Course syllabus

Medicinsk optik
Medical Optics

FAFN35, 7,5 credits, A (Second Cycle)

Valid for: 2023/24
Faculty: Faculty of Engineering, LTH
Decided by: PLED F/Pi
Date of Decision: 2023-04-18

General Information

Main field: Photonics.
Elective Compulsory for: MFOT1
Elective for: BME4-bf, E4-mt, F4, F4-f, F4-mt, N4, Pi4
Language of instruction: The course will be given in English

Aim

The aim of the course is to provide the students with fundamental knowledge related to the propagation of light through, and interaction with, highly scattering and absorbing media, such as biomedical tissues and blood samples. This knowledge is central for the development of a large number of clinical diagnostic tools as well as for the application of laser based treatment modalities.
Biomedical optics and imaging is a rapidly developing field of research which has undergone large progress over the two past decades thanks to the continuous advancement of sensors, illumination sources and computational light propagation models. The medical industry continuously requires qualified personnel within this field.
The course also aims at stimulating interest in optical diagnostics problems and solutions within the fields of medicine, life-science and other related areas. Apart from lectures, computer and laboratory exercises, the course builds to a large degree on a project within which the student should apply and deepen his/her knowledge. The project is presented both orally and in writing.

Learning outcomes

Knowledge and understanding
For a passing grade the student must

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

Competences and skills
For a passing grade the student must

- be able to measure optical properties of tissue
- be able to model light propagation in tissue with different methods
- be able to write a report with in depth analysis of published data and own results
- be able to include, analyze and judge information from different sources
- be able to 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
For a passing grade the student must

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

Contents

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.

Examination details

Grading scale: TH - (U,3,4,5) - (Fail, Three, Four, Five)
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, giving the grade 3. To achieve a higher grade (4 or 5), 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).

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.

Parts
Code: 0123. **Name:** Written Examination.
Credits: 0. **Grading scale:** TH. **Assessment:** Passed exam.
Code: 0223. **Name:** Laboratory and Computer Exercises.
Credits: 3. **Grading scale:** UG. **Assessment:** Passed laboratory and computer exercises.
Code: 0323. **Name:** Project.
Credits: 4,5. **Grading scale:** UG. **Assessment:** Passed project.

Admission

Assumed prior knowledge: Basic courses in physics, mathematics and optics.
The number of participants is limited to: No
The course overlaps following course/s: FAF150

Reading list

- Caroline Boudoux: Fundamentals of Biomedical Optics. ISBN: 9781366451194.

Contact and other information

Course coordinator: Cord Arnold, cord.arnold@fysik.lth.se
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Course homepage: http://www.atomic.physics.lu.se/education/elective-courses/fafn35-fyst22-medical-optics/