Technology
Arts Sciences
TH Köln

# Course Manual WIB

wave optics, interference, diffraction

Version: 1 | Last Change: 05.10.2019 17:07 | Draft: 0 | Status: vom verantwortlichen Dozent freigegeben

## General information

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|---|---|
| **Long name** | wave optics, interference, diffraction |
| **Approving CModule** | WIB_BaET |
| **Responsible** | Prof. Dr. Michael Gartz<br>Professor Fakultät IME |
| **Valid from** | summer semester 2022 |
| **Level** | Bachelor |
| **Semester in the year** | summer semester |
| **Duration** | Semester |
| **Hours in self-study** | 78 |
| **ECTS** | 5 |
| **Professors** | Prof. Dr. Michael Gartz<br>Professor Fakultät IME |
| **Requirements** | complex number<br>Mathematics 1 and 2<br>Physics, generally wave theory |
| **Language** | German |
| **Separate final exam** | Yes |

### Literature

Pedrotti, Pedrotti, Bausch, Schmidt: Optik für Ingenieure. Grundlagen (Springer)

Hecht: Optik (Oldenbourg)

Bergmann, Schaefer, Bd.3, Optik, de Gruyter

Max Born und Emil Wolf, Principles of Optics, Cambridge University Press

Saleh, Teich, Grundlagen der Photonik, Wiley-VCH

### Final exam

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|---|---|
| **Details** | Written examination with differentiated types of exercises of taxonomy ratings understanding, appliance, analyzing and synthesizing. That means, within the excersises the terms coherence, interference, diffraction and polarisation have to be understood and can be exerted.The optical terms like harmonic wave, plane wave and spherical wave as well as the model of the electric magnetic wave have to be taken for the solution of an analysed optical question and have to be understood and can be exerted. Understood and remebered formula and optical prinziple have to be combined for the solving of new types of excercises. Formulas have to be converted. |
| **Minimum standard** | 50 % of the exercises with different taxonomy ratings correctly processed |
| **Exam Type** | EN Klausur |

## − Lecture / Exercises

### Learning goals

| Goal type | Description |
|---|---|
| Knowledge | optical settings align<br>Light in the description of wave optics<br>delimitation of the wave optics to the geometrical optics<br>Wave equation<br>mathematical definition of a wave<br>electric field strength<br>magnetic field strength<br>mathematival description of waves<br>harmonic wave<br>definition of intensity |
| Knowledge | interference of waves<br>superposition principle = linear system<br>Two beam interference: mathematical description<br>Michelson interferometer<br>Young's Double slit experiment<br>Mach-Zehnder interferometer<br>interference at thin layers |
| Knowledge | coherence<br>definition of the coherence<br>temporal coherence / spectral distribution<br>spatial coherence / geometrical dilatation |
| Knowledge | Diffraction<br>elementary waves<br>Huygen's principle<br>Fraunhofer diffraction<br>diffraction at a slit<br>diffraction at a circular aperture<br>diffraction at a grating<br>diffracton at a zone plate<br>resolution power of optical instruments<br>Rayleigh criterion<br>Fraunhofer diffraction as Fourier transformation<br>transmission function of a slit<br>Fresnel diffraction<br>diffraction regime<br>Fresnel diffraction images<br>Fresnel zones<br>Fresnel zone plate<br>diffraction at a slit<br>Babinetsches principle |

### Special requirements

none

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|---|---|
| **Accompanying material** | Presentation slides for the lecture as pdf-files, exercise task as downloadable files |
| **Separate exam** | No |

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|---|---|
| Knowledge | polarisation<br>generation of polarised light<br>Brewster angle<br>dichroism<br>birefringence<br>reflection<br>scattering<br>linear, circular and elliptical polarisation<br>presentation of polarisation states as superposition of two linear polarised waves<br>mathematical description of polarisation<br>Jones vectors, Jones matrices<br>polarisation of active optical components |
| Skills | calcualtion of<br>field strength and intensity of two beam interference<br>coherence length<br>coherence time<br>spectral width of light source<br>contrast<br>path difference and phase difference |
| Skills | defining of<br>the wave function and<br>the complex wave function |
| Skills | generation<br>of a harmonic grating,<br>of polarised light |
| Skills | determination of<br>states of polarisation<br>of chromatic lenght aberration of a zone plate |
| Skills | distinguish / denominate<br>the interference phenomenon in case of polarised light<br>of astigmatism of a zone plate |

## Expenditure classroom teaching

| Type | Attendance (h/Wk.) |
|---|---|
| Lecture | 2 |
| Exercises (whole course) | 1 |
| Exercises (shared course) | 0 |
| Tutorial (voluntary) | 0 |

## − Practical training

### Learning goals

| Goal type | Description |
|---|---|
| Skills | align of optical settings |
| Skills | make record series of measurements and document them |
| Skills | generate diagrams |
| Skills | checking results for plausibility |
| Skills | recognize and understand correlations |
| Skills | make error analysis |
| Skills | realize basical optical set-ups, assemble, align, make a functional check |
| Skills | investigate natural scientific and technical principles by optical set-ups<br>project record series of measurements,<br>estimate error effects,<br>check the suitability of the set-up |
| Skills | make the evaluation of self generated record series of measurements<br>present measurement values graphically<br>calculate implicit values in correct mathematical manner from measurement values<br>recognize logical errors and name them<br>simulate measurement values with given formulas |
| Skills | compose a traceable report<br>describe the conceptual formulation<br>state the method of resolution<br>represent the results in a clear manner<br>discuss the results in a technical, academic manner |

### Special requirements

none

| | |
|---|---|
| **Accompanying material** | written instructions to each experiment as pdf-files |
| **Separate exam** | No |

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|---|---|
| Skills | work on complex technical tasks by teamwork<br>organize in subtasks<br>present the results and make a critical discussion |

### Expenditure classroom teaching

| Type | Attendance (h/Wk.) |
|---|---|
| Practical training | 1 |
| Tutorial (voluntary) | 0 |

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