Faculty of Science

FYSN25, Physics: Experimental Tools, 7.5 credits

Fysik: Experimentella verktyg, 7,5 högskolepoäng

Second Cycle / Avancerad nivå

Details of approval

The syllabus was approved by Study programmes board, Faculty of Science on 2022-12-14 to be valid from 2022-12-14, autumn semester 2023.

General Information

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

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 the student, after completing the course, will have acquired a deeper knowledge of important tools and techniques in experimental science in general and a mastery of physics experiments in particular, especially within electronics and statistics.

Knowledge and understanding

After the completion of the course, the student should be able to:

- describe thoroughly the function of accelerators and radiation sources
- explain deciding properties of the beams with which reactions are created
- account for signal processing from sensor to storing of digital data
- understand the function of analog and digital electronics
- account for different ways to present a measurement results
- be familiar with possibilities and limitations in modern electronic design
- be familiar with digital electronics in modern society in general.

Competence and skills

After the completion of the course, the student should be able to:

- connect up and analyse simple analog and digital circuits
- work with digital oscilloscope and logic analysator
- fit a function to data points and quantify the results with chi2 test
- decide if a result can be explained as random
- explain statistical methods for evaluation of measurement results and confidence levels
- include several independent sources of errors in error analysis.

Judgement and approach

After the completion of the course, the student should be able to:

- cooperate with electronics engineers for realisation of measurement system
- reflect on the role of the electronics and the digital technology in the modern society
- assess if a result is reasonable and significant.

Course content

The course covers important tools and technologies that are used in experimental natural sciences in general and physics experiments in particular and be orientated about future perspectives for the infrastructure of exerimental physics.

The course consists of two parts, electronics and Statistics and the data handling.

The electronics covers how signal processing and data collection take place in modern experiments. The similarity with modern electronics and digital technology in the society are striking and everyday examples are highlighted. The function of accelerators and radiation sources are studied at excursions to research departments that show and explain the infrastructure in use. The major aim of the electronics part is to describe how data is collected from analog electronic processing of electric signals from a sensor/detector via digitisation to collection and storing of data in real time. Basic analog and digital electronics constitutes the basis but also advanced modern solutions, like application specific integrated circuits and programmable digital electronics as well as standard instrumentation in a laboratory environment are concerned. The experimental chain of electronics is put in relation to modern, digital home electronics by elaborated examples. Practical parts in analog and digital electronics are included.

Statistics and the data handling contain basic statistics and probability theory. Binomial-, normal- and poisson distributions are studied. The concept of confidence level is introduced.
Further, statistics and the data handling part contains principles of presentation of measurement result where function fitting with chi2 test and principles of parametrisation of data are studied. Error estimation and presentation of statistical and systematic errors are carried out. Acquired knowledge is applied on simulated data in a computer exercise.

Course design

The teaching consists of lectures, laboratory sessions and group work and study visits. Participation in laboratory sessions and group work and thereby integrated other

teaching is compulsory.

Assessment

Examination takes place during the course with assignments presented orally and in writing and with written laboratory session reports and reports from practical exercises.

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.
A Pass grade requires approved laboratory reports, passed written assignments and active participation in compulsory parts. The final grade is determined by combining the results of the different parts of the examination.

Entry requirements

Access to the course requires 75 credits Physics and 45 credits Mathematics, or a Bachelor's degree in Physics or equivalent, as well as English 6/B.

Further information

The course replaces FYSN15, Experimental Tools, 7.5 credits and can't be included in a degree together with this course, or with FKFN05, Experimental Tools in Subatomic Physics, 7.5 credits.

The course is given by the Department of Physics, Lund University.

Subcourses in FYSN25, Physics: Experimental Tools

Applies from H23

2301 Electronics: Laboratory session reports, 1,5 hp
Grading scale: Fail, Pass, Pass with distinction
2302 Electronics: Assignments, 4,0 hp
Grading scale: Fail, Pass, Pass with distinction
2303 Statistics: Assignments, 2,0 hp
Grading scale: Fail, Pass, Pass with distinction