Technology
Arts Sciences
TH Köln

Course
OSA - Optical Spectroscopy and Applications

Version: 1 | Last Change: 19.10.2019 14:38 | Draft: 0 | Status: vom verantwortlichen Dozent freigegeben

General information

Long name	Optical Spectroscopy and Applications
Approving CModule	OSA_MaET
Responsible	Prof. Dr. Michael Gartz Professor Fakultät IME
Level	Master
Semester in the year	summer semester
Duration	Semester
Hours in self-study	78
ECTS	5
Professors	Prof. Dr. Michael Gartz Professor Fakultät IME
Requirements	Geometric optics radiometry, photometry, radiation physics Optical metrology wave optics Mathematics 1 / 2 Physics 1 / 2
Language	German
Separate final exam	Yes

Final exam

Details

Oral examination in which the taxonomy levels of understanding, applying, analysing, synthesising and evaluating are tested by students presenting and explaining their projects carried out during the semester and showing that they can understand and apply the technical terms, theories and

procedures developed in the lecture, have analysed the requirements of their project task and have synthesised a solution to their project task and can evaluate it in the examination interview.

Minimum standard

50 % of the questions and tasks out of all parts (project, lecture) of the examination correctly answered

Exam Type

Oral examination in which the taxonomy levels of understanding, applying, analysing, synthesising and evaluating are tested by students presenting and explaining their projects carried out during the semester and showing that they can understand and apply the technical terms, theories and procedures developed in the lecture, have analysed the requirements of their project task and have synthesised a solution to their project task and can evaluate it in the examination interview.

Lecture

Learning goals

Knowledge

First application
Layer thickness measurement by optical sepktroscopy
measuring principle
superstructure
sensitivity

Basics of spectroscopy
dispersion
angular dispersion
linear dispersion
prism
Beam path in prism
Dispersion of the prism
diffraction grating
Diffraction at the grating
Dispersion at the grating
usable spectral range of the grating
grating types
transmission grating
reflection grating
echelette grating
concave grating
manufacturing techniques
scored gratings
holographic gratings
Diffraction efficiency of gratings
measurement
Blaze Technique
Comparison: grating and prism

Structure of spectrometers
Structure of the monochromator
Structure of the prism spectrometer
resolving capacity of the prism spectrometer
beam path
Structure of the grating spectrometer
resolving capacity of the grating spectrometer
beam path
negative effects in the spectrometer
ghost images
scattered light
Second Order Effects
radiation sources
Properties of radiation sources
Thermal sources
discharge lamps
light-emitting diodes
laser
Detectors / Receivers
Properties of Receivers
photodiode
CCD / CMOS line / matrix
thermal detectors
filters
absorption filter
interference filters
Calibration of spectrometers
wavelength calibration
intensity calibration

Characteristics of spectrometers
Spectral resolution capability
diffraction efficiency
free spectral range

Commercial spectrometers
UV spectrometer
VIS spectrometer
IR / NIR spectrometer
Multichannel Spectrometer

Fourier spectroscopy
Principle of Fourier Spectroscopy
Fourier transform
Discrete Fourier transformation
Fourier spectrometer

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applications
Raman spectroscopy
fundamentals
Applications of Raman spectroscopy
colorimetry
transmission measurement
remission measurement

emission measurement
coating thickness measurement
Spectral Element Analysis
(further topics according to selection)

Skills

calculate
the spectral resolution
angular and linear dispersion
of the free spectral range
the working range of the chromatic longitudinal aberration sensor
the resolution of the light section sensor

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select
a spectrometer for a special measuring task
a light source for absorption and
transmission measurements

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determine
the transmission curve of various optical components
the spectral reflectance
the thickness of non-opaque layers

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assess
the sensitivity of a spectrometer
the usability of a spectrometer

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analyze
of measuring tasks from the field of optical
spectroscopy

Expenditure classroom teaching

Type	Attendance (h/Wk.)
Lecture	2
Tutorial (voluntary)	0

Separate exam

none

Project

Learning goals

Skills

Adjusting spectrometer superstructures

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record, evaluate and document optical spectra

Check results for plausibility

Recognizing and understanding interrelationships

Selecting the spectrometer type for a specific measurement task

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Calculation of the different spectral display modes

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analyse a spectroscopic optical measuring task
Independently recognized measuring task can be analyzed
a given measuring task can be analyzed

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design a solution approach for the analyzed optical measuring task
Consideration of laboratory resources
Consideration of the available time quota

Presentation of a project outline
Describe the task
outline the approach
Present results in a clearly structured way
Discuss results in technical and scientific manner

Milestone presentation to check the progress of the project
Describe the task
outline the approach
Present results in a clearly structured way
Discuss results in technical and scientific manner

Final presentation with presentation of the realized solution approach
Describe the task
outline the approach
Present results in a clearly structured way
Discuss results in technical and scientific manner

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basic spectrometer setups can be realized by yourself
build
adjust
Carry out function test

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investigate scientific/technical principles with an optical structure
Plan measurement series

Estimate error influences

Check the suitability of the superstructure

Evaluate self-acquired measurement series

Graphic display of measured values

Calculate implicit quantities from measured values math.

correctly

discover and name logical errors

Simulate measured values using predefined formulas

Work on complex technical tasks in a team

Organize into subtasks

Discuss measurement results

complement each other meaningfully

Expenditure classroom teaching

Type	Attendance (h/Wk.)
Project	2
Tutorial (voluntary)	0

Separate exam

none