**HALMSTAD UNIVERSITY**
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School of Information Technology



# Applied Electromagnetics 7.5 credits

Tillämpad elektromagnetism 7.5 hp

Second cycle
Main field: Electronics, Second cycle, has only first-cycle course/s as entry requirements (A1N)
Syllabus is adopted by the Research and Education Board (2024-03-20) and is valid for students admitted for the autumn semester 2024.

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## Placement in the Academic System

The course is included in the Master's programme in Electronics Design, 60 credits and as an elective course in the Programme Computer Science and Engineering, 300 credits and in the Programme Master of Science in Engineering, Intelligent Systems, 300 credits. The course is also offered as a freestanding course.

## Prerequisites and Conditions of Admission

Bachelor of Science degree (or equivalent) in an engineering subject. The degree must be equivalent to a Swedish kandidatexamen and must have been awarded from an internationally recognised university. Courses in electrical engineering of at least 90 credits, including thesis. Courses in mathematics of at least 30 credits or including calculus, linear algebra and transform methods. English 6. Exemption of the requirement in Swedish is granted.

## Course Objectives

The student shall acquire good knowledge about concepts and phenomena that can be explained by electromagnetic field theory within the field of electronics. Beyond this the course aims to provide a basic introduction to several application areas within the field of electronics, in particular electromagnetic wave propagation in vacuum as well as in conducting and dielectric materials.

Following successful completion of the course the student should:

*Knowledge and understanding*

- explain how electrical charges and currents interact with electrical and magnetic fields
- explain wave propagation and the most common wave phenomenon encountered in electromagnetism
- account for waveguides and antennas basic physical properties and working principles

*Skills and ability*

- calculate the electric and magnetic fields from simple- and symmetric current and charge distributions
- use physical laws like Faraday's law; Ampere-Maxwell's law; Gauss' law for electrical and magnetic fields; the relation between flux density and field intensity for both magnetic and electrical fields and Lorentz's force equation. Both in traditional form and phasor notation
- perform simple calculations on more complex phenomena, such as induction, polarization in dielectrics, wave propagation, reflection/transmission
- use industry-standard software to design and simulate transmission lines for a given application
- use printed circuit board (PCB) production techniques to manufacture and test transmission lines

*Judgement and approach*

- discuss and question the contents of a simulation report in relation to electromagnetic field theory and its applications
- show good knowledge regarding the limitations and advantages of electromagnetic field theory
- judge the potential human and environmental impact in relation to electromagnetic fields

## Primary Contents

Forces between charged particles at rest and while moving. Magnetic dipolmoment and magnetization. Energy in static and time varying fields: capacitors, inductors and Poynting's vector. Mazwell's equations and time varying fields. Electromagnetic waves and propagation in vacuum, conductors and dielectric materials.
Applications: How static and time varying fields are affected by boundaries between different matierals. Transmission lines and the telegrapher's equations.

Coupling between different electromagnetic properties and simulation, design and
testing.

### Teaching Formats

Teaching comprises lectures, exercises, homework and compulsory computer
simulations.

Teaching is in English.

### Examination

The overall grades of Fail, 3, 4 or 5 will be awarded for the course.
The examination consists of a written exam and passed oral and written presentation of one of the computer simulations. All examination is carried out individually.

| Name of the test | | Grading |
|---|---|---|
| Written Examination | 5 credits | U/3/4/5 |
| Presentation of Computer Simulations | 2,5 credits | U/G |

If there are special reasons, the examiner may make exceptions from the specified examination format and allow a student to be examined in another way. Special reasons can e.g. be a decision on learning support.

For elite sports students according to Riktlinjer för kombinationen studier och elitidrott vid Högskolan i Halmstad, DNR: L 2018/177, the examiner has the right to decide on an adapted examination component or let the student complete the examination in an alternative way.

### Course Evaluation

Course evaluation is part of the course. This evaluation should offer guidance in the future development and planning of the course. Course evaluations should be documented and made available to the students.

## Course Literature and Other Study Resources

Fawwaz T. Ulaby, Eric Michielssen, Umberto Ravaioli. *Fundamentals of Applied Electromagnetics, Global Edition.* A latest edition.