Technology
Arts Sciences
TH Köln

Course Manual OMT

Optical metrology

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General information

Long name	Optical metrology
Approving CModule	OMT_BaET, OMT_BaOPT
Responsible	Prof. Dr. Michael Gartz Professor Fakultät IME
Valid from	winter semester 2022/23
Level	Bachelor
Semester in the year	winter semester
Duration	Semester
Hours in self-study	78
ECTS	5
Professors	Prof. Dr. Michael Gartz Professor Fakultät IME
Requirements	geometrical optics radiometry Mathematics 1 and 2 Physics wave optics
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
- Schröder, Technische Optik, Vogel Verlag
- Naumann, Schröder, Bauelemente der Optik, Hanser Verlag
- Mark Johnson, Photodetection and Measurement, Mc Graw Hill

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	EN Klausur

− Lecture / Exercises

Learning goals

Goal type	Description
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
Knowledge	reflectometry antireflection coatings dielectric mirrors

Special requirements

none

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

Knowledge	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
Knowledge	multi beam interference Fabry-Perot interferometer laser mode / laser resonator free spectral range interference filter
Knowledge	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
Knowledge	optical measurement systems light barrier set-up transmission ligt barrier reflection light barrier laser light barrier operating factors applications safety engineering velocimetry automating
Skills	calculation of the reflectivity of the layer thickness based of spectral measurements
Skills	to characterise the spectral rsponse function of optical receiver the time response of optical detectors

Skills	selection of photodiodes for special applications light fibre types for claimed applications
Skills	to evaluate and to assess the precision of optical measurements the usabilityof different detectors for optical measurement tasks
Skills	to recognize measurement requirements
Skills	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

− 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	measurement by oscilloscope
Skills	make mathematical 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 project record series of measurements, estimate error effects, check the suitability of the set-up
Skills	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
Skills	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

Special requirements

none

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

Skills	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