Technology
Arts Sciences
TH Köln

Course Manual OSA

Optical Spectroscopy and Applications

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General information

Long name	Optical Spectroscopy and Applications
Approving CModule	OSA_MaET
Responsible	Prof. Dr. Michael Gartz Professor Fakultät IME
Valid from	summer semester 2021
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

Literature

- Demtröder, Laser-Spektroskopie, Springer
- Demtröder, Experimentalphysik 2, Springer
- Schmidt Werner, Optische Spektroskopie, Wiley-VCH
- Pedrotti, Pedrotti, Bausch, Schmidt, Optik für Ingenieure, Grundlagen, Springer
- Schröder, Treiber, Technische Optik, Vogel Verlag
- Hecht, Optik, Oldenbourg
- Bergmann, Schaefer, Bd.3, Optik, de Gruyter
- Max Born und Emil Wolf, Principles of Optics, Cambridge University Press

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	EN mündliche Prüfung, strukturierte Befragung

− Lecture / Exercises

Learning goals

Goal type	Description
Knowledge	First application Layer thickness measurement by optical sepktroscopy measuring principle superstructure sensitivity
Knowledge	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

Special requirements

none

Accompanying material	Presentation slides for the lecture as pdf-files
Separate exam	No

Knowledge	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
Knowledge	Characteristics of spectrometers Spectral resolution capability diffraction efficiency free spectral range
Knowledge	Commercial spectrometers UV spectrometer VIS spectrometer IR / NIR spectrometer Multichannel Spectrometer
Knowledge	Fourier spectroscopy Principle of Fourier Spectroscopy Fourier transform Discrete Fourier transformation Fourier spectrometer

Knowledge	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
Skills	select a spectrometer for a special measuring task a light source for absorption and transmission measurements
Skills	determine the transmission curve of various optical components the spectral reflectance the thickness of non-opaque layers
Skills	assess the sensitivity of a spectrometer the usability of a spectrometer
Skills	analyze of measuring tasks from the field of optical spectroscopy

Expenditure classroom teaching

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

− Lecture / Exercises

Learning goals

Goal type	Description
Skills	Adjusting spectrometer superstructures
Skills	record, evaluate and document optical spectra
Skills	Check results for plausibility
Skills	Recognizing and understanding interrelationships
Skills	Selecting the spectrometer type for a specific measurement task
Skills	Calculation of the different spectral display modes
Skills	analyse a spectroscopic optical measuring task Independently recognized measuring task can be analyzed a given measuring task can be analyzed
Skills	design a solution approach for the analyzed optical measuring task Consideration of laboratory resources Consideration of the available time quota
Skills	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
Skills	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

Special requirements

none

Accompanying material	oral discussions with project supervisor with individual given references
Separate exam	No

Skills	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
Skills	basic spectrometer setups can be realized by yourself build adjust Carry out function test
Skills	investigate scientific/technical principles with an optical structure Plan measurement series Estimate error influences Check the suitability of the superstructure
Skills	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
Skills	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