



LUND
UNIVERSITY

Faculty of Science

FYST67, Physics: 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 2022-06-13 to be valid from 2022-06-13, spring semester 2023.

General Information

The course is an elective course for second cycle studies for a scientific candidate - or Master's degree (120 credits) in physics.

Language of instruction: English

Main field of studies

Physics

Depth of study relative to the degree requirements

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

Learning outcomes

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

Knowledge and understanding

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

- identify the complexity in the connections 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 the basics of membrane biophysics including current applications and

relevant tools.

- describe the interaction of cells with nano-structured surfaces relevant to nanosafety and for theranostic applications in medicine of nanoparticles.
- describe systems: lab on a chip, integration, nerve chip.

Competence and skills

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

- independently seek information beyond the reading list.
- assimilate and summarise scientific articles in an efficient and goal oriented way.
- critically review sources of information for example by being aware of different forms of mechanisms that lead to bias.
- 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 presentation and actively participate discussions based on scientific arguments.

Judgement and approach

Aty the end of the course, the student should be able to:

- reflect on problem formulation in research-oriented projects.
- critically discuss limitations and possibilities associated with miniaturisation of bioanalytical tools.
- identify different approaches to optical problems in biophysics and biomedicine from a broad perspective ranging from individual molecules to tissue.

Course content

The course contains two modules:

Module 1, Theory, 4.5 credits: The teaching consists of lectures and discussion seminars. During this part, relevant topics 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:

- Order of magnitudes in biology and physics,
- Scientific critical approach,
- Micro and nanofluidics: fundamental mechanisms, relevant microtechnology, relevant applications inter alia separation and analysis of molecules and cells,
- Detection of individual molecules with optical, electronic and mechanical detection methods,
- Advanced imaging technologies for biological structures: mainly optical super resolution methods, but also photo acoustic microscopy and scanning-probe technologies,
- Lipid bilayers together with relevant technologies and current application areas,
- The interaction of proteins and cells with nano-structured surfaces from both a nanosafety perspective and an application perspective: manipulation and control of motor proteins, outgrowth of axons, antibody-antigen reactions for protein

chip applications,

- System aspects: Methods for communication with the nervous system, lab-on-a-chip applications.

Module 2, Laboratory sessions, 4.5 credits: The second part consists of laboratory exercises, mainly in our research laboratories. The students will get acquainted with equipment that is actively used within the biophysics research at the division.

A selection of laboratory techniques is included from the following list based on available expertise and current topics in the literature:

- Basic fluorescence microscopy,
- The use of total internal reflection for detection and imaging of single molecules,
- Optical tweezers,
- Soft lithography and microfluidics,
- Applications of micro fluidics, for example particle sorting, microdroplets, etc,
- Surface based sensors.

Module 3, Project, 6.0 credits: 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 work may have both experimental and theoretical character. In the latter case, it mainly is primarily simulations, but also about advanced data processing with relevance for furthermore experimental studies. The projects are defined jointly by course responsible, supervisor and student.

Course design

The teaching consists of lectures, laboratory sessions, group work and project work. Participation in laboratory sessions and project work and thereby integrated other teaching is compulsory.

Assessment

Examination of module 1 is in the form of written assignments during the time of the module.

Examination in module 2 is arranged orally in the form of an individual examination in connection with laboratory sessions during the course.

Examination in module 3 is arranged in writing in the form of a report from respective project group at the end of the course.

For students who have not passed the regular examination, an additional examination during the scheduled 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.

To pass the entire course, the requirement is a passed written examination, passed

oral exam for the laboratory exercises, passed project presentation with report and participation in all compulsory components.

The final grade is first calculated as a weighted sum of the percentages for the results in the respective modules, where module 1 and 2 each have weights of 30% and module 3 has a weight of 40%. The resulting percentage is then translated to a grade where 50% is required for the grade Pass and 80% is required for the grade Pass with distinction.

Entry requirements

Admission to the course requires 120 credits scientific or technical studies, or a scientific or Degree of Bachelor of Science - in both cases including knowledge equivalent to at least the Physics of the upper-secondary school 2/B and English 6/B.

Further information

This course replaces FYST23 Physics: Experimental biophysics, 7.5 credits, and cannot be included in qualification together with this course.

The course is coordinated in its entirety with the course FFFN20 Experimental biophysics, 7.5 credits that is offered at Lund's institute of technology LTH.

The examination of the course is scheduled in accordance with the LTH exam schedule.

The course is offered at the Department of Physics, Lund University.

Subcourses in FYST67, Physics: Experimental Biophysics

Applies from V23

- 2301 Theory, 4,5 hp
Grading scale: Fail, Pass, Pass with distinction
- 2302 Laboratory Exercises, 4,5 hp
Grading scale: Fail, Pass, Pass with distinction
- 2303 Project, 6,0 hp
Grading scale: Fail, Pass, Pass with distinction