Faculty of Science

FYST59, Physics: Medical Optics, 7.5 credits

Fysik: Medicinsk optik, 7,5 högskolepoäng

Second Cycle / Avancerad nivå

Details of approval

The syllabus was approved by Study programmes board, Faculty of Science on 2021-12-12 to be valid from 2021-12-12, autumn semester 2022.

General Information

The course is an elective course for second-cycle studies for a Bachelor or Master's degree in Science.

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 to convey deep understanding of how light interacts with strongly scattering media with focus on medical diagnostics and therapy. The course is arranged around a project with an open problem setting.

Knowledge and understanding

On completion of the course, the students shall be able to:

- describe fundamental mechanisms of light-tissue interaction
- explain how light propagates in tissue in different conditions
- discuss how optical properties of scattering dominated media can be measured and modelled
- explains approaches to improving contrast in imaging applications
- describe in detail an example of how optical methods and lasers are being used in biomedical applications
- discuss the overarching mechanisms for a number of relevant therapeutical applications in laser medicine

- explain the basic principles for laser diagnostics in medicine.

Competence and skills

On completion of the course, the students shall be able to:

- measure optical properties of tissue
- model light propagation in tissue with different methods
- write a report with in depth analysis of published data and own results
- include, analyze and judge information from different sources
- plan and conduct a project within medical optics in a group with another student (or alone) within a given time frame and present the project orally and in writing.

Judgement and approach

On completion of the course, the students shall be able to:

- choose and motivate a modelling approach for light propagation in a turbid medium under specific conditions
- choose and motivate a suitable measurement technique to obtain the optical properties of tissue depending on tissue type and condition
- evaluate the critical laser parameters for a specific medical laser application
- independently find relevant information from sources not provided as course material, e.g. with help of the library services, and critically judge this information.
- demonstrate an understanding of the challenges in medical laser applications.

Course content

The course is oriented towards solving an openly formulated problem in the form of a project on how light is transported inside strongly scattering media. The lab exercises and computer exercises that are part of the course provide the tools and the knowledge to solve the problem. The project is presented both orally and in writing. The course contains a number of lectures on medical applications of light and lasers. The theory of light transport in strongly scattering media is introduced and discussed. During the course different analytical and numerical approaches to light transport will be discussed. As many medical laser treatment modalities are based on thermal effects, heat diffusion is introduced as well. Two laboratory exercises are dedicated to the optical properties of strongly scattering media. The course finishes with the presentation of the projects.

Course design

The teaching consists of lectures, laboratory sessions and project work. Participation in laboratory sessions and project work and related teaching, is compulsory.

Assessment

The assessment is performed through the project, in writing and oral presentation, in the end of the course as well as through the obligatory course elements, i.e. laboratory exercises and computer exercises.

To achieve a higher grade (Pass with distinction), the students have the possibility for an optional written exam in the end of the course. A well performed project provides extra points for the ordinary exam (not for re-exams).

An additional written exams is offered in the first re-exam period following the end of the course.

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.
For passing the course, the project and all obligatory course parts need to be accepted by the examinators. The grading scale for the project and the obligatory course parts is Fail, Pass. The grading scale for the optional exam is Fail, Pass, Pass with distiction. The final grade is determined by the optional exam, if taken, otherwise by the project and the obligatory course parts.

Entry requirements

For admission to the course, 135 credits of natural science studies, including 90 credits in physics and 45 credits in mathematics, is required, alternatively a bachelor in physics. In both cases, knowledge equivalent to FYSA13, Physics: Introduction to University Physics, with Optics, Waves and Quantum Physics, 7.5 credits, FYSB22, Physics: Basic Quantum Mechanics, 7.5 credits and FYSB24 Physics: Atomic and Molecular Physics, 7.5 credits, are required. English 6/B.

Further information

The course may not be included in a degree together with FYST22, Physics: Medical Optics, 7.5 credits.

The course is to be studied together with FAFN35, Medical Optics 7,5 credits, which is coordinated by LTH.

The written examination is scheduled according to LTH's examination periods.

Subcourses in FYST59, Physics: Medical Optics

Applies from H22

2201 Project, 4,5 hp
Grading scale: Fail, Pass
The project is performed in groups of two students. The project can be done by a single student, if for example the number of students in the course is odd. During the oral presentation of the project, the students must explain their contribution to the project.

2203 Computer exercise, 3,0 hp
Grading scale: Fail, Pass
Credits will be granted after all laboratory and computer exercises have been performed and evaluated.

2204 Written exam, 0,0 hp
Grading scale: Fail, Pass, Pass with distinction