Faculty of Science

FYST55, Physics: Biophotonics, 7.5 credits

Fysik: Biofotonik, 7,5 högskolepoäng

Second Cycle / Avancerad nivå

Details of approval

The syllabus was approved by Study programmes board, Faculty of Science on 2021-06-10 to be valid from 2021-06-10, spring semester 2022.

General Information

The course is developed for students at master's level in physics and related engineering programmes (engineering physics) and for doctoral students in related subjects. The course is open to students from other programmes, provided that they have sufficient prior knowledge.

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
Photonics	A1N, Second cycle, has only first-cycle course/s as entry requirements

Learning outcomes

The general aim of the course is that the students should acquire knowledge of the basic physical principles of interaction of light with biological tissue in living beings, organic material and our natural environment. The intention is that the students by understanding this interaction then should be able to choose appropriate measurement methods and design optimal instrumentation to characterise, classify or rank biological samples for example with regard to health/quality. The course gives an overview of experimental methods developed in biophotonics until today. The methods that are treated in the course include scales from microscopical cellular level via macroscopic scale up to scales for remote sensing of the biosphere. For increased understanding and practical experience, the course contains a creative experimental project where students in groups develop a basic

setup for a measurement technique in biophotonics, use it to investigate a sample and present the study at the end of the course. The course provides the student knowledge with a unique set of methods valuable for development and application of modern photonics in life sciences.

Knowledge and understanding

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

- explain the principles of interaction between light and the types of biological samples covered in the course.
- explain the principles of the diagnostic methods covered in the course.
- explain the concepts for data analysis that are covered in the course.

Competence and skills

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

- apply methods and instrumentation of biophotonics in experimental studies.
- search and analyse information in the field of the course from sources in addition to the course material, e.g. in scientific articles and advanced literature.
- discuss and analyse results of the methods covered in the course.
- present results of the methods covered in the course.
- write reports on the laboratory sessions of the course with analysis and discussion of results.

Judgement and approach

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

- demonstrate an understanding of possibilities and limitations of methods and instrumentation that are covered in the course.
- suggest appropriate methods and instrumentation for applications of biophotonics.
- interpret and assess results of the methods covered in the course.
- interpret and assess information in the field of the course from sources in addition to the course material, e.g. scientific articles and advanced literature.

Course content

The course gives an introduction to physical phenomena that are encountered in optical diagnostics of biological samples and organic material, and introduces methods and instrumentation for characterisation of biological tissue and organic material. These methods include optical remote sensing for studies of biological flora and fauna; laser spectroscopy based on diode lasers for measurement of absorption and fluorescence; polarisation techniques for the analysis of light scattered from biological samples; techniques for imaging and microscopy. The course also includes certain data analysis related to the methods that are treated.

Special emphasis is placed on projects where the students in groups arrange an instrumentation for studies of different biological samples. The experimental part of the projects includes optoelectronics, optomechanical design, signal collection and measurements, which are followed by interpretation of data and presentation. The course contains two additional laboratory sessions. The course also includes study visits at laboratories on Lund's university and local companies with activities in biophotonics.

Course design

The teaching consists of lectures, laboratory sessions, a course project with a seminar for presentation and study visits. Participation in the laboratory sessions and the course project are compulsory.

Assessment

Examination takes place through written examination at the end of the course, a seminar with oral presentation of the course project at the end of the course, and written laboratory reports during the course.

For students who have not passed the regular examination, an additional examination during timetabled retake period is offered.

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.
Laboratory sessions and course projects are graded with Failed or Passed and examination is graded according to the scale Failed, Passed (>=50% of the maximum number of points on the exam), Passed with distinction (>=80 of the maximum number of points on the exam).

To pass the entire course it is required to have a passed project presentation, passed laboratory reports and passed written examination.

The final grade is decided through the grade on the written examination.

Entry requirements

Entry to the course requires English 6/B or the equivalent and 90 credits scientific studies in physics, mathematics and including knowledge equivalent to: FYSA13 Introduction to University Physics, with Optics, Waves and Quantum Physics, 7.5 credits, and FYSB24 Atomic and Molecular Physics, 7.5 credits.

The courses FYSN14 Lasers, 7.5 credits, and FYST14 Atomic and Molecular spectroscopy, 7.5 credits, are recommended but are not compulsory.

Further information

The course is coordinated with Engineering programmes in engineering physics and the master's programmes in photonics at LTH. The examination of the course is scheduled in accordance with the LTH exam schedule.

Subcourses in FYST55, Physics: Biophotonics

Applies from V22

2201 Written Exam, 4,0 hp
Grading scale: Fail, Pass, Pass with distinction
2202 Laboratory Exercises and Course Project, 3,5 hp
Grading scale: Fail, Pass