Faculty of Science

FYST70, Physics: Advanced Optics and Lasers, 7.5 credits

Fysik: Avancerade laser- och optiksystem, 7,5 högskolepoäng

Second Cycle / Avancerad nivå

Details of approval

The syllabus was approved by Study programmes board, Faculty of Science on 2022-06-14 to be valid from 2022-06-14, spring semester 2023.

General Information

The course is an elective course for second-cycle studies for a scientific candidate - or Master's degree in physics.

Language of instruction: English

Main field of studies	*Depth of study relative to the degree requirements*
Physics	A1N, Second cycle, has only first-cycle course/s as entry requirements

Learning outcomes

The aim of the course is develop the students' knowledge of light and lasers and to provide methods for describing different characteristics and how these characteristics can be manipulated.

Knowledge and understanding

On completion of the course, the student should be able to:

- account for the principles of acousto-optic and electro-optic effects and their technical applications,
- account for how optical components and optical systems modifies ultrashort laser pulses,
- account for transverse coherence and longitudinal coherence and describe technical applications where coherence is used,
- describe the basic principles of non-linear interactions between light and matter,
- carry out theoretical calculations of the efficiency for non-linear processes,
- account for the basics of laser safety.

Competence and skills

On completion of the course, the student should be able to:

- qualitatively and quantitatively analyse advanced optical systems based on acousto-optical, electro-optical and non-linear optical effects,
- design optical systems based on acousto-optical, electro-optical and non-linear optical effects for specific tasks,
- calculate pulse shapes of ultrashort laser pulses following propagation through optical components and optical systems,
- calculate coherence properties based on the spectrum, the size and distance of the light source,
- tackle and solve more extensive and complex theoretical problems,
- search for and integrate knowledge from extensive English reading lists.

Judgement and approach

On completion of the course, the student should be able to:

- assess and find optical methods to develop new advanced technological applications, methods and systems based on polarization, non-linear, optics, acousto-optics, electro-optics, coherence and ultrashort pulses.

Course content

- Light propagation in anisotropic materials,
- Acusto-optical effects and modulators,
- Electro-optical effects and modulators,
- Non-linear interaction between light and matter,
- Ultrafast optics, propagation of short laser pulses in dispersive non-linear media,
- Basic laser safety.

Course design

The teaching consists of lectures, two laboratory sessions (non-linear optics, ultrafast optics (titanium-sapphire laser)) including preparatory laser safety, group work and a project in optical design by means of a modern ray tracing program. Participation in laboratory sessions, projects and related teaching is compulsory. Study visit showing current research information is offered.

Assessment

The examination is based on laboratory sessions and project work and their related reports during the course and on a written examination at the end of the course. Before the laboratory exercises, the student shall complete a course with a test in basic laser safety. Students who do not pass the regular exam are offered a new possibility during a scheduled re-examination period.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

Subcourses that are part of this course can be found in an appendix at the end of this

document.

Grades

Marking scale: Fail, Pass, Pass with distinction.
To pass the entire course, approved written examination, approved test in basic laser safety, approved laboratory reports and project report and participation in all compulsory parts are required. The marking scale for laboratory reports, test in basic laser safety and project report is Fail, Pass, while the written examination is marked according to marking scale Fail, Pass, Pass with distinction.
The final grade is decided by the results of the written examination.

Entry requirements

Admission to the course requires 120 credits studies in natural sciences, of which 75 credits in physics and 45 credits in mathematics is included, alternatively a Bachelor degree in physics – in both cases including knowledge equivalent to FYSA13 Introduction to University Physics, with Optics, Waves and Quantum Physics, 7.5 credits, and English 6/B.

Further information

The course replaces FYST32 Physics: Advanced Optics and Lasers, 7.5 credits, and cannot be counted in a degree together with this course.

The course is entirely co-read with FAFN10, Advanced Optics and Lasers, 7.5 credits, which is a course at the Faculty of engineering, LTH. The examination of the course is scheduled in accordance with LTH's examination schedule.

Knowledge equivalent to FYSB21 Mathematical Methods for Vibrations, Waves and Diffusion, 7.5 credits, is recommended but is no requirement.

The course is the fourth in a series of four courses within photonics that uses the same book.

The course is given by the Department of Physics, Lund University.

Subcourses in FYST70, Physics: Advanced Optics and Lasers

Applies from V23

2301 Exam, 5,0 hp
Grading scale: Fail, Pass, Pass with distinction
2302 Laser safety, 0,5 hp
Grading scale: Fail, Pass
2303 Laboratory Exercises, 1,0 hp
Grading scale: Fail, Pass
2304 Project, 1,0 hp
Grading scale: Fail, Pass