UNIVERSITY OF GOTHENBURG

PHYSICS

ASM501 Electromagnetic Waves and Components, 7.5 higher education credits

Elektromagnetiska vågor och komponenter, 7,5 högskolepoäng

Second Cycle

Confirmation

This course syllabus was confirmed by Department of Physics on 2013-08-06 and was last revised on 2017-06-13 to be valid from 2017-06-13, spring semester of 2017.

Field of education: Science 100%
Department: Physics

Position in the educational system

The course ASM500 is a programme course in the Physics, Master Programme, as well as a single subject course at University of Gothenburg.

The course can be part of the following programmes: 1) Complex Adaptive Systems, Master's Programme (N2CAS), 2) Physics of Materials and Biological Systems, Master's Programme (N2PMB) and 3) Physics, Master's Programme (N2PHY)

Main field of studies	*Specialization*
Physics	A1N, Second cycle, has only first-cycle course/s as entry requirements

Entry requirements

To be eligible for the course ASM501 the equivalent of 30 higher education credits in advanced courses on the first cycle is required. The student should also possess basic knowledge of multi variable calculus and electromagnetic field theory.

Learning outcomes

Students who have followed the course should be able to:

- Apply Maxwell's equations to analyse and solve wave propagation problems with simple boundary conditions and interpret the results.
- Analyse the propagation of plane and paraxial electromagnetic waves through homogeneous and inhomogeneous lossy media, how the wave reflects/refracts at dielectric and conducting boundaries, and evaluate how the wave is affected by dispersion and scattering.
- Describe the mechanism for propagation and reflection of voltage waves along transmission lines.
- Explain what is meant by: characteristic impedance, wave impedance, complex index of refraction, Poynting vector, phase velocity, group velocity, dispersion, and scattering.
- Perform calculations of blackbody radiation, and emission of waves by electric dipoles.
- Perform calculations of scattering of waves (e.g. Rayleigh and Thompson).
- Perform calculations on a two-level system (including stimulated emission, spontaneous emission, absorption, collisions).
- Describe physical mechanisms for emission and absorption of electromagnetic waves, and methods to create and detect them.
- Use computer tools to visualize electromagnetic field phenomena and design a hologram.
- Describe the working principles of basic photonic and microwave components, which are based on wave phenomena.
- Perform experimental work in the photonics and microwave areas.
- Present clearly documentation of computer based work and summarize the experimental work in written form in English.

Course content

The aim of the course is to enhance the student's insight into the physical concepts and principles used to describe the generation and detection of electromagnetic waves, and their propagation through different types of media.

The manipulation of electromagnetic waves in modern wireless and photonics components is highlighted. This course provides a basis for further studies in engineering branches, which rely heavily on the usage of electromagnetic waves (e.g. microwave engineering, photonics, electronic communication and remote sensing).

- Recapitulation of basic concepts from electromagnetics and vector analysis.
- Transmission line theory (Telegrapher's equations, characteristic impedance, reflections).
- Propagation of plane waves and paraxial waves in homogeneous and inhomogeneous lossy media (wave equations, Poynting vector, refraction, reflection,

polarization, dispersion, absorption, scattering, diffraction).
- Generation and detection of electromagnetic waves (Larmor formula, dipole radiation, Blackbody radiation, detection principles).
- Excitation/de-exciation of a two-level system (including the laser mechanism).

Form of teaching

Lectures. Problem solving sessions. Laboratory excercises (computer simulations and experimental work).

Language of instruction: English

Assessment

Written examination. Reports of laboratory excercises.

A student who has failed a test twice has the right to change examiner, unless weighty argument can be adduced. The application shall be sent to the board of the department and has to be in writing.

Grades

The grading scale comprises: Pass with Distinction (VG), Pass (G) and Fail (U). Grade G on both written examination and laboratory work is required to obtain grade G on entire course.

Grade VG on written examination and grade G on laboratory work is required to obtain grade VG on entire course.

Course evaluation

The results of the evaluation will be communicated to the students and will function as a guide for the development of the course.

Additional information

The course ASM501 Electromagnetic Waves and Components replaces the course ASM500 Electromagnetic Waves and Spectroscopy, and these courses can not be combined in a final exam.