Faculty of Science

FYST22, 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 2007-06-14 to be valid from 2007-07-01, autumn semester 2007.

General Information

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

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 that students should have acquired the following knowledge and skills on completion of the course:

Knowledge and understanding

To pass the course, the student should:

- be able to explain how light propagates in tissue under different conditions
- be able to describe how optical quantities in strongly scattering media can be measured and modelled
- be able to describe in detail some example of how optical methods and lasers are used in biomedical applications.
- be able to discuss generally the mechanisms for some therapeutic laser applications in the medical field

- be able to explain the basic principles of laser diagnostics in the medical field

Skills and abilities

To pass the course, the student should:

- be able to measure optical quantities in tissue
- be able to model light propagation in tissue
- be able to write a report with detailed analysis of published data and own results
- be able to integrate and analyse information from different sources

Judgement and approach

To pass the course, the student should:

- be able to evaluate which parameters for a laser that is essential for a specific medical issue
- having acquired increased skill in written and oral presentations of observations and calculations.
- be able to independently search for information outside reading lists, e.g. via library functions and internet
- have acquired a curiosity for optical problems within medicine, especially related to light propagation in tissue

The course aim
The aim of the course is that the student should get a fundamental knowledge of how light propagates in strongly scattering media, such as tissue. This understanding is central for both a large number medical measuring techniques, and for laser-based medical treatments. This is a strong progressive and interdisciplinary field of research Since these methods are rapidly developing, this type of knowledge is increasingly requested in the medical technical industry.
The course intends furthermore to stimulate to a curious approach to optical problems within medicine and related fields, especially related to light propagation in tissue

Course content

The course consists of lectures, laboratory sessions and project work.
The course is oriented around a project and structured so that laboratory parts and the theoretical exercises combine to give a good understanding of the full problem about how light are transported in tissue. The project work is to determine the optimal parameters for a light source in some optical measure- or treatment situation. In the beginning of the course, a number of lectures will describe different medical laser applications. These will be given by both physicians and physicists with a long experience in this field to give as broad a background as possible. After that, light propagation in strongly scattering media is treated theoretically. The starting point is the transport equation, where the wave properties of light is neglected Since the transport equation can not be solved analytical, the course will discuss how the diffusion equation can be obtained under certain circumstances and be solved analytical for simple geometries. Numerical solutions are possible for more

complicated geometries. Monte Carlo simulations are used when the preconditions for the diffusion equation is not satisfied. This technique is therefore treated also. Many laser-based treatments are based on thermal effects, hence the heat equation is treated also. Three different laboratory sessions treat how one can measure the optical properties of strongly scattering materials, while the temperature distribution in tissue after laser illumination is studied in a fourth laboratory session. Mathematical modelling of light and heat distribution in tissue are made in two theoretical exercises. The course is completed with a project as mentioned above.

Course design

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

Assessment

For a passing grade the student must have passed all subparts. For a higher grade the student must also pass a written test. Well implemented project can give additional credits on the written examination.

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 laboratory reports and passed project presentation are required and participation in all compulsory parts.
The final grade is decided by the result of the written examination.

Entry requirements

For admission to the course is required:

English B, FYSA31, Physics 3 and Modern physics, 30 credits, or the equivalent.

Subcourses in FYST22, Physics: Medical Optics

Applies from V08

0701 Medical Optics, 7,5 hp
Grading scale: Fail, Pass, Pass with distinction