Technology
Arts Sciences
TH Köln

# Course
# OMT - Optical metrology

Version: 1 | Last Change: 06.10.2019 20:18 | Draft: 0 | Status: vom verantwortlichen Dozent freigegeben

## General information

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|---|---|
| **Long name** | Optical metrology |
| **Approving CModule** | OMT_BaET, OMT_BaOPT |
| **Responsible** | Prof. Dr. Michael Gartz<br>Professor Fakultät IME |
| **Level** | Bachelor |
| **Semester in the year** | winter semester |
| **Duration** | Semester |
| **Hours in self-study** | 78 |
| **ECTS** | 5 |
| **Professors** | Prof. Dr. Michael Gartz<br>Professor Fakultät IME |
| **Requirements** | geometrical optics<br>radiometry<br>Mathematics 1 and 2<br>Physics<br>wave optics |
| **Language** | German |
| **Separate final exam** | Yes |

### Final exam

#### Details

Written examination with differentiated types of exercises of taxonomy ratings like understanding, appliance, analyzing and synthesizing.
That means, within the exercises the terms like CCD, CMOS, thermal or quantum-mechanical detectors have to be understood and can be exerted.
The optical and electronical correlations like quantum-mechanical generation of electron-hole pairs have to be understood and to be exerted for

analyzed optical measurement questions.
Understood and remembered formula and optical principles have to be combined (synthesized) for the solving of new types of exercises. Formulas have to be converted.

### Minimum standard

50 % of the exercises with different taxonomy ratings correctly processed

### Exam Type

Written examination with differentiated types of exercises of taxonomy ratings like understanding, appliance, analyzing and synthesizing.
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## Lecture / Exercises

## Learning goals

### Knowledge

Optical detectors:
photodiode
optical properties
spectral sensitivity
detectivity
random noise
temporal response
electrical parameters
photocurrent
capacity
saturation voltage
sensitivity / efficiency
wiring
element mode of operation
biased mode of operation
avalanchediode
optical properties
spectral sensitivity
detectivity
random noise
temporal response
electrical parameters
photocurrent
capacity
saturation voltage
sensitivity / efficiency
wiring
element mode of operation
biased mode of operation

photomultiplier
optical properties
spectral sensitivity
detectivity
random noise
temporal response
electrical parameters
photocurrent
capacity
sensitivity / efficiency
wiring
mode of operation

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reflectometry
antireflection coatings
dielectric mirrors

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spectroscopy
types of spectrometer
prism spectrometer
grating spectrometer
angle- and linear dispersion
spectral resolution
calibration and scaling
emission spectroscopy
absorption spectroscopy
application of spectroscopy
spectral measurement / colour measurement
non-contact layer thickness measurement

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multi beam interference
Fabry-Perot interferometer
laser mode / laser resonator
free spectral range
interference filter

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optical wave guide
principle of the light guiding
total reflection
composition of the light wave guide
monomode fiber
multimode fibre
step index fibre
graded index fiber
aperture
materials of the light fibre
attenuation
band width
gradient optics

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optical measurement systems
light barrier
set-up
transmission ligt barrier

reflection light barrier
laser light barrier
operating factors
applications
safety engineering
velocimetry
automating

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### Skills

calculation
of the reflectivity
of the layer thickness based of spectral measurements

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to characterise
the spectral rsponse function of optical receiver
the time response of optical detectors

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selection of
photodiodes for special applications
light fibre types for claimed applications

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to evaluate and to assess
the precision of optical measurements
the usabilityof different detectors for optical measurement tasks

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to recognize measurement requirements

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to denominate
methods for resolution of a recognized optical measurement
requirement

## Expenditure classroom teaching

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

## Separate exam

none

## Practical training

### Learning goals

**Skills**

align of optical settings

make record series of measurements and document them

generate diagrams

checking results for plausibility

recognize and understand correlations

measurement by oscilloscope

make mathematical error analysis

realize basical optical set-ups, assemble, align, make a functional check

investigate natural scientific and technical principles by optical set-ups
project record series of measurements,
estimate error effects,
check the suitability of the set-up

make the evaluation of self generated record series of measurements
present measurement values graphically
calculate implicit values in correct mathematical manner from
measurement values
recognize logical errors and name them
simulate measurement values with given formulas

compose a traceable report
describe the conceptual formulation
state the method of resolution
represent the results in a clear manner
discuss the results in a technical, academic manner

work on complex technical tasks by teamwork
organize in subtasks
present the results and
make a critical discussion

### Expenditure classroom teaching

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

## Separate exam

none