Faculty of Science

FYST23, Experimental Biophysics, 15 credits

Fysik: Experimentell biofysik, 15 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 (120 credits).

Language of instruction: English and Swedish
When needed, the course is given in 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

Knowledge and understanding

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

- problematise the connection between dimensions in biology and the dimension of microelectronic devices and how this can be used when creating new tools for biomedical analysis.
- explain basic concepts and problems within micro- and nanofluidics.
- describe advanced imaging methods.
- explain basic technologies for studies of single molecules.
- explain basic mechanisms of molecular engines
- explain the fundamentals of surface based sensors.

- describe how cells interact with nano-structured surfaces.
- describe systems- lab on a chip, integration, nerve chip.

Skills and abilities

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

- independent seek information in beyond the reading list
- assimilate and summarise scientific articles
- develop simple experiments i.e. evaluate and choose appropriate experimental technology for a specific issue
- plan a scientific project
- write well-structured project reports that summarise, explain and analyse experimental and/or theoretical work
- present own results in an oral talk and actively participate in arguing scientific discussions

Judgement and approach

On completion of the course, the student should

- have experienced work within research-oriented projects.
- understand limitations and possibilities offered by the miniaturisation of bioanalytical tools and have acquired an inquisitive approach to optical problems within medicine, especially related to light propagation in tissue.

The aim of the course

The course gives a specialisation in interdisciplinary work with a focus on experimental methods within biophysics. The course aims specifically at giving an introduction to the intersection of modern physics, nanotechnology, biomolecular chemistry and biology. By being based on current scientific articles, the course prepares the students for future research work.

Course content

The course contains three main parts.

The first part of the course consists of lectures and seminars. During this part, relevant subjects according to the list below are treated and current articles are discussed. Especially during the seminar exercises, it is required that the students take active part in the discussions. An important aspect is to train efficient reading and extraction of information from scientific articles. A consistent theme within the course is micro- and nanostructures within biology and technology and their mutual connection.

Specific subjects that are included in the course:

- Magnitudes in biology and physics
- Micro- &nanofluidics: Separation and analysis of molecules and cells, soft lithography
- Detection of single molecules: Optical, electronic and mechanical detection methods including sensor principles based on SERS, fluorescence, evanescent

waves.
- Surface phenomena and surface sensors: SPR, QCM, lipid bilayer
- The interaction of proteins and cells with nano-structured surfaces: manipulation and control of motor proteins, outgrowth of axons, antibody-antigen reactions for protein chip applications.
- Imaging of biological structures: AFM & STM technologies.
- Using low-dimensional electronic materials within life science.
- System aspects: Methods for communication with the nervous system, lab-on-a-chip applications.

The second part consists of laboratory exercises, mainly in our research laboratories. The students will get aquainted with equipment that is actively used within the biophysics research at the division.

Specific laboratory parts that are included:

- Basic fluorescence microscopy including optical tweezers.
- The use of total internal reflection for detection and imaging of single molecules.
- Soft lithography and microfluidics.
- Surface based sensors.
- Neurobiophysics

The last part of the course is a project, where the students work individually or in small groups doing, preferably innovative but at the same time simple, experiments in a scientific environment somewhere within or outside the university. The projects are defined jointly by course responsible, supervisor and student.

Course design

The teaching consists of lectures/laboratory sessions/project work. Participation in laboratory sessions and projects as well as other teaching integrated with that, is mandatory.

Assessment

All subparts are part of the examination. A written examination is required for grades higher than 3. A 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 as well as participation in all compulsory parts.
The final grade is given by the results of the written examination.

Entry requirements

For admission to the course is required:

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

Subcourses in FYST23, Experimental Biophysics

Applies from V08

0701 Theory, 4,5 hp
Grading scale: Fail, Pass, Pass with distinction
0702 Laboratory work, 4,5 hp
Grading scale: Fail, Pass, Pass with distinction
0703 Project, 6,0 hp
Grading scale: Fail, Pass, Pass with distinction