Faculty of Science

FYTB13, Theoretical Physics: Electromagnetism, 7.5 credits

Teoretisk fysik: Elektromagnetism, 7,5 högskolepoäng

First Cycle / Grundnivå

Details of approval

The syllabus was approved by Study programmes board, Faculty of Science on 2016-05-15 and was last revised on 2016-05-15. The revised syllabus applies from 2016-05-15, spring semester 2017.

General Information

The course is an elective course for first-cycle studies for a Bachelor of Science in Physics.

Language of instruction: English

Main field of studies	*Depth of study relative to the degree requirements*
Physics	G2F, First cycle, has at least 60 credits in first-cycle course/s as entry requirements

Learning outcomes

The overall aim of the course is that the students should learn the basics of the electromagnetic field theory based on Maxwell's equations and the Lorentz force.

Knowledge and understanding

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

1. state and justify which of Maxwell's equations that are relevant in different physical situations
2. describe the potential formulation of Maxwell's equations
3. explain the phenomena of polarisation and magnetisation
4. at a general level explain the meaning of gauge, gauge choice and gauge transformations.

Competence and skills

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

5. apply the tools of vector calculus and use fundamental integral relations to solve problems in electromagnetism,
6. apply general methods of solution such as separation of variables and multipole expansion to solve electromagnetic problems,
7. use Maxwell's equations in both microscopic and macroscopic form to derive the fields around simple symmetric stationary charge and current distributions as well as boundary conditions for the fields at boundaries between vacuum and linear media,
8. analyse energy content and energy transport for electromagnetic fields in vacuum and linear media
9. calculate propagation, reflection and transmission of electromagnetic waves
10. describe a modern application of electromagnetic theory in writing.

Judgement and approach

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

11. in writing review and assess the factual content in written reports.

Course content

The course contains basic electromagnetic field theory as well as related vector calculus. In particular it includes:

- vector calculus: derivatives of vector fields and related integral theorems as well as Dirac's delta function,
- Maxwell's equations on differential and integral form in both microscopic and macroscopic formulation,
- stationary electric and magnetic fields in vacuum and matter,
- electrodynamics: Lorentz force and induction,
- conservation laws and energy transport,
- electromagnetic waves: reflection and transmission in linear media,
- scalar and vector potential: separation of variables, multipole expansion, the gauge principle and gauge choices.

Course design

The teaching consists of lectures and problem solving sessions as well as compulsory written hand-in assignments. Furthermore, a compulsory project is included.

Assessment

The examination consists of

- compulsory written assignments- examines a selection of the intended learning outcomes
- written project report and written feedback on other students' reports- examines in particular intended learning outcomes 10 and 11

- a written examination at the end of the course- examines all the intended learning outcomes. Under special circumstances the written exam can be replaced by an oral one.

Students who do not pass the regular exam are offered a new possibility shortly after the regular exam.

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 course, approved written examination, passed project report, passed written feedback on other student's report and passed hand-in assignments are required. The final grade is determined by combining the results of the different parts of the examination.

Entry requirements

For admission to the course, general entry requirements are required as well as 30 credits in physics and 45 credits in mathematics, including knowledge equivalent to FYSA01 General physics, 30 credits, NUMA01 Scientific Computing, 7.5 credits, MATB21 Multivariable analysis 1, 7.5 credits and MATB22 Linear algebra 2, 7.5 credits. English 6/English B.

Further information

The course may not be credited towards a degree together with FYTA12 Basic theoretical physics 30 credits.

Subcourses in FYTB13, Theoretical Physics: Electromagnetism

Applies from V17

1601 Hand-in Assignments and Project, 1,5 hp
Grading scale: Fail, Pass
1602 Written Examination, 6,0 hp
Grading scale: Fail, Pass, Pass with distinction