Technology
Arts Sciences
TH Köln

Course Manual NLO

Nonlinear optics

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General information

Long name	Nonlinear optics
Approving CModule	NLO_MaET
Responsible	Prof. Dr. Uwe Oberheide 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. Uwe Oberheide Professor Fakultät IME
Requirements	Physics: wave propagation, phase velocity Laser technology: laser types, basic principle of stimulated emission Light-matter interaction: absorption, scattering, refractive index, birefringence
Language	German
Separate final exam	Yes

Literature

- Boyd – Nonlinear Optics, Elsevier
- Pedrotti – Optik für Ingenieure, Springer
- Saleh, Teich – Grundlagen der Photonik, Wiley VCH

Final exam

Details	Checking the taxonomy levels of understanding and applying by describing elementary applications and interaction processes in an idealized application environment. Checking the taxonomy levels analyzing and synthesizing on the basis of real application cases and the associated selection of the required optical components and processes according to the respective interaction processes determined
Minimum standard	50 % of the questions correctly answered

Exam Type	EN mündliche Prüfung, strukturierte Befragung

− Lecture / Exercises

Learning goals

Goal type	Description
Knowledge	Optical frequency multiplication (crystal coherence lengths, phase matching, quasi phase matching and periodic polarity) Frequency mixing Optical-parametric oscillation and amplification Electro-, magneto- and acousto-optical effects Q-switch, mode coupling, ultrashort pulse laser Application of multiphoton processes Photorefraction, stimulated Brillouin scattering, phase conjugating mirrors
Skills	Recognizing analogies of known linear physical processes (light-matter interaction at low intensity) and transferring them to nonlinear processes Describe processes mathematically and transfer the result into physical effects Transfer idealized systems to real systems and derive qualitative behavior Describe and explain correlations of quantities (saturable absorption / multidimensional refractive index) and transfer them to real materials. Analyze technical applications and problems, break them down into individual processes and solve them using known nonlinear interactions.

Special requirements

none

Accompanying material	Presentation slides for the lecture Links to Internet resources with basic information
Separate exam	No

Expenditure classroom teaching

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

Tutorial (voluntary)	0

− Lecture / Exercises

Learning goals

Goal type	Description
Knowledge	Presentations on applications/processes based on the content of the course (transfer of course content to other applications). Examples: - spectral broadening in a femtosecond laser by self-phase modulation - temporal measurement of ultrashort laser pulses - compensation of imaging errors by the use of phase conjugating mirrors - laser induced nuclear fusion - multiphoton processes - generation and application of higher harmonics - optical parametric oscillators - free-electron laser
Skills	Procurement of suitable literature/information Familiarisation with new technical field of expertise Use of english technical literature Evaluation of available literature Checking the relevance of information Filtering out essential information and preparing it for the appropriate target group

Expenditure classroom teaching

Type	Attendance (h/Wk.)
Seminar	1
Tutorial (voluntary)	0

Special requirements

none

Accompanying material	Links to Internet resources with basic information
Separate exam	Yes

Separate exam

Exam Type	EN Fachgespräch (Interview) zu besonderen Fragestellungen (Szenario, Projektaufgabe, Lieraturrecherche)
Details	Presentation on a given topic with literature research The presentation should be adapted to the previous knowledge of the students of the course and enable a discussion of the content.
Minimum standard	structured presentation of the most important points with a list of related sources