in groups about specific problems and about the best solutions and applications related to a particular measurement problem.

#### Special (methods) skills, if applicable:

They are enabled to systematically select the suitable metrology setup for various measurement problems.

<table>
<thead>
<tr>
<th>Competence Area</th>
<th>Concentration</th>
<th>Mini-Concentration</th>
<th>In Small Amounts</th>
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</thead>
<tbody>
<tr>
<td><strong>Professional Competence</strong></td>
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<tr>
<td><strong>Social Competence</strong></td>
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</tr>
</tbody>
</table>

### Teaching Contents

**Lecture:**
- Basic principles of interference
- Interferometers
- Detection techniques and algorithms
- Calibration techniques
- Accuracy and error sources
- Testing the quality of optical materials
- Examples for Application of Interferometry
- Testing the geometry of optical components

### Language

- [ ] German
- [x] English
- [ ] Spanish
- [ ] French
- [ ] Chinese
- [ ] Portuguese
- [ ] Russian
- Other: [ ]

### Literature

- Hand-out, detailed manuscript with exercises
- Dörband, Müller, Gross: "Handbook of Optical Systems, Vol. 5"
- Hecht „Optics“ (Fundamentals)
- Malacara „Optical Shop Testing“

### Composition of the Final Mark

30 % PLR, 70 % PLM (20 min)

### Comments / Other

### Last Updated

28.02.2019 Börret

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1 SHW = Semester Hours per Week
**Module Name**: Quantum optics  
**Module No**: 33003

<table>
<thead>
<tr>
<th>CP</th>
<th>SHW¹</th>
<th>Workload</th>
<th>Contact Time</th>
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<tr>
<td>5</td>
<td>4</td>
<td>150h</td>
<td>60h</td>
<td>90h</td>
<td>Winter Semester</td>
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<td>1 Semester</td>
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<td>Summer Semester</td>
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<td>2 Semesters</td>
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</table>

**Degree Objective**

Master of Science  
PM - Compulsory Module

**Study Form**

- Lecture
- Tutorial
- Lab
- Self-Study
- Seminar
- Assignment
- Projekt Work
- Other: Paper, Report

**Prerequisites**

Mathematics, physics of technical bachelor degree

**Supporting Modules / Courses**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Title of the Module / Course</th>
<th>Lecturer</th>
<th>Type</th>
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</tbody>
</table>

**Allowed Exam Materials**

lecture notes, calculator

¹ SHW = Semester Hours per Week
**Learning Goals / Competences**

Special (methods) skills, if applicable:

The student can analyse literature and separate from non-relevant and relevant information. Students are able to model the performance of photonic devices through the quantum logic of modern physics.

Over professional competence (social skills and ability to work independently):

The students can understand and interpret logic and randomness through the concepts of quantum optics and stochastics.

Professional competence (professional knowledge and skills, professional expertise):

Students are able to describe and understand quantum optical phenomena mathematically, to interpret the theoretical predictions in terms of experimental relevance, to apply quantum physical principles to technical applications e.g. to reduce noise effects.

<table>
<thead>
<tr>
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<tr>
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</tr>
<tr>
<td>Social Competence</td>
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<td>☒</td>
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</tbody>
</table>

**Course Contents**

Stochastics, linear algebra, quantum physics, quantum optics.

**Teaching Contents**

-Literature

Quantum optics, lecture notes with bibliography

**Composition of Final Grade**

PLK (100%);

**Comments / Other**

**Last Updated**

10.02.2017 TH

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1 **SHW** = Semester Hours per Week
### Module Name
Photonic Detectors and Devices

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<table>
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<td>150h</td>
<td>60 h</td>
<td>90 h</td>
<td>☑ Winter Semester ☐ Summer Semester</td>
<td>1</td>
<td>☑ 1 Semester ☐ 2 Semesters</td>
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#### Target Degree
Master of Science

#### Module Type (PM/WPM/WM)
PM - Compulsory Module

#### Study Division
Use in Courses of Study

#### Form of Studies
☑ Lecture ☐ Tutorial ☐ Lab ☐ Self-Study ☐ Seminar
☐ Assignment ☐ Projekt Work ☐ Other: Paper, Report

#### Admission Requirement
Basic knowledge in Optics & Math

### Supporting Mini-Modules / Courses

<table>
<thead>
<tr>
<th>Subjekt No.</th>
<th>Title of the Mini-Module / Course</th>
<th>Lecturer</th>
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<td>Photonic detectors and devices</td>
<td>Prof. Dr. Andreas Heinrich</td>
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<tr>
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</tbody>
</table>

### Allowed Aids
none

¹ SHW = Semester Hours per Week
Learning Goals / Competences

Professional competence:
The student can name and classify optical parts and electro-optical components. He can understand and apply
the basic principles of this component.

Over professional competence (social skills und ability to work independently):
The student can evaluate the advantages and disadvantages of different concepts and discuss them in a team.
The student is able to communicate scientifically and apply his in-depth knowledge.

Special (methods) skills, if applicable:
The students can evaluate scientific research and relevant literature.

<table>
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<tr>
<td>Social Competence</td>
<td></td>
<td>☒</td>
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</tbody>
</table>

Teaching Contents

- advanced optical components
  - gradient-index lenses, diffusers, Fresnel lenses, light pipes, tapers, Axicons,
  - optical filters (absorption filters, Fabry Perot filters, Interference filters, electrical tuneable filters, gratings)

- electro-optical components
  - light sources and illumination (LED, SMD, OLED, structured illumination, requirements for an adequate illumination)
  - projectors (SLMs, LCOS, LCDs, GLVs, DMDs, DLPs)
  - detectors (CCD, CMOS, polarization camera, plenoptical camera)
  - displays (3D Displays and imaging: stereoscopic, autoscopic, holographic)

Language

- German
- English
- Spanish
- French
- Chinese
- Portuguese
- Russian
- Other:

Literature

Hand-out, detailed manuscript with exercises

Composition of the Final Mark

written exam (50%)
oral presentation (50%)

Comments / Other

precondition for exam: accomplished group work

Last Updated

Feb. 28th, 2019 / Wa

1 SHW = Semester Hours per Week
### Module Description

**Faculty**
Optics and Mechatronics

**Degree Program**
Applied Photonics (Master)

**Module Coordinator**
Prof. Dr. T. Hellmuth

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<table>
<thead>
<tr>
<th>Module Name</th>
<th>Non-linear Optics</th>
<th>Module No: 33005</th>
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<td><strong>Semester</strong></td>
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**Degree Objective**
Master of Science

**Module Type**
PM - Compulsory Module

**Division (Upper/Lower)**

**Incorporated in Degree Programs**

**Study Form**
- Lecture
- Tutorial
- Lab
- Self-Study
- Seminar
- Assignment
- Projekt Work
- Other: Paper, Report

**Prerequisites**
Mathematics, physics of technical bachelor degree

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### Supporting Modules / Courses

<table>
<thead>
<tr>
<th>Course No.</th>
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**Module Type (PM/WPM/WM)**
PM - Compulsory

**Division (Upper/Lower)**

**Incorporated in Degree Programs**

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**Allowed Exam Materials**
lecture notes, calculator

<sup>1</sup> SHW = Semester Hours per Week
### Learning Goals / Competences

**Professional competence (professional knowledge and skills, professional expertise):**  
Students are able to describe and understand non-linear optical laser phenomena mathematically, to interpret the theoretical predictions in terms of experimental relevance, to analyse tolerances and specify non-linear crystals.

**Special (methods) skills, if applicable:**  
Students can analyze literature and distinguish between relevant and irrelevant information. They can design and specify optical devices.

**Over professional competence (social skills und ability to work independently):**  
The Students are able to search specifications and physical properties of non-linear crystals in groups to design non-linear laser devices for industrial applications.

<table>
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<tr>
<td>Social Competence</td>
<td>☐</td>
<td>☐</td>
<td>☒</td>
</tr>
</tbody>
</table>

### Course Contents

**Teaching Contents**  
Polarization optics, crystal optics, non-linear optics of second and third order

<table>
<thead>
<tr>
<th>Language</th>
<th>☐ German</th>
<th>☒ English</th>
<th>☐ Spanish</th>
<th>☐ French</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>☐ Chinese</td>
<td>☐ Portuguese</td>
<td>☐ Russian</td>
<td>Other:</td>
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</tbody>
</table>

**Literature**  
Lecture notes with bibliography

**Composition of Final Grade**  
PLK (100%)

**Comments / Other**

**Last Updated**  
21.07.2017 TH

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1 SHW = Semester Hours per Week
### Module Name
Advanced Optical Communications Technology

<table>
<thead>
<tr>
<th>CP</th>
<th>SHW¹</th>
<th>Workload</th>
<th>Contact Time</th>
<th>Self-Study</th>
<th>Begin</th>
<th>Sem</th>
<th>Duration</th>
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<tbody>
<tr>
<td>5</td>
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<td>1 Semesters</td>
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#### Degree Objective
- **Module Type** (PM/WPM/WM)
- **Division** (Upper/Lower)
- **Incorporated in Degree Programs**
  - Master of Science: PM - Compulsory Module, HS - Hauptstudium, Photonics

#### Study Form
- Lecture
- Self-Study
- Seminar
- Assignment
- Projekt Work
- Other: Paper, Report

#### Prerequisites
- Proved knowledge of optical fiber communication (admission for exam)

#### Supporting Modules / Courses

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Title of the Module / Course</th>
<th>Lecturer</th>
<th>Type</th>
<th>SHW¹</th>
<th>CP</th>
<th>Sem</th>
<th>Module Exam Type/ Length/ Graded</th>
</tr>
</thead>
<tbody>
<tr>
<td>33202</td>
<td>Advanced Optical Communications Technology</td>
<td>Prof. Dr. J. Krapp</td>
<td>V</td>
<td>4</td>
<td>5</td>
<td>2</td>
<td>PLK 90 benotet</td>
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</tbody>
</table>

- **Module Type** (PM/WPM/WM)
- **Division** (Upper/Lower)
- **Incorporated in Degree Programs**
  - PM - Compulsory
  - HS - Hauptstudium
  - Photonics

### Allowed Exam Materials
- None

¹ SHW = Semester Hours per Week
Learning Goals / Competences

Professional competence (professional knowledge and skills, professional expertise):

Students will be able to explain and evaluate a sound knowledge of fiber optic networks, including structure, functionality and properties of the corresponding components. They will be able to compare sustainable network concepts and understand the principles of coherent optical transmission.

Special (methods) skills, if applicable:

Methodically this subject emphasize on self-reliant learning by guided seminars. The student can analyze the corresponding literature on his own responsibility and differentiate between relevant and irrelevant information. He is able to present solutions and results.

<table>
<thead>
<tr>
<th>Competence Area</th>
<th>Heavy</th>
<th>Medium</th>
<th>Light</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical Competence</td>
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<tr>
<td>Methods Competence</td>
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<tr>
<td>Social Competence</td>
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Course Contents


Language

- ☐ German
- ☒ English
- ☐ Spanish
- ☐ French
- ☐ Chinese
- ☒ Portuguese
- ☐ Russian
- Other: Other:

Literature

Composition of Final Grade

PLR seminar presentation 20%, PLK examinations 80%

Comments / Other

Last Updated

19.03.2019; J. Krapp

\(^1\) SHW = Semester Hours per Week
### Module Name
Optical Systems

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<thead>
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<th>Workload</th>
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<th>Self-Study</th>
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<tr>
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<td>60 h</td>
<td>90 h</td>
<td>Winter Semester</td>
<td>2</td>
<td>1 Semester</td>
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</table>

**Target Degree**
Master of Science

**Study Division**
PM - Compulsory Module

**Use in Courses of Study**
PM - Compulsory

**Form of Studies**
- Lecture
- Lab
- Self-Study

**Admission Requirement**
Basic knowledge in Optics & Math and Matlab

### Supporting Mini-Modules / Courses

<table>
<thead>
<tr>
<th>Subjekt No.</th>
<th>Title of the Mini-Module / Course</th>
<th>Lecturer</th>
<th>Type</th>
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<th>Sem</th>
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<td>Prof. Dr. Andreas Heinrich</td>
<td>V L</td>
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</table>

**Mini-Module Type (PM/WPM/WM)**
PM - Compulsory

**Study Division**

**Use in Courses of Study**

**Allowed Aids** none

¹ SHW = Semester Hours per Week
### Learning Goals / Competences

**Professional competence (professional knowledge and skills, professional expertise):**

Students can implement optical systems and perform system tests. Parallel to the theoretical lecture, students can build up experiments and apply their theoretical knowledge. They are able to illustrate, analyze and discuss different experimental solutions.

**Over professional competence (social skills und ability to work independently):**

The students can discuss and convince their opponents with a scientific discussion. They can find a common solution.

**Special (methods) skills, if applicable:**

Students can set up and carry out experiments, transfer theoretical knowledge and identify and solve problems that arise in practice.

<table>
<thead>
<tr>
<th>Competence Area</th>
<th>Concentration</th>
<th>Mini-Concentration</th>
<th>In Small Amounts</th>
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<tbody>
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<tr>
<td>Social Competence</td>
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<td>☒</td>
</tr>
</tbody>
</table>

### Teaching Contents

- basics in optical systems design
- introduction in opto-mechanical systems
- tolerancing of optical systems (decenter and tilt tolerances, tolerance costs, compensators and adjustments, tolerance distributions, practical tolerancing)
- building up an optical system (telescope) - mirror grinding and polishing, design of ocular and mountings etc.
- System testing (basic parameters of optical systems, measurement of image quality)

### Language

- ☒ German
- ☒ English
- ☐ Spanish
- ☐ French
- ☐ Chinese
- ☐ Portuguese
- ☐ Russian
- Other: ☐

### Literature

Hand-out, detailed manuscript with exercises

### Composition of the Final Mark

PLM (100%)

### Comments / Other


### Last Updated

January 15th, 2019 Andreas Heinrich
June 15th, 2016

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1 SHW = Semester Hours per Week
### Module Name

<table>
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<tr>
<th>Module Name</th>
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<td><strong>Degree Objective</strong></td>
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<td>Master of Science</td>
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<td><strong>Study Form</strong></td>
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### Supporting Modules / Courses

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<td>5</td>
<td>2</td>
<td>PLM 30 benotet</td>
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</tbody>
</table>

### Allowed Exam Materials

none

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\(^1\) SHW = Semester Hours per Week
**Learning Goals / Competences**

Professional competence (professional knowledge and skills, professional expertise):

Studierende can understand wave optics. They can understand phenomena that describe the interaction of light waves with material. This will illustrate the difference between beam and wave optics. Students will be able to identify the limits of beam optics and describe improved optical effects using wave optics.

Special (methods) skills, if applicable:

Students are able to analyse literature. They can differ between relevant and non-relevant information and evaluate and judge optical phenomena.

Over professional competence (social skills und ability to work independently):

Students are able to discuss the advantages and disadvantages of different approaches in a team. They can express themselves scientifically and complete their knowledge.

<table>
<thead>
<tr>
<th>Competence Area</th>
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<th>Medium</th>
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<tr>
<td>Social Competence</td>
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</table>

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**Course Contents**

basics of wave optics, light interference, light diffraction / inverse diffraction, light polarization, light scattering

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<table>
<thead>
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<table>
<thead>
<tr>
<th>Literature</th>
<th>Monographien und Originalartikel</th>
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<tr>
<td></td>
<td>B. E.A. Saleh, M.V. Teich: Fundamentals of Photonics</td>
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<th>Composition of Final Grade</th>
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<th>Comments / Other</th>
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<th>Last Updated</th>
<th>March 10th, 2019 Andreas Heinrich</th>
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\(^1\) SHW = Semester Hours per Week
## Module Name
 Photonics Communications Engineering

### Module No: 33030

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<td>1 Semester</td>
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</tbody>
</table>

### Degree Objective
- Master of Science
- Module Type: PM - Compulsory Module
- Division: HS - Hauptstudium
- Incorporated in Degree Programs: Photonics

### Study Form
- Lecture
- Self-Study

### Prerequisites
- no

### Supporting Modules / Courses

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Title of the Module / Course</th>
<th>Lecturer</th>
<th>Type</th>
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<tbody>
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<td>33130</td>
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<td>V E</td>
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<td>1</td>
<td>PLK 90 benotet</td>
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</table>

### Module Type (PM/WPM/WM)
- WM - Elective Module
- Division (Upper/Lower): HS - Hauptstudium
- Incorporated in Degree Programs: Photonics

### Allowed Exam Materials
- none

¹ SHW = Semester Hours per Week
Learning Goals / Competences

competence:
The students can describe and use their knowledge of fiber optic communication systems, the structure and properties of the corresponding components. Students will be able to obtain basic data about signal power and noise by evaluation.

The students are able to expand their knowledge and develop new consolidating insights. They are able to answer, evaluate and develop questions on the individual topics.

soft skills and self-reliance:
The student
• is able to understand and handle complex problems and experiments
• has an increased ability to abstract thinking

special (methods) skills, if applicable:
Students can analyze literature and distinguish between relevant and irrelevant information.

<table>
<thead>
<tr>
<th>Competence Area</th>
<th>Heavy</th>
<th>Medium</th>
<th>Light</th>
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<tbody>
<tr>
<td>Technical Competence</td>
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<td>Methods Competence</td>
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</tr>
<tr>
<td>Social Competence</td>
<td>☒</td>
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<td>☒</td>
</tr>
</tbody>
</table>

Course Contents

STRUCTURE AND LIGHT PROPAGATION IN FIBERS, FIBER ATTENUATION, FIBER DISPERSION, FIBER OPTIC SOURCES, FIBER COUPLING; OPTICAL AMPLIFIERS WITH ERBIUM DOPED FIBERS, PHOTODETECTORS; RECEIVERS

Language

<table>
<thead>
<tr>
<th>Language</th>
<th>German</th>
<th>English</th>
<th>Spanish</th>
<th>French</th>
</tr>
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</table>

Literature

Composition of Final Grade

final examination PLK

Comments / Other

Last Updated

25.07.2017; J. Krapp

1 SHW = Semester Hours per Week
### Module Description

**Faculty**
Optics and Mechatronics

**Course of Study**
Applied Photonics (Master)

**Module Coordinator**
Prof. Dr. P. Zipfl

<table>
<thead>
<tr>
<th>Module Name</th>
<th>Applications of Photonics Detectors</th>
<th>Modul No : 33031</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP</td>
<td>SHW</td>
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<table>
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<tr>
<th>Target Degree</th>
<th>Module Type (PM/WPM/WM)</th>
<th>Study Division</th>
<th>Use in Courses of Study</th>
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</thead>
<tbody>
<tr>
<td>Master of Science</td>
<td>WPM - Compulsory Elec.</td>
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<table>
<thead>
<tr>
<th>Form of Studies</th>
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<tbody>
<tr>
<td>☒ Lecture</td>
<td>☒ Tutorial</td>
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| Admission Requirement | |
|----------------------| |

<table>
<thead>
<tr>
<th>Supporting Mini-Modules / Courses</th>
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<tbody>
<tr>
<td><strong>Subjekt No.</strong></td>
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<tr>
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<th><strong>Lecturer</strong></th>
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<th><strong>SHW</strong></th>
<th><strong>CP</strong></th>
<th><strong>Sem</strong></th>
<th><strong>Modul Exam Type/ Length/ Marked</strong></th>
</tr>
</thead>
</table>

| Allowed Aids | Text Books, Calculator, any kind of communication is forbidden |

\(^1\) SHW = Semester Hours per Week
Learning Goals / Competences

Professional competence (professional knowledge and skills, professional expertise):
The students are able to inform about elements of photonic specific signal chains at the interface between optical and electronic signals. They can select suitable optical sensors for certain applications. Under practical aspects, they can set up appropriate electronics for signal preprocessing of the optical sensor signals. They are able to analyze and implement circuits for photonic applications. Students can calculate signal transmission characteristics and perform noise analyses.

Over professional competence (social skills und ability to work independently):
Students can put theoretical knowledge into practical laboratory work, work in teams and write laboratory reports.

Special (methods) skills, if applicable:
The students are able to analyze and construct electronic circuits or systems with a focus on photonic applications. They are able to design circuits taking into consider a non-ideal behavior of the circuit elements. Furthermore, basic integrated circuits and discrete electronics can be adapted to the special needs of photonic applications.

Competence Area | Concentration | Mini-Concentration | In Small Amounts
---|---|---|---
Professional Competence | ☒ | | |
Methods Competence | ☒ | | |
Social Competence | | | ☒

Teaching Contents

Linear photonics specific sensors and systems in Laplace- and time-domain.
Linear photonic circuits for analog signal processing.
Nonideal behaviour of photonic specific circuits under realistic considerations.
Noise sources, spectral densities of noise and transfer functions.
Simulation techniques using SPICE and computer algrebra software.

Language

- German
- English
- Spanish
- French
- Chinese
- Portuguese
- Russian
- Other:

Literature

- Zipfl: Script und several application notes (intranet), Graeme: Amplifiers for Photonic Application,
- Wilmshurst: Signal Recovery, Motchenbacher,
- Connelly: Low-Noise Electronic System Design.

Composition of the Final Mark

Oral Examination PLM 20 minutes

Comments / Other

Last Updated

20.06.2016 Zipfl

¹ SHW = Semester Hours per Week
### Faculty
Optics and Mechatronics

### Degree Program
Applied Photonics (Master)

### Module Coordinator
Prof. Dr. Harald Riegel

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<table>
<thead>
<tr>
<th>Module Name</th>
<th>Laser Application Technology</th>
<th>Module No : 33033</th>
</tr>
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<tbody>
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<td>SHW&lt;sup&gt;1&lt;/sup&gt;</td>
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### Degree Objective

- **Module Type (PM/WPM/WM)**
- **Division (Upper/Lower)**
- **Incorporated in Degree Programs**

- Master of Science
  - WPM - Compulsory Elect

### Study Form
- ❑ Lecture
- ❑ Tutorial
- ❑ Lab
- ❑ Self-Study
- ❑ Seminar
- ❑ Assignment
- ❑ Projekt Work
- ❑ Other: Paper, Report

### Prerequisites
Basic knowledge in Optics, Physics (Thermodynamics) and Mathematics

### Supporting Modules / Courses

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Title of the Module / Course</th>
<th>Lecturer</th>
<th>Type</th>
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<tbody>
<tr>
<td>WM - Elective Mo</td>
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</tbody>
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### Allowed Exam Materials
- non programmable calculator

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<sup>1</sup> SHW = Semester Hours per Week
### Learning Goals / Competences

The students can apply a detailed and well-founded knowledge in the technologies of laser material processing. They can develop advanced principles of the technologies, optimize processes, distinguish suitable lasers and develop complex and modified experimental set-ups for practical work.

The students could discuss and explain the advantages and disadvantages of different methods. They can express themselves scientifically and apply their specialist language skills.

Students can analyse and interpret scientific papers and corresponding literature and combine them with the content of the lecture.

<table>
<thead>
<tr>
<th>Competence Area</th>
<th>Heavy</th>
<th>Medium</th>
<th>Light</th>
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<tbody>
<tr>
<td>Technical Competence</td>
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<tr>
<td>Social Competence</td>
<td>☐</td>
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</tr>
</tbody>
</table>

### Course Contents

#### Teaching Contents

1) Basics: Laser, beam propagation, process efficiency
2) Fresnel absorption (cutting),
3) Melt flow in weld bath (welding)
4) Isophotes (drilling)
5) Undisturbed weld bath (polishing)
5) Interaction with no weld bath (ultra-short-pulsed lasers)

Questions are encouraged in English language. Teaching will be done on elected topics bilingual.

### Language

<table>
<thead>
<tr>
<th></th>
<th>German</th>
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<th>Russian</th>
<th>Other:</th>
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<td>☐</td>
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</table>

### Literature

- script to lecture
- Stehen, Mazumder, Laser Material Processing, Springer Verlag
- Poprawe, Tailored Light 2, Springer Verlag
- Bliedtner, Müller, Barz, Lasermaterialbearbeitung Hanser Verlag

### Composition of Final Grade

- written exam, PLK (100%)

### Comments / Other

### Last Updated

22.04.2016 HR

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1 SHW = Semester Hours per Week
<table>
<thead>
<tr>
<th>Module Name</th>
<th>Simulation of Sensor Systems</th>
<th>Modul No : 33024</th>
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<tbody>
<tr>
<td>CP</td>
<td>SHW¹</td>
<td>Workload</td>
</tr>
<tr>
<td>5</td>
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<td>150h</td>
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</table>

- **Target Degree**: Master of Science
- **Module Type**: WPM - Compulsory Elect
- **Form of Studies**: Lecture, Lab, Self-Study
- **Admission Requirement**: Basic knowledge in Optics & Math

### Supporting Mini-Modules / Courses

<table>
<thead>
<tr>
<th>Subjekt No.</th>
<th>Title of the Mini-Module / Course</th>
<th>Lecturer</th>
<th>Type</th>
<th>SHW¹</th>
<th>CP</th>
<th>Sem</th>
<th>Modul Exam Type/ Length/ Marked</th>
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<tbody>
<tr>
<td>33134</td>
<td>Simulation of Sensor Systems</td>
<td>Prof. Dr. Andreas Heinrich</td>
<td>V</td>
<td>4</td>
<td>5</td>
<td>1</td>
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</tr>
</tbody>
</table>

- **Mini-Module Type (PM/WPM/WM)**: WPM - Compulsory Elect
- **Study Division**: Use in Courses of Study

**Allowed Aids**: Matlab Help function

¹ SHW = Semester Hours per Week
Learning Goals / Competences

Professional competence (professional knowledge and skills, professional expertise):

Students can recognize the Matlab programming language and use it to solve mathematical problems and simulate systems and image analyses. In this way, students can build and simulate models for experimental systems, including the evaluation of measurement data or results of an optical imaging system, as required for industrial applications.

Over professional competence (social skills und ability to work independently):

The students are able to structure their abilities in the division of a problem and to extend and transfer them to partial areas. They can solve complex problems.

Special (methods) skills, if applicable:

The students are able to design and simulate models with Matlab.

<table>
<thead>
<tr>
<th>Competence Area</th>
<th>Concentration</th>
<th>Mini-Concentration</th>
<th>In Small Amounts</th>
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<tbody>
<tr>
<td>Professional Competence</td>
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<td>Methods Competence</td>
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</tr>
<tr>
<td>Social Competence</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
</tr>
</tbody>
</table>

Teaching Contents

- introduction into Matlab
- setting up a model to describe an experimental set-up
- setting up a simulation for the model using Matlab
- evaluate the simulation results
- sensor system based on image analysis

The teaching contents are based on case studies (starting from easy experimental findings like light propagation through optical components to Metrology systems based on image processing)

Language

- ☒ German
- ☒ English
- ☐ Spanish
- ☐ French
- ☐ Chinese
- ☐ Portuguese
- ☐ Russian
- Other:

Literature

Hand-out, detailed manuscript with exercises

Composition of the Final Mark

written exam (100%)

Comments / Other

Last Updated

October, 2017 Andreas Heinrich

¹ SHW = Semester Hours per Week
# Module Name
Fundamental Optics

<table>
<thead>
<tr>
<th>CP</th>
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<th>Workload</th>
<th>Contact Time</th>
<th>Self-Study</th>
<th>Begin</th>
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### Degree Objective
- Master of Science
- WPM - Compulsory Elect

### Study Form
- Lecture
- Tutorial
- Lab
- Self-Study
- Seminar
- Assignment
- Projekt Work
- Other: Paper, Report

### Prerequisites
- Mathematics, physics of technical Bachelor degree

### Supporting Modules / Courses

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Title of the Module / Course</th>
<th>Lecturer</th>
<th>Type</th>
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<td>1</td>
<td>PLM 30 benotet</td>
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</table>

### Module Type
- PM/WPM/WM

### Division
- Upper/Lower

### Incorporated in Degree Programs
- Master of Science
- WPM - Compulsory Elect

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¹ SHW = Semester Hours per Week
**Learning Goals / Competences**

Professional competence (professional knowledge and skills, professional expertise):

Students are able to design and analyze simple optical systems in paraxial approximation, to evaluate and interpret interference, polarization, total reflection and other basic optical effects in order to develop simple optical systems.

The learning goal of the students’ self study is to reach the level of optical knowledge regarding paraxial optics and optical instruments addressed in:


Over professional competence (social skills und ability to work independently):

Students can analyse relevant literature and distinguish between relevant and irrelevant information. They can independently design optical devices according to given specifications.

Soft skills and self-reliance:

The laboratory work enables the students to apply the theoretical knowledge. They are able to perform experiments in a self-reliant way within a small team to set-up and validate optical systems in practice.

<table>
<thead>
<tr>
<th>Competence Area</th>
<th>Heavy</th>
<th>Medium</th>
<th>Light</th>
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<tr>
<td>Social Competence</td>
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</tr>
</tbody>
</table>

**Course Contents**

Refraction, reflection, paraxial optical systems, optical devices, polarization, interference

**Language**

- ☐ German
- ☒ English
- ☐ Spanish
- ☐ French
- ☐ Chinese
- ☐ Portuguese
- ☐ Russian
- Other: ____________

**Literature**

lecture notes with bibliography

**Composition of Final Grade**

PLM 100%

**Comments / Other**

**Last Updated**

21.07.2017, TH

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1 SHW = Semester Hours per Week
### Module Name
Optical design strategies

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<td>4</td>
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<td>90 h</td>
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<td>1 Semester</td>
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### Degree Objective
Master of Science

**Module Type** (PM/WPM/WM)

**Division (Upper/Lower)**

**Incorporated in Degree Programs**

**Study Form**

- Lecture
- Lab
- Self-Study
- Seminar
- Assignment
- Projekt Work
- Other: Paper, Report

**Prerequisites**
Lecture "Fundamental Optics"

### Supporting Modules / Courses

<table>
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<th>Course No.</th>
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**Module Type** (PM/WPM/WM)

**Division (Upper/Lower)**

**Incorporated in Degree Programs**

### Allowed Exam Materials

¹ SHW = Semester Hours per Week
**Learning Goals / Competences**

Professional competence (professional knowledge and skills, professional expertise):

The Students are able to design optical systems and analyze optical aberrations to optimize optical system performance and to compare and validate different approaches. They are able to handle tool elements of an optical design program to design, simulate and analyse optical systems.

Special (methods) skills, if applicable:

Students can analyze literature and can differentiate between relevant and non-relevant information and are able to design, simulate and optimize simple optical devices according to given specifications.

Professional competence (social skills und ability to work independently):

Through project work, students can design different parts of an optical system and combine them in a team to develop optomechanical devices.

<table>
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<th>Light</th>
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<tr>
<td>Social Competence</td>
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</table>

**Course Contents**

Seidel aberrations, Fourier optics, design strategies, analysis and visualisation of aberrations

<table>
<thead>
<tr>
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<th>German</th>
<th>English</th>
<th>Spanish</th>
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<td>Composition of Final Grade</td>
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1 SHW = Semester Hours per Week
## Module Name
Optics technology

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<table>
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<th>Module Type (PM/WPM/WM)</th>
<th>Study Division</th>
<th>Use in Courses of Study</th>
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<tbody>
<tr>
<td>Master of Science</td>
<td>WM - Elective Module</td>
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<tbody>
<tr>
<td>Lecture</td>
<td>Tutorial</td>
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<td>Lab</td>
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<td>Seminar</td>
<td>Assignment</td>
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<td>Projekt Work</td>
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<td>Other: Paper, Report</td>
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<table>
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<tr>
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<td>Module 33035 (Fundamental Optics) or equivalent course</td>
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### Supporting Mini-Modules / Courses

<table>
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<th>Subjekt No.</th>
<th>Title of the Mini-Module / Course</th>
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</table>

### Allowed Aids

¹ SHW = Semester Hours per Week
### Learning Goals / Competences

**Professional competence (professional knowledge and skills, professional expertise):**

The students are able to describe and apply their profound knowledge of optical technologies and measurement techniques by themselves. The Students are able to analyze the optical specifications in order to choose the right technologies and suppliers. They are able to set up an adequate process chain for specific optical components due to the technical and economic constraints in companies.

**Over professional competence (social skills and ability to work independently):**

Students can present and defend their results. They can work in a team. Special (methods) skills, if applicable:

They can interpret and apply the DIN ISO specification.

### Competence Area

<table>
<thead>
<tr>
<th>Competence Area</th>
<th>Concentration</th>
<th>Mini-Concentration</th>
<th>In Small Amounts</th>
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<tr>
<td>Social Competence</td>
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<td>☒</td>
</tr>
</tbody>
</table>

### Teaching Contents

- specifications: From ISO 10 110 to power spectral density
- error budget optics
- selected processes for fabrication of different optical elements
- new moulding processes for glass and plastics
- coating design and coating technology
- design, specifications and fabrication of diffractive optical elements

### Language

- German
- English
- Spanish
- French
- Chinese
- Portuguese
- Russian
- Other:

### Literature

- Manuscript and publications
- J. Bliedtner, G. Grafe, R. Hector, Optical Technology
- Braunecker, Hentschel, Tiziani, Advanced Optics with Aspherics
- J.D. Rancourt, Optical Thin Films

### Composition of the Final Mark

100 % PLM

### Comments / Other

### Last Updated

28.02.2019/ Börret

¹ SHW = Semester Hours per Week
# Biophotonics

## Module Description

**Module No:** 33038

<table>
<thead>
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<th>SHW&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Workload</th>
<th>Contact Time</th>
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<th>Begin</th>
<th>Sem</th>
<th>Duration</th>
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<tbody>
<tr>
<td>5</td>
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<td>150h</td>
<td>60 h</td>
<td>90 h</td>
<td></td>
<td>2</td>
<td>1 Semester</td>
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</table>

**Degree Objective**

Master of Science: WPM - Compulsory Elect

**Study Form**

- Lecture
- Tutorial
- Lab
- Self-Study
- Seminar
- Assignment
- Projekt Work
- Other: Paper, Report

**Prerequisites**

None

## Supporting Modules / Courses

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Title of the Module / Course</th>
<th>Lecturer</th>
<th>Type</th>
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<th>Sem</th>
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<td>Division (Upper/Lower)</td>
<td>Incorporated in Degree Programs</td>
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</tr>
</tbody>
</table>

**Allowed Exam Materials**

Manuscript, books, calculator

<sup>1</sup> SHW = Semester Hours per Week
### Learning Goals / Competences

Professional competence (professional knowledge and skills, professional expertise):

The students can recognize light-induced molecular and cellular mechanisms and describe photonic methods for the recognition and healing of diseases. They can apply knowledge about environmental effects on cells and organisms.

Over professional competence (social skills und ability to work independently):

Students can analyse literature and carry out laboratory and research projects as a team.

Special (methods) skills, if applicable:

Students can apply and transfer complex systems (e.g. lasers, spectrometers and microscopes) and their applications to laboratories and research projects. They are able to develop and document scientific results.

<table>
<thead>
<tr>
<th>Competence Area</th>
<th>Heavy</th>
<th>Medium</th>
<th>Light</th>
</tr>
</thead>
<tbody>
<tr>
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<td><strong>Methods Competence</strong></td>
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<tr>
<td><strong>Social Competence</strong></td>
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<td>☒</td>
</tr>
</tbody>
</table>

### Course Contents

Molecular physics and biophysics, optical spectroscopy and microscopy, light propagation in tissue, interaction of laser radiation with cells and tissues, diagnostic and therapeutic applications.

### Language

- [ ] German
- ☒ English
- [ ] Spanish
- [ ] French
- [ ] Chinese
- [ ] Portuguese
- [ ] Russian
- Other: 

### Literature

relevant publications and exercises

### Composition of Final Grade

PLK (100%);

### Comments / Other

prerequisite laboratory work completed

### Last Updated

13.10.2016, Schneckenburger

¹ SHW = Semester Hours per Week
**Module Name**: Advanced optical design

<table>
<thead>
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<th>Workload</th>
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<tbody>
<tr>
<td>5</td>
<td>4</td>
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</table>

- **Degree Objective**: Master of Science
  - Module Type: WPM - Compulsory Elect

- **Study Form**:
  - Lecture
  - Tutorial
  - Self-Study
  - Seminar
  - Assignment
  - Projekt Work
  - Other: Paper, Report

- **Module Type (PM/WPM/WM)**: WPM - Compulsory Elect
- **Division (Upper/Lower)**: Incorporated in Degree Programs

- **Prerequisites**: Fundamental Optics

**Supporting Modules / Courses**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Title of the Module / Course</th>
<th>Lecturer</th>
<th>Type</th>
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</table>

- **Module Type (PM/WPM/WM)**: WPM - Compulsory Elect
- **Division (Upper/Lower)**: Incorporated in Degree Programs

- **Allowed Exam Materials**: Calculator

\(^1\) SHW = Semester Hours per Week
## Learning Goals / Competences

Professional competence (professional knowledge and skills, professional expertise):

Students are able to design advanced optical systems with the optical design program CodeV, simulate physical optical phenomena, design and simulate illumination systems.

Special (methods) skills, if applicable:

Students are able to select and apply methods for the analysis and validation of optical systems to optimize and develop innovative solutions.

Over professional competence (social skills und ability to work independently):

Students can simulate, design and validate optical systems with an optical design program for the development of optomechanical systems. They are able to present the results.

<table>
<thead>
<tr>
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<tr>
<td>Social Competence</td>
<td>☐</td>
<td>☐</td>
<td>☒</td>
</tr>
</tbody>
</table>

### Course Contents

Aberration theory, correction strategies, programming and handling of optical design programs

### Language

- ☐ German
- ☒ English
- ☐ Spanish
- ☐ French
- ☐ Chinese
- ☐ Portuguese
- ☐ Russian
- Other:

### Literature

Lecture notes and data sheets

### Composition of Final Grade

PLK (100%)

### Comments / Other

### Last Updated

10.02.2017, TH

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1 SHW = Semester Hours per Week
# Module Description

**Faculty**
Optics and Mechatronics

**Degree Program**
Applied Photonics (Master)

**Module Coordinator**
Prof. Dr. T. Hellmuth

## Module Name
Laser photonics

<table>
<thead>
<tr>
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<th>Self-Study</th>
<th>Begin</th>
<th>Sem</th>
<th>Duration</th>
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<td>5</td>
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<td>150h</td>
<td>60h</td>
<td>90h</td>
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<td>2 Semesters</td>
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- Winter Semester
- Summer Semester

## Degree Objective
Module Type (PM/WPM/WM), Division (Upper/Lower), Incorporated in Degree Programs

- Master of Science
- WPM - Compulsory Elect

### Study Form
- Lecture
- Tutorial
- Lab
- Self-Study
- Seminar

- Assignment
- Projekt Work
- Other: Paper, Report

## Prerequisites
Fundamental optics

### Supporting Modules / Courses

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Title of the Module / Course</th>
<th>Lecturer</th>
<th>Type</th>
<th>SHW¹</th>
<th>CP</th>
<th>Sem</th>
<th>Module Exam Type/ Length/ Graded</th>
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<tbody>
<tr>
<td>33240</td>
<td>Laser photonics</td>
<td>Hellmuth</td>
<td>V L</td>
<td>4</td>
<td>5</td>
<td>2</td>
<td>PLM 30 benotet</td>
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</tbody>
</table>

- Module Type (PM/WPM/WM)
- Division (Upper/Lower)
- Incorporated in Degree Programs

### Allowed Exam Materials

¹ SHW = Semester Hours per Week
### Learning Goals / Competences

Professional competence (professional knowledge and skills, professional expertise):

The Students are able to understand and validate different laser types, design, analyse and validate resonator optics, align lasers and determine their performance experimentally.

Special (methods) skills, if applicable:

Students can analyze the literature and choose between relevant and irrelevant information. They can get an overview of the state of the art.

Professional competence (social skills und ability to work independently):

The laboratory work enables students to apply theoretical knowledge. The students are able to apply theoretical knowledge. They are able to perform experiments on their own responsibility in a small team. They can use methods to identify and eliminate negative effects in a practical environment.

<table>
<thead>
<tr>
<th>Competence Area</th>
<th>Heavy</th>
<th>Medium</th>
<th>Light</th>
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</thead>
<tbody>
<tr>
<td>Technical Competence</td>
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<td></td>
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<tr>
<td>Methods Competence</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Social Competence</td>
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<td>✗</td>
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</tr>
</tbody>
</table>

### Course Contents

Laser dynamics, pulsed lasers and pulse dispersion, laser clocks, advanced resonator design, femtosecond lasers, coherence and stochastic optics

### Teaching Contents

Laser photonics lecture notes with bibliography;

### Language

- [ ] German
- ✗ English
- [ ] Spanish
- [ ] French
- [ ] Chinese
- [ ] Portuguese
- [ ] Russian
- Other: 

### Literature

Laser photonics lecture notes with bibliography;

### Composition of Final Grade

PLM (100%);

### Comments / Other

### Last Updated

21.07.2017, TH

¹ SHW = Semester Hours per Week
### Module Description

<table>
<thead>
<tr>
<th>Module No : 33041</th>
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<tbody>
<tr>
<td><strong>Module Name</strong></td>
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<td><strong>Module Coordinator</strong></td>
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<table>
<thead>
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<th>Module No</th>
<th>33041</th>
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<td>Workload</td>
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<td>Contact Time</td>
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<td>Self-Study</td>
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<tr>
<td>Begin</td>
<td>Winter Semester, Summer Semester</td>
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<tr>
<td>Duration</td>
<td>1 Semester</td>
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#### Degree Objective
- **Module Type (PM/WPM/WM)**: WM - Elective Module
- **Division (Upper/Lower)**: HS - Hauptstudium
- **Incorporated in Degree Programs**: Photonics

### Study Form
- Lecture
- Self-Study
- Self-Study
- Seminar
- Assignment
- Projekt Work
- Other: Paper, Report

### Prerequisites
- no

### Supporting Modules / Courses

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<thead>
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<th>Course No.</th>
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<td>Dr. Johannes Eisenmenger</td>
<td>V</td>
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<td>Module Type (PM/WPM/WM)</td>
<td>Division (Upper/Lower)</td>
<td>Incorporated in Degree Programs</td>
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<td>WM - Elective Module</td>
<td>HS - Hauptstudium</td>
<td>Photonics</td>
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</table>

### Module Exam
- Type/ Length/ Graded: PLK 90 benotet

### Allowed Exam Materials
- none

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1 SHW = Semester Hours per Week
Learning Goals / Competences

Professional competence (professional knowledge and skills, professional expertise):

Students can understand the lighting in a basic way. They can describe their knowledge of phenomena that describe the interaction of light waves in optical systems. This allows them to represent the difference between beam and wave optics. This will allow students to see the limits and describe improved optical effects. In addition, students can apply simulation software and transfer their understanding of lighting system design. Special (methods) skills, if applicable:

Students are able to analyse literature and distinguish between relevant and irrelevant information. They can evaluate and judge optical phenomena.

Over professional competence (social skills und ability to work independently):

They can discuss and evaluate the advantages and disadvantages of different approaches in a team. They can express themselves scientifically and apply their knowledge.

<table>
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<tr>
<td>Social Competence</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
</tr>
</tbody>
</table>

Course Contents

The students can choose out of this topics:

1. Introduction
2. Radiometry and apertures
3. Illumination in Imaging Systems
4. Illumination in Nonimaging Systems
5. Spectoradiometric Quantities
6. Radiometric and Photometric quantities
7. Color
8. Scattering of Light
9. Illumination Properties of Materials
10. Sources of Illumination
11. Coherence
12. Fibers, Lightpipes and Lightguides
13. Classical Illumination Design
14. Uniform Illumination
15. Source Modeling Methods
16. Nonimaging Compound Concentrators
17. Displays
18. Characterizing Illumination Systems
19. Software Modelling
20. Architectural Illumination
21. Light and Visual Performance
22. Lighting Design
23. Illumination in Photography
24. Luminaire for Open-Plan Office
25. Daylight Compensation
26. Exterior Lighting
27. Parking
28. Roadway Lighting
29. Resolution Enhancement by Illumination in Microscopy and Photolithography
30. Special Illumination Techniques for Measurements
31. Illumination in Particle Optics

Language

☐ German ☒ English ☐ Spanish ☐ French

1 SHW = Semester Hours per Week
<table>
<thead>
<tr>
<th>Literature</th>
<th>-</th>
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<tbody>
<tr>
<td>Composition of Final Grade</td>
<td>PLK (100%)</td>
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<tr>
<td>Comments / Other</td>
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<td>Last Updated</td>
<td>14.03.17 Andreas Heinrich</td>
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1 SHW = Semester Hours per Week